Project Manual

Sunnybrook Health Sciences Centre
M-Wing Level 2 Hybrid OR Suite

Project No. ONBL19-0186

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Issued for Tender

NORR

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Project Manual
For
Sunnybrook Health Sciences Centre
M-Wing Level 2 Hybrid OR Suite

SPECIFICATIONS

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MANDATORY INSTRUCTIONS TO BIDDERS

Submission Instructions

Please follow these instructions to submit via our Public Portal.

1. Prepare your submission materials:

Requested Information

Name	Type
Submission	File Type: Any (.csv, .pdf, .xls, .xlsx, .ppt, .pptx, .bmp, .gif, .jpeg, .jpg, .jpe, .png, .tiff, .tif, .txt, .text, .rtf, .doc, .docx, .dot, .dotx, .word, .dwg, .dwf, .dxf, .mp3, .wav, .avi, .mov, .mp4, .mpeg, .wmv, .zip)

Requested Documents:

Please note the type and number of files allowed. The maximum upload file size is 100 MB.

Please do not embed any documents within your uploaded files, as they will not be accessible or evaluated.

2. Upload your submission at:

https://sunnybrook.bonfirehub.ca/projects/view/31225

Your submission must be uploaded prior to the Closing Time **August 27, 2020, 2:00:00pm Toronto Time.** We strongly recommend that you give yourself sufficient time and **at least ONE (1) hour** before Closing Time to begin the uploading process and to finalize your submission.

To supplement uploaded Bid Security and Agreement to Bond documents uploaded to the Bonfire portal, original hard copy documents of the Bid Security and Agreement to bond must be received by the Tendering Call Authority upon request, within 48 hours of the request.

Important Notes:

Each item of Requested Information is instantly sealed and will only be visible after the Closing Time.

Uploading large documents may take significant time, depending on the size of the file(s) and your Internet connection speed.

You will receive an email confirmation receipt with a unique confirmation number once you finalize your submission.

Minimum system requirements: Internet Explorer 8/9/10+, Google Chrome, or Mozilla Firefox. Javascript must be enabled.

Need Help?

Sunnybrook Health Sciences Centre uses a Bonfire portal for accepting and evaluating proposals digitally. Please contact Bonfire at Support@GoBonfire.com for technical questions related to your submission. You can also visit their help forum at https://bonfirehub.zendesk.com/hc

1 BIDS

1.1 Intent

The intent of this Bid call is to solicit and receive a formal Bid for the M-Wing Level 2 Hybrid Operating Room Renovations for Sunnybrook Health Sciences Centre (the “Owner)

Only Prequalified General Contractors may submit bid submissions on this Tender. The Prequalified General Contractors, from RFSQ SB 2019-8012:

- EllisDon
- Maystar General Contractors Inc.
- REA Construction Ltd
- Dineen Construction Corporation
- Gillam Group Inc.
- MJ Dixon Construction Limited
- Elite Construction Inc.

Only Prequalified Mechanical Subcontractors from RFSQ SB 2019-8012 can be named as subcontractors on this project:”

- Black & McDonald Ltd.
- Bird Mechanical Ltd.
- English and Mould Mechanical Systems Ltd.
- Pipe All Plumbing & Heating Limited
- Battaglia Mechanical Systems
- Geo. A. Kelson Co. Ltd.
- VR Mechanical Services Inc.
- Plan Group Inc.
- Urban Mechanical Ltd.

Only Prequalified Electrical Subcontractors from RFSQ SB 2019-8012 can be named as subcontractors on this project:

- Black McDonald Ltd.
- Ontario Electrical Construction Company Limited
- Danik Electrical Construction Company Limited
- Plan Group Inc.

A mandatory formal briefing meeting and site tour will be held at date and time and location as stipulated in Invitation to Bidders. All Prequalified General Contractors, along with Prequalified Mechanical/Electrical Subcontractors must attend the Mandatory Formal Briefing Meeting and Site Tour. The Formal Briefing and Site Tour is the evening of August 6, 2020. Due to COVID 19 protocols be prepared for a tour late into the evening, after the OR closes for the day. Meeting Location and time of your tour can only be obtained by RSVP to Elli Fusco, email: elli.fusco@sunnybrook.ca RSVP your attendance before August 4, 2020.

.1 Submission requirements: Submission must be in accordance with the M-Wing Level 2 Hybrid Operating Room Renovations Drawings and Specifications included with these Submission Documents for:

Sunnybrook Health Sciences Centre
2075 Bayview Avenue, Toronto ON M4N 3M5

And will be received

Prior to 02:00:00 o'clock p.m., local time, on August 27, 2020.
Bids will NOT be opened publicly.

.2 Submission must consist of:

.1 Completed Bid Form

(a) Note 1:
- Bid Form must be filled out in its entirety; failure to do so may result in disqualification.

(b) Note 2:
- Inconsistencies between dollar amounts in numerical form and in written form may result in disqualification

.2 Bid Security

.3 Agreement to Bond

.4 Proposed Construction Schedule.

a) The Schedule shall indicate time to mobilize before commencing the work after award of Contract, milestone dates of major activities of the Work with sufficient details of critical events and their inter-relationship for successful performance within the Contract Time.

b) Assume Contract Award date will occur within 2 weeks of Bid Closing date.

.3 Submissions must be submitted on the Bid Form provided, filled out and signed by an authorized signing officer from the Bidder's organization and sealed. Bids must be submitted on one copy of the Bid Form provided. **All instructions to Bidders for Bid Submission in this document are Mandatory. Any instructions not followed will result in Bid Disqualification.**

.4 Bid forms must be completed without delineation, alteration or erasures and there is to be no re-capitulation of the work to be done.

.5 Bids must be for a Stipulated Sum without escalation clauses or other qualifications.

.6 List of Subcontractors and Cost Breakdown will be requested from the successful bidder prior to contract award. Contractor is to provide this information when requested.

.7 Prices must exclude: Harmonized Sales Tax where indicated.

.8 Oral, telephoned, or fax bids, or bids submitted by any other means will not be accepted nor acknowledged. Bids will only be accepted via the Sunnybrook Bonfire Portal described on page 1.Paragraph 1.1.1 states time up to which Bids will be received. This time may be extended by public notice or by written Addendum. Bids not submitted by the submission deadlines stipulated in Paragraph 1.1.1 will be rejected.

.9 Bidders are reminded that they must base their bids on the manufacturers, installers, materials, equipment and products specified. Bids that are submitted based on alternatives not called for will not be acceptable and will be cause for disqualification.

.10 Submissions will not be opened until the Owner is in receipt of the submissions and after the closing time.

1.2 Description of the Works

Construction fit-up for the new Hybrid Operating Room on M Wing, 2nd Floor.

The project scope include interior renovations of an existing standard operating room No 14 and upgrade to the current healthcare standards for conversion into an image-guided operating room. The new Hybrid OR is equipped with a ceiling suspended C-arm (by Philips), fusing angiography and CT scanning capabilities along with video display system, medical equipment booms on articulating arms (by Getinge-Maquet), new surgical equipment and OR lighting. The new Hybrid OR is supported by a new dedicated Control Room and lead lining within the walls of the suite will be provided, in accordance with Sunnybrook Radiation Safety's requirements. It is imperative that the occupied clinical areas and support spaces adjacent to the new Hybrid Operating Room are required to remain nominally functional and access to these spaces kept unimpeded throughout the course of the renovations. As such, the construction work will have to be undertaken in a multi phased approach to minimize disruptions to hospital operations.

The General Contractor acknowledges and agrees, that in order to avoid Constructor Issues as defined by Ministry of Labour, the General Contractor agrees to be responsible for the complete coordination, removal of existing equipment, delivery and installation of the new equipment and provide complete direction and instruction to Philips Canada (the Equipment Supplier) to follow safety policies within the construction site.

1.3 Completion times

Substantial Performance of the Work and Occupancy shall be obtained within Six months of written notification of Contract award.

2 CONTRACTORS/ SUB-CONTRACTORS

.1 Bidders must submit on the Bid Form, identified list of sub-contractors and corresponding costs to whom it is proposed to sublet any part of the work.

.2 Bidder must name only one Subcontractor for each trade Section.

.3 Should Bidder be awarded the Contract, parties named, including Bidder's own forces must be used to perform the work for which they are named and must not be changed without the Owner's written consent.

.4 The term "Own Forces", or other such phrase, will not be acceptable where such work will knowingly not be provided by Bidder's own forces. Such flagrant use may be cause for disqualification of bid.

.5 Immediately after notice of Contract award, the successful Bidder must notify it's named Subcontractors that they have been named.

.6 The list of sub-contractors set forth must not to be altered or changed except as may be agreed by the Owner and the Consultant prior to the signing of the Contract. Contractor has fully investigated and informed itself as to the qualifications of their named Subcontractors. Contractor fully understands that each named Subcontractor can meet and will provide all of their work as per Bid Documents. Where it is found that a named Subcontractor cannot or will not provide its work as per Bid Documents, the Contractor will be obligated to retain a qualified Subcontractor who will provide the work as per Bid Documents. All costs, including cost differences between Subcontractor's prices, required to change the named Subcontractor to a qualified Subcontractor will be at Contractor's own expense and the Owner will not entertain any requests for any additional monies

3 QUESTIONS DURING BIDDING

3.1 Document review

.1 Bidders finding discrepancies, ambiguities, or omissions in the Drawings or Specifications are to immediately notify solely the Tender Calling Authority who will issue written instructions to all Bidders in the form of posted written Addenda.

3.2 Questions arising during the bidding period must be solely directed to:

Elli Fusco (Tender Calling Authority)
E mail: elli.fusco@sunnybrook.ca

.1 Bidders seeking information with regard to organization of documents and clarification and interpretation of information on drawings or in specification may contact only the Tender Calling Authority by email and questions will be collected, collated, printed and answered by published, written Addenda.

.2 Bidders seeking information with regard to the organization of the documents and location of information on drawings or in specification may contact only the Tender Calling Authority by email.

.3 Questions including questions with regard to quantities, quality, or acceptable manufacturers of materials and equipment or questions with regard to interpretation of the documents will not be discussed or answered by telephone and must be e-mailed to the Tender Calling Authority not less than ten (10) days before date set for receipt of Bids . **Questions are due no later than August 17, 2020**

.4 E-mailed questions will be collected, collated, printed and answered by published, posted written Addenda

.5 Bidders must not contact the Owner, its employees, or its agents, including the Consultant, except via the Tender Calling Authority in regards to this tender.

.6 Under no circumstances must the Bidder rely upon any information or instructions from the Owner, its employees, or its agents, including the Consultant, unless the information or instructions are provided in writing by the Tender Calling Authority; and

.7 The Owner, its employees and/or its agents, including the Consultant, will not be responsible for any information or instructions provided to the Bidder, with the exception of information or instructions provided in writing by the Tender Calling Authority.

4 ADDENDA

.1 During bidding period Bidders may be advised by Addenda of additions, deletions, or alterations to the Specifications and Drawings. The information contained in the Addenda is to supersede and amend the Drawings, Specifications and Schedules. These revisions to the work are to be allowed for in the Bid and the Addenda are to become part of the Contract Documents.

.2 Bidders to state in the space provided on the Bid Form the numbers of the Addenda received and included for in the preparation of the Bid.

5 EXAMINATION OF SITE

5.1 MANDATORY FORMAL BRIEFING MEETING AND SITE TOUR

.1 A mandatory formal briefing meeting and site tour will be held at date and time and location as stipulated in Invitation to Bidders**. This site tour is a Mandatory Requirement for all Prequalified General Contractors, and for Prequalified Mechanical and Electrical Sub-Contractors:**

.1 Time: Only available by RSVP before August 4, 2020 , email: elli.fusco@sunnybrook.ca

.2 Date: August 6, 2020 (evening hours)

.3 Due to COVID-19 protocols only 1 person per Contractor or Sub-Contractor can attend.

.2 Purpose of meeting is to review full extent of the Project, conduct an inspection of existing premises and to discuss any questions regarding this Project.

.3 One representative(s) from each Bidding Contractor must attend. The minutes of this pre-Bid meeting listing attendees may be issued as an Addendum.

.4 It is mandatory that General Contractors and Mechanical and Electrical Sub-contractors attend the meeting. All other interested Bidders/sub-trades are also invited to attend. Bids will be accepted only from Bidders (General, Mechanical, Electrical contractors) that attended the mandatory site tour. Bids from Bidders (General, Mechanical, Electrical contractors) who did not participate in the site tour will be disqualified.

.5 Bidders must visit and examine the site and the existing building and satisfy themselves as to the conditions of the site, the means of access to same and the nature and quantity of work required.

.6 Also ascertain the extent, nature and location of concealed services which may have to be protected, removed or relocated.

.7 Information shown on the Drawings is furnished in good faith by the Consultant, but in no way relieve Bidders of the responsibility for ascertaining to their own satisfaction, the nature of conditions at the site. No claims for extra costs for failure to determine any/ all existing conditions will be entertained.

.8 Take note of the nature of existing surfaces and include for temporary work necessary to maintain Owner's use of the premises, the roads, and the pathways during the progress of the Contract.

5.2 SITE VISITS

.1 In addition to paragraph 5.1, Bidders must visit the Place of the Work as required to become fully conversant with conditions which will be met in performing the Work of the Contract.

.2 Claims for extra payment and extensions to Contract Time will not be considered in respect to conditions which could have been ascertained by an inspection of the Place of the Work prior to close of bids.

6 ITEMIZED PRICES

Not applicable for this project.

7 SEPARATE PRICES.

Not applicable for this project.

8 SUBMISSION

.1 Submission of Bids to constitute proof of the Bidder's inclusion in the proposal for the work to complete the Contract in every respect and provisions for conditions and limitations, particularly with respect to access facilities, working conditions, existing conditions, storage space, codes, laws, ordinances, and regulations, whether mentioned in the Bid Documents or not.

.2 Arrangements have been provided for the Bidder to obtain clarification with regard to discrepancies, ambiguities, or omissions in the Bid Documents and to visit and review the conditions at the site and therefore the submission of a Bid will be construed as a waiver of any claims for extra compensation on account of un-anticipated work caused by existing conditions or un-expected interpretation of the Bid Documents.

.3 The Bidder acknowledges and agrees that nothing contained herein, no act done or expense incurred in the preparation of the Bid, no trade or industry custom or practice and no representation or assurance that may have been given to the Bidder by the Owner or Consultant, must in any manner legally bind the Owner to accept this Bid, the lowest Tender or any Tender submitted. The Bidder acknowledges and agrees that the Owner must have complete and unrestricted liberty in this regard and may reject or accept any Bid in whatever manner, at whatever Bid Price and on whatever terms and for whatever reason as the Owner, in their sole discretion, considers to be in their best interest, all without liability or obligation of any kind to any Bidder.

.4 The Owner must not be held responsible for any liability, cost, expense loss of damage incurred, sustained or suffered by any Bidder prior to, subsequent to, or by any reason of delay in the acceptance or non-acceptance of this Bid save as provided in the Contract. Bids are subject to a formal Contract being prepared and executed.

.5 No Bid must be submitted or accepted from any persons or corporations which has any claim or legal proceeding against the Owner with respect to any previous Contract. No Subcontractor that has any claim or legal proceeding against the Owner must be named as a Subcontractor of the Bidder.

.6 In the event that two or more Bidders submit compliant Bids that contain identical Bid pricing, each bidder will be notified of the tie and will have the opportunity to submit a new bid in the proper form within twenty-four hours of being notified

9 RESERVED RIGHTS OF THE OWNER

.1 Bids not received as per the Submission Instructions will be disqualified and will not be accepted by the Owner.

.2 In addition to disqualification in the event of non-compliance with any of the Mandatory Requirements, the Owner reserves the right, in the Owner's sole discretion, to reject or disqualify any bid that does not, in Owner's reasonable discretion, comply with any other instruction, requirement, term or condition set out herein; or otherwise any non-responsive, and conditional Bids or Bids that are improperly prepared, that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind.

.3 The Owner reserves the right to disqualify the Bid of any Bidder who experiences a material change in circumstances after submission of its Bid, including where the Bidder's staffing is materially different from that specified in its pre-qualification documentation.

.4 Bids received from any other Bidder that has any claim, legal proceeding, or other Construction Project issues, with the Owner or that names a Subcontractor that has any claim, legal proceeding or other Project issues with the Owner, with respect to any previous contract or tender may be rejected at the sole discretion of the Owner.

.5 Presentation of evidence of collusion, intent to defraud, or illegal practices on the part of a Bidder, will cause its bid to be declared non-compliant and disqualified whether opened or not.

.6 The Owner reserves the right, in Owner's sole discretion, to cancel this tender at any time without awarding a Contract to any Bidder.

.7 The owner reserves the right to disregard all non-confirming, non-responsive and conditional bids.

.8 The Owner reserves the right to negotiate Contract terms with the lowest compliant Bidder or Bidders, or should the Owner not receives any satisfactory or compliant bids, to negotiate a Contract in accordance with Section 12(below).

.9 Discrepancies between words and figures will be resolved in favour of words. Discrepancies between the indicated sum of any column of figures and correct sum thereof will be resolved in favour of the correct sum.

.10 The Owner reserves the right to request a Bidder to provide clarification regarding any aspect of its Bid, and/or to submit supplementary written information in relation to such request; and to incorporate a Bidder's response to any such request for clarification into the Bidder's Bid, provided that any such clarification must only permit the provision of additional detail but may not contradict or amend a material term of the Bid. The Submission of a Bid does not obligate the Owner to accept any Bid or to proceed further with the Project. The Owner may, in its sole discretion, elect not to proceed with the Project, in whole or in part, and the Owner may elect not to accept any bid that, in Owner's reasonable discretion, does not comply with any instruction, requirement, term or condition herein; and Owner reserves the right, in Owner's sole discretion, to cancel this Bid at any time without awarding a Contract to any Bidder.

.11 Alternatively, should the Owner not receive any satisfactory Bids, it may, in its sole and absolute discretion, revise the Instructions to Bidders, issue Post-Bid Addenda for re-pricing, or negotiate a Contract for the whole or any part of the Project with any of the Bidders.

.12 A Bidder's Bid shall be null and void and disqualified
- .1 Upon the institution by or against the Bidder of insolvency, receivership or bankruptcy proceedings or any other such proceedings;
- .2 Upon the Bidder making an assignment for the benefit of creditors; or
- .3 Upon the Bidder's dissolution or ceasing to do business

.13 The Owner reserves the right not to accept the Bidder's proposed Schedule and reserves the right to clarify or negotiate the Schedule with the successful Bidder.

10 WITHDRAWAL AND ACCEPTANCE OF BIDS

.1 A bid may be withdrawn at any time prior to the time and date fixed for receiving bids, but only on a request in writing, signed by the Bidder or his agent-in-fact.

.2 Withdrawn bids may be resubmitted provided the resubmitted bid is received at the office previously indicated prior to the time and date fixed for receiving bids.

A bid may not be withdrawn at or after the time and date fixed for receiving bids and must be irrevocable and remain open to acceptance by the Owner:

(1) until some other party has entered into a Contract with the Owner for performance of the Work, or

(2) until 150 days after the time and date fixed for delivering bids, whichever occurs first (the "Bid Acceptance Period").

.3 The 150 day period referred to above must commence at 12:00:00 a.m. of the day fixed for receiving bids and must terminate at 12:00:00 a.m. of the 150th day thereafter. If the 150th day falls on a Saturday, Sunday or statutory holiday, such day or days must be omitted from the computation.

.4 The lowest or any bid will not necessarily be accepted and the Owner reserves the right to reject any and all bids, including without limitation, the lowest priced bid, and to award the Contract who whomever the Owner, in its sole and absolute discretion, deems appropriate, notwithstanding any custom, usage or agreement in the industry or trade, or any other policy or practice to the contrary. The Owner further reserves the right, in its sole and absolute discretion, to accept or reject any bid which in the Owner's view is incomplete, obscure, or irregular, which has erasures or corrections in the documents, which omits one or more the prices, fees, or costs required to be stipulated in the bidding forms, which contains prices that the Owner considers unbalanced, or which is not accompanied by the proper bid security.

.5 Without limiting the generality of the rights prescribed in the preceding paragraph above, the Owner may, in its sole discretion, elect not to proceed with the project and elect not to accept any and all bids for any reason including, but not limited to, bids not being within the Owner's budget. Alternatively, should the Owner not receive any satisfactory bid including, but not limited to receipt of no compliant bids, it may, in its sole and absolute discretion, revise the Instructions to Bidders, or negotiate a contract for the whole or any part of the project with any one or more of the Bidders, or firms not previously pre-qualified. Under no circumstances, must the Owner be responsible for any costs incurred by the Bidders in the preparation of their bid.

.6 The criteria used and applied by the Owner in evaluating the bids and awarding the contract are within the Owner's sole and absolute discretion. Without limiting the generality of the foregoing, additional criteria to be considered by the Owner in evaluating the bids may also include one or more the following: total costs to the Owner, completion times in the bid, any changes to pre-qualification information, ability to ensure continuous availability of qualified and experienced personnel, proposed Construction Schedule, price compliance of bids, and any other factor that the Owner, in its sole discretion, deems relevant.

.7 Alternatively, should the Owner not receive any satisfactory Bids, it may, in its sole and absolute discretion, revise the Instructions to Bidders, issue Post-Bid Addenda for re-pricing, or negotiate a Contract for the whole or any part of the Project with any of the Bidders.

.8 Award of Contract will be by written notification to the successful Bidder

.9 Delivery by registered mail or common carrier, to the address given by the Bidder in its Bid form, of notification of award of the Contract to the Bidder by the Owner must constitute acceptance of said bid.

.10 If bidder has not been so notified within the *Bid Acceptance Period*, the bidder may, unless bidder has otherwise agreed or offered and except as otherwise provided herein, withdraw its bid without penalty, forfeit, or obligation to the *Owner* of any kind.

11 ERRORS IN BIDS

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1 Owner will not entertain requests for gratuitous payments arising from any errors alleged to have been made in the Bid that the Owner has accepted with the procedures described in the Bid Documents.

12 CONTRACT (MANDATORY REQUIREMENTS)

.1 The successful Bidder must be required to sign, in triplicate, Canadian Standard Construction Document CCDC 2-2008 for Stipulated Price Contract, as amended by Section 00 73 00, as bound herein, and return the executed Contract to the Owner within seven (7) days after award of Contract by Owner.

.2 The Bidder accepts and agrees that, after delivery to the Owner of the executed Contract and required Bonds and Certificates of Insurance, the Owner will provide written authorization to the Bidder to commence the Work and that, upon receipt of such authorization, the Bidder will commence the Work actively at the Place of the Work within 10 Working Days.

.3 The successful Bidder must provide List of Subcontractors and Cost Breakdown, when requested prior to award of Contract by Owner.

13 BONDS AND INSURANCE

13.1 Agreement to Bond

Each Bidder must submit with its bid an Agreement to Bond issued by a duly incorporated surety company authorized and licensed to issue such instruments and Bonds in the Province of Ontario obliging the surety company to issue a Performance Bond and a Labour and Material Payment Bond, each in the amount of 50% of the Total Amount Payable (inclusive of HST), and in the forms as follows:

.1 Performance Bond: Form 32, Under Section 85.1 of the Construction Act

.2 Labour and Material Payment Bond: Form 31, under section 85.1 of the Construction Act.

.3 The Agreement to Bond must be valid for the Bid Acceptance Period.

.4 Cost for all bonds is included in the bid price.

.5 Performance Bond and Labour and Material Payment Bond (collectively the "Bonds") must be issued by a duly incorporated surety company authorized it issue such instruments in the Province of Ontario.

13.2 Bid Security

.1 Bidders must attach to their Bid a Bid Bond made payable to Sunnybrook Health Sciences Centre for the amount of **10% of the Bid Value** as evidence of good faith that, if awarded the Contract, the Bidder will execute and enter into a formal agreement within the time required and will furnish the security required to secure the performance of the terms and conditions of the Contract.

.2 Bidders must attach and submit bid security together with Bid Form.

.3 The Bid Bond must be in force for a period of 150 days from day fixed for receiving bids.

.4 Bid Bonds must be in accordance with the Construction Act.

.5 Bid Bonds must be issued by a duly incorporated surety company authorized to transact business in the Province of Ontario.

.6 Bid bonds must be properly executed by both Bidder and Surety.

.7 If a Bidder whose bid is accepted by the Owner, within the specified 150 day acceptance period, refuses or fails, within 15 days after a Contract is offered to him for acceptance, (1) to enter into a Contract with the Owner for the performance of the Work or (2) to provide contract performance security, or security for payment of claims, or both, if and as required by the Bid Documents, the Bidder must be liable to the Owner for the difference in money between the amount of his bid and the greater amount for which a Contract for the Work is entered into with some other party, up to the maximum amount of the bid security provided.

.8 Bid security will be returned to all Bidders after an agreement has been signed by both the Owner and the successful Bidder and the Bonds and Certificate of Insurance have been delivered to the Owner

.9 Bids submitted without Bid Security will be disqualified. .

13.3 Labour and Materials Payment Bond (Mandatory Requirements)

.1 Bidders must include with their Bid agreements to Bond for 50% labour and materials payment.

.2 Agreement to bond must be valid for the bid acceptance period.

.3 Bidders must submit security to Owner within 3 business days of date of receiving notification that Bidder has been awarded Contract but before signing Contract.

.4 Labour and Material Payment Bond must be in accordance with the Form 31 of Section 85.1 of the Construction Act,

.5 Labour and Material Payment Bond must be issued by a duly surety company authorized to transact business in the Province of Ontario.

.6 Labour and Material Payment Bond must be issued by Surety Company acceptable to the Owner.

.7 Labour and Material Payment Bond must be properly executed by both the Bidder and Surety Company.

.8 Submission of the Labour and Material Payment Bond must be a pre-condition to commencement of the Work.

13.4 Performance Bond (Mandatory Requirements)

.1 Bidders must include with their Bid agreements to Bond for 50% performance.

.2 Performance Bond must be in accordance with Form 32 of Section 85.1 of the Construction Act.

.3 Agreement to bond must be valid for the bid acceptance period.

.4 Security in the form of a bank letter of credit is not acceptable.

.5 Bidders must submit security to the Owner within 3 business days of the date of receiving notification that Bidder has been awarded Contract but before signing Contract.

.6 Bidder must submit with his Bid the Sunnybrook Hospital's standard form of Agreement to Bond stating that Surety Company is prepared to provide the required Performance Bond.

.7 Performance Bond must be issued by a duly incorporated surety company authorized to transact business in the Province of Ontario.

.8 Performance Bond must be issued by Surety Company acceptable to the Owner.

.9 Performance Bond must be properly executed by both the Contractor and Surety Company.

.10 Submission of the Performance Bond must be a pre-condition to commencement of the Work.

13.5

NOTE: Submission of Documents

To supplement uploaded Bid Security and Agreement to Bond documents uploaded to the Bonfire portal, original hard copy documents of the Bid Security and Agreement to bond must be received within 48 hours of the request.

13.6 INSURANCE (MANDATORY REQUIREMENTS)

.1 Bidders must submit certificate of insurance confirming a general liability insurance as stipulated in CCDC 2, 2008 and Sunnybrook Supplemental Terms and Conditions to the Owner within 3 business days of the date of receiving notification that Bidder has been awarded Contract but before signing Contract.

.2 In addition, successful Bidder must provide Insurance Certificate for the Hybrid OR equipment described in this tender document for the period of Equipment Delivery until the time of Installation. Total value of the equipment is under $5 million.

.3 Certificates of insurance must be issued by a duly incorporated insurance company authorized to transact business in the Province of Ontario.

.4 Bidders must submit Builder's Risk Insurance to the Owner within 3 business days of the date of receiving notification that Bidder has been awarded Contract but before signing the Contract.

.5 Insurance documents shall meet the requirements of CCDC 2 – 2008, as amended by 00 73 13 – Supplementary General Conditions.

14 BID DOCUMENTS

.1 Bidder is responsible for checking the Drawings and Specifications received to ensure that the documents are complete in accordance with the List of Bid Documents.

.2 After the Contract is signed the successful Bidder will be given set of Specifications and Drawings in addition to the signed and sealed Contract Document set.

15 MATERIALS AND EQUIPMENT

.1 Bids must be based upon materials and equipment of manufacture, type and design specified.

.2 Bid Price must be based on using materials or equipment of the manufacturer named in the Specification. If more than one manufacturer's name is listed in Specification for a specific item, the Bidder may choose the manufacturer, whose price is used in preparing Bid.

.3 Material and equipment, considered equal to that specified, may be proposed at time of Bidding. When requested, submit specifications, information and details of proposals to Consultant for

16 INTERPRETATIONS AND MODIFICATIONS OF BID DOCUMENTS

.1 Submit questions about the meaning and intent of the Bid Documents to the Bid Administrator

.2 Bidders must promptly notify the Bid Administrator of any ambiguity, inconsistency or error which they may discover upon examination of the Bid Documents or of the site, existing premises and local conditions.

.3 Replies to questions and modification of the Bid Documents will be issued in writing by Addenda. Replies to questions and modifications made in any other manner will not be binding and must be without legal effect.

.4 The Owner and Consultant will not recognize nor participate in any electronic project management program.

17 CUTTING AND REMEDIAL WORK

.1 Refer to General Conditions regarding cutting and remedial work.

.2 Bidders must include costs for cutting and remedial work in their bid price.

.3 Bidders must obtain required information from their various Subcontractors requiring such cutting and remedial work prior to submission of bid.

18 REVIEW OF BID DOCUMENTS

.1 No parts of the Bid Documents must be issued by Contractors to any Subcontractors or material or equipment Supplier, for bidding purposes without Section 00 73 00 and Division 1, General Requirements, being attached thereto.

.2 Contractors will be responsible for reviewing the Bid Documents, and ensuring their Subcontractors, Product and materials Suppliers review the Bid Documents, prior to submitting a bid to ensure they have an overall understanding of the entire Project's scope of work. Mechanical and electrical Subcontractors are specifically instructed to review non-mechanical and non-electrical parts of the Bid Documents for additional information and details related to their trades.

.3 The Contractor's attention is drawn to the intricacy of working in the existing building, or reworking existing building components to accommodate new construction. This involves removals, cutting, restoration, and protection of existing work or conditions during the duration of the Contract.

.4 While every effort has been made to show or note the extent of the work in the Contract Documents, the Contractor by submitting its bid acknowledges the complexities involved in a Project of this size and type.

.5 It is therefore imperative that Contractor evaluates the Contract Documents and visits the Place of the Work and conducts a survey of existing conditions upon which new work will be dependent. The Owner on account of the Contractor's failure to comply with the foregoing will entertain change in either Contract Time or Contract Price.

.6 Well in advance of commencement of the Work; notify Consultant and Owner in writing of any part of the Work that is to be started within existing building. At no time interfere with operation of any department without written approval of Owner. It is essential for existing building to remain functional at

all times. Contractor must, when required on occasion, expedite work outside of Contractor's normal working hours. Owner will cooperate to keep such overtime hours to a minimum.

19 OVERTIME COSTS

.1 Bids have been requested only from Pre-Qualified Contractors. Overtime costs may be required to perform the Work without adversely affecting the normal operation of the Owner and to maintain the Project schedule as specified.

.2 Any overtime costs, including extended and/or double shift and weekend work hours, necessary to complete the Work or any part thereof within the Contract Time must to be included in the bid price.

.3 Bidders are hereby advised that time is of the essence and the Project schedule cannot be extended except as provided for in the Contract Documents.

20 INFECTION CONTROL DURING CONSTRUCTION

.1 The successful Bidder will be required to provide infection control during the Work in accordance with Spec Section 01 35 33 in conjunction with Sunnybrook's IP&C guidelines and requirements, whichever is more stringent.

.2 The Contractor shall submit detailed hoarding plans, infection control procedures and associated hoarding wall details to demonstrate compliance and will be reviewed on site with Hospital IP&C, Risk and CPD PM to secure required approvals prior to start of any demolition & construction activities on site. Hoarding wall types, their extent and boundary limits may change to suit site conditions and hospital operating requirements.

.3 Owner's Infection Prevention Control Services (IPCS) will investigate and advise on the risks of organisms that exist in the Place of Work. In addition to the requirements in the Contract Documents, the Contractor will take all reasonable steps to eliminate any infectious risks where possible and minimize those risks that cannot be eliminated.

21 STAFF

.1 All Contractors and Subcontractors will be expected to maintain the staff team from start to finish. The Site Superintendent is required and shall be on site at all times for any Work activities that occur within the Contractor's work zones. Any modifications to the team composition from those involved must be approved in writing by the Owner prior to implementation. 2 weeks notice is required prior to any proposed change for Owner review prior to the start of the Work. Four weeks notice is required prior to any proposed change for Owner review during the Work.

22 COLD WEATHER WORKING

.1 Particular attentions is drawn to the requirement that the Bidder must commence work immediately after the Contract is executed and the Certificates of Insurance is delivered to the Owner and must continue full scale operations through winter months until the work described is complete.

.2 The Bid Price must include the costs for temporary heating, temporary shelters and all other necessary cold weather measures to enable the work to proceed without delay regardless of adverse weather conditions.

23 CASH ALLOWANCES

.1 Include in bid price cash allowances specified in Section 01 00 00. Cash allowances are to be carried administered by Division 1 (and not by other Divisions), including Mechanical and Electrical allowances.

.2 Contractors shall make provision in their schedule for incorporation in the work of products/materials and labour covered under cash allowances.

.3 Cash allowances must be utilized only for the purpose of which the cash allowance was intended.

.4 Cash allowances may be transferred from one category to another at the discretion of the Consultant and/or Owner. All cash allowances are to be administered through issuance of a change order which identifies the cash allowance item.

24 SCHEDULING OF WORK (MANDATORY REQUIREMENTS)

.1 Time is the essence of this Contract. Time to mobilize is not on the Bid Form. Time to complete is given to the them (6 months)

.2 Prior to award of the Contract, the Owner will request that the Bidder supply a final updated Construction Schedule which would include the updated project start date and any other changes to the Construction Schedule from the schedule provided with the Bid submission. This revised Construction Schedule must be approved by the Owner and Consultant prior to Contract Award.

25 DEBRIEFING

Unsuccessful Bidders may request a debriefing after receipt of a notification of award. All requests must be in writing sent to same location as described in section 3.02 and must be made within sixty (60) days of notification of award. The intent of the debriefing information session is to aid the unsuccessful Bidder in presenting a better bid in subsequent bidding opportunities. Any debriefing provided is not for the purpose of providing an opportunity to challenge the procurement process.

26 BID PROCESS PROTEST

A Bidder who wishes to protest the process utilized in this Bid Call must deliver written notice of the protest to the Owner. Sunnybrook shall acknowledge receipt of the protest in writing within five (5) working days; and deliver a response to the Bidder in writing within twenty (20) working days. Sunnybrook' Bid Protest Process is subject to the relevant Bid Protest terms as set out in the AIT and Ontario-Quebec Procurement Agreement.

27 CONFLICT OF INTEREST

Bidders must disclose any actual or possible conflict of interest that may arise from its submission of a Bid, or execution of a Contract for the provisioning of Work as a result of this bid process. Please declare such information in writing to the Owner, prior to submission of Bid.

If, at the sole and absolute discretion of Owner, it is discovered that a Bidder fails to disclose all

actual or potential Conflicts of Interest, Owner may disqualify the Bidder or terminate any Contract awarded to that Bidder pursuant to this bid process.

If there is no declaration, the Bidder will be deemed to declare that: (1) there was no Conflict of Interest in preparing its bid; and (2) there is no foreseeable Conflict of Interest in performing the contractual obligations.

28 FREEDOM OF INFORMATION AND PROTECTION OF PRIVACY ACT

The Freedom of Information and Protection of Privacy Act (Ontario), applies to records in the custody or control of Ontario hospitals, and includes any information provided by Bidders in connection with this RFQ. Such information may be subject to requests for access under that Act, and can only be withheld from disclosure in specific circumstances.

29 COMPETITION ACT

Under Canadian law, a Bidder's submission must be prepared without conspiracy, collusion, or fraud. For more information on this topic, visit the Competition Bureau website at http://www.cbbc.gc.ca/eic/site/cb-bc.nsf/eng/01240.html, and in particular, part VI of the *Competition Act,* R.S.C. 1985, c. C-34.

30 AGREEMENT ON INTERNAL TRADE

This bid call is subject to Annex 502.4 ("Procurement – Provisions for Municipalities, Municipal Organizations, School Boards and Publicly Funded Academic, Health and Social Services entities") of the Agreement on Internal Trade.

END OF SECTION

TO: Sunnybrook Health Sciences Centre

1 **BID/OFFER**

1.1 I/We declare that I/we have carefully examined the bidding documents including Addenda No. ___ to No. ___, prepared by NORR Architects and Engineers Limited, and visited and investigated the site, and examined all conditions affecting the Work for

Sunnybrook Health Sciences Centre
M-Wing Level 2 Hybrid OR Suite

and if notified in writing of the acceptance of this Bid within one-hundred and fifty (150) days from the date of bid closing, I/we agree to provide all materials and labour for the proper completion of the Work for the Stipulated Price of:

_____and___/100 Dollars

($_____) in lawful money of Canada; included in which are labour, materials, products, equipment, allowances, services and respective overhead, profit, duties, taxes (except the Harmonized Sales Tax), disbursements and all other charges.

1.2 I/We have identified that the Harmonized Sales Tax, in the amount of _____and /100 Dollars ($_____) in lawful money of Canada, is applicable to the Work, but is excluded from my/our Bid Price.

2 **CASH ALLOWANCES**

2.1 I/We have included in my/our Stipulated Price all Cash Allowances identified in Section 01 00 00, General Requirements.

3 **COMPLETION DATE**

3.1 I/We agree, if notified of award of a Contract, to immediately commence Work actively and will attain completion as indicated below:

.1 Substantial Performance of the Work and Occupancy shall be obtained within Six months of written notification of Contract award.

4 **BONDS AND INSURANCE**

4.1 Attached herewith is a Bid Bond issued by a Surety Company licensed to conduct surety in Province of Ontario, made payable to the Owner in the amount of ten percent (10%) of the Bid Price and carrying one-hundred and fifty (150) days' time limit from the time set for receipt of Bids, which may be used in part or in whole, at the discretion of the Owner, in the event we fail to enter into a Contract for the Work when notified.

4.2 Attached herewith is an Agreement to Bond from a Surety Company licensed to conduct surety in Province of Ontario, stating that they agree to provide a Performance Bond for 50% of the Total Amount Payable and a Labour and Material Payment Bond for 50% of the Total Amount Payable.

4.3 I/We agree to comply with the requirements of document CCDC2-2008, as amended, with respect to Bonds and Insurance.

5 SUBCONTRACTORS

5.1 I/We submit that, in proposing the following subcontractors, I/we have consulted each and has ascertained to my/our complete satisfaction that those named are fully acquainted with the extent and nature of the work involved and of the proposed construction schedule, and that they will execute the work to conform to the requirements of the Contract Documents.

No.	Description of work	Subcontractor's Company Name	Price ($)
.1	Mechanical		
.2	Electrical		
.3	Epoxy Flooring		

6 BID IN FORCE

6.1 I/We agree that this Bid is valid and subject to acceptance by the Owner for a period of one-hundred and fifty (150) days from date of bid closing, and that if notified of award of the Contract I/we will:

.1 Furnish to the Owner, within 3 business day of Notice of Contract Award, the following documents:

.1 Copies of insurance policies as required by the Contract.

.2 Performance Bond and Labour and Material Payment Bond, issued by a Surety acceptable to the Owner, each in the amount of 50% of the Total Amount Payable.

.3 Workers Compensation Clearance Certificate, in accordance with the laws of the Province of Ontario.

.4 Notice of Project

.2 Execute the Contract with the Owner on the specified Form of Agreement.

.3 Undertake to schedule and organize the progress of the Work so that priorities for completion of various areas will be maintained, as indicated by the Construction Schedule.

6.2 I/We acknowledge that the Owner has 5 business days to execute the Contract.

6.3 I/We agree not to proceed with the Work until required documents are provided and the Contract has been executed by Owner and Contractor.

Name of Company: _____

Address of Company: _____

_____
Signature(s) of Authorized Representative(s)

_____
Name(s) and Title(s) of Authorized Representatives (Please print or type)

_____
Signature of Witness

_____
Name(s) and Title(s) of Witness (Please print or type)

Dated at _____ this _____day of _____ 20___

H.S.T. Registration Number _____

SEAL

Bids by Limited companies shall be submitted under corporate seal.
Bids by individuals or partnerships shall be witnessed.

END OF BID FORM

HAZMAT ACKNOWLEDGEMENT FORM

SUNNYBROOK HEALTH SCIENCES CENTRE

CONTRACTOR'S ACKNOWLEDGEMENT

.1 Sunnybrook Health Sciences Centre ("Sunnybrook") has included in the Tendering information for this contract a copy of the list of any designated substances present at the Project or Work site. The Notice of Designated Substances included in the Tendering Information is attached to this Acknowledgement.

.2 If awarded this contract, the Contractor, as Contractor within the meaning of the OHSA, undertakes:

.1 to inform other contractors and all subcontractors retained to perform services on the Project or the Work of the existence of the designated substances, if any, which are present at the Project, and to provide to other contractors and all subcontractors a copy of the list of designated substances which is attached to this Acknowledgement, prior to entering into any contracts with those other contractors or subcontractors for the supply of services;

.2 to notify Sunnybrook and project consultant of the presence of any potentially hazardous materials, odour materials, or toxic substances which will be bought to the project or the Work by the Contractor, or Contractor's employees and to provide all applicable MSDS sheets, if any, to Sunnybrook;

.3 to ensure that other contractors and all subcontractors retained to supply services for the Project or the work notify Sunnybrook and project consultant of the presence of any potentially hazardous materials odour materials, or toxic
substances they bring to the Project or the Work and ensure that they provide all applicable MSDS sheets, if any, to the Contractor, other contractors and all subcontractors to so comply.

.3 Contractor:

3.1 Contract to be performed:

.1 The Contractor acknowledges that he has received the List of Designated Substances attached to the Tendering Information, and agrees to be bound by the undertakings set out above.

_____ _____

Date Contractor's Signature

Note: This Acknowledgement is an integral element of the Tender Documents. This Acknowledgement must be signed and returned with the Tender Bid documents.

Issued for Tender

NOTICE OF DESIGNATED SUBSTANCES

.1 the following Designated Substances are present at Sunnybrook Health Sciences Centre as outlined in the 'Limited Designated Substance Survey Report' dated June 27, 2019 by Maple Environmental Inc.

Designated Substance	Location

Issued for Tender

NOTICE OF BIOLOGICAL, CHEMICAL AND PHYSICAL HAZARDS

Biological:

Sunnybrook Health Sciences Centre (Sunnybrook) is a fully functioning hospital and medical research facility. As such any biological hazard that could infect a person outside the facility can be expected within the facility. This includes any communicable or non-communicable disease.

Physical Hazards:

Sunnybrook also contains physical hazards common to all public buildings. Contractors, their employees, and subcontractors must be aware of the general hazards associated with any kind of work in a full service public facility with residential living.

In addition to “normal” physical hazards there are also specific departmental hazards. Contractors must make their employees and subcontractors aware of the hazards they may encounter and the safety precautions to take. Contractors are required to contact SHSC departmental managers, and/or the safety office, and/or the Corporate Planning and Development or maintenance project manager regarding any specific hazards.

Chemical Hazards:

In addition to the designated substances mentioned under The Notice of Designated Substances there are approximately 5000 WHMIS regulated chemicals at Sunnybrook and several thousand chemicals covered by The Food and Drug Act, The Pest Control Act, The Atomic Energy Control Act, and the Explosives Act. All contractors are required to have their workers WHMIS trained to work on the premises. Contractors are required to contact SHSC departmental managers, and/or the safety office, and/or the Corporate Planning and Development or maintenance project manager regarding any specific hazards.

Issued for Tender

CONDITIONS OF CONTRACT
00 70 00

1 FORM OF CONTRACT

.1 Subject to the modifications specified in Section 00 73 00, the Stipulated Price Contract of the Canadian Standard Construction Document CCDC 2 - 2008, consisting of The Agreement between Owner and Contractor, Definitions, the General Conditions Articles GC 1.1 to GC 12.3 inclusive, CCDC 40 Rules for Mediation and Arbitration of Construction Disputes, and CCDC 41 CCDC Insurance Requirements are hereby made a part of the Contract as though written out in full herein.

2 CONTRACT COPYRIGHT AND AVAILABILITY

.1 The CCDC form of Contract is a copyrighted document published by the Canadian Construction Documents Committee (CCDC). It is incorporated into the Contract Documents by reference. It is available for purchase from any CCDC document outlet. Refer to www.ccdc.org.

END OF SECTION

Amendments to CCDC 2 – 2008

GENERAL REFERENCE

This Agreement may be executed in any number of counterparts. Each executed counterpart shall be deemed to be an original. All executed counterparts taken together shall constitute one agreement. Receipt of an electronic version of an executed signature page by a Party shall constitute satisfactory evidence of execution of this Agreement by such Party

The Standard Construction Document, CCDC 2 - 2008, Stipulated Price Contract, consisting of the Agreement between *Owner* and *Contractor*, Definitions and the General Conditions of the Stipulated Price Contract, and these Supplementary Conditions, are part of the *Contract Documents*.

The following Supplementary Conditions shall be read in conjunction with the Canadian Standard Construction Document, CCDC 2 - 2008.

Section and paragraph references below are to the corresponding sections and paragraphs of the Agreement between *Owner* and *Contractor*, Definitions and General Conditions of the Stipulated Price Contract all forming part of Standard Construction Document, CCDC 2 - 2008, Stipulated Price Contract. The Stipulated Price Contract, CCDC 2 - 2008, is amended as follows:

1. GENERAL

1.1 These Supplementary Conditions and Amendments shall modify, delete and/or add to the Agreement between the *Owner* and the *Contractor*, Definitions and General Conditions of the Stipulated Price Contract CCDC 2-2008.

1.2 Where any article, paragraph or subparagraph in the Agreement, Definitions or General Conditions is supplemented by one of the following, the provisions of such article, paragraph or subparagraph shall remain in effect and the supplemental provisions shall be considered as added thereto.

1.3 Where any article, paragraph or subparagraph in the Agreement, Definitions or General Conditions is amended, deleted, voided, or superseded by any of the following, the provisions of such article, paragraph or subparagraph not so amended, voided, deleted or superseded, shall remain in effect, and the numbering of the deleted item will be retained, unused.

2. AGREEMENT BETWEEN OWNER AND CONTRACTOR

2.1 ARTICLE A-1 THE WORK

Amendments to CCDC 2 – 2008

2.1.1 Delete paragraph 1.3 and insert new paragraph 1.3 to read as follows:

1.3 commence the *Work* by the _____ day of_____ in the year _____ and, subject to adjustment in the *Contract Time* as provided for in the *Contract Documents* attain *Substantial Performance of the Work*, by the _____ day of _____ in the year _____ .; and attain the *Total Completion Date*, by the _____day of _____ in the year _____ _____.

2.2 ARTICLE A-5 PAYMENT

2.2.1 Change paragraph 5.1: In line 3, insert “ten” before “percent “, and insert “10” before “%”.

2.2.2 Delete paragraph 5.1.2 and insert new paragraph 5.1.2 to read as follows:

5.1.2 upon *Substantial Performance of the Work*, as certified by the *Consultant*, sixty one (61) days after the publication of the certificate of substantial performance and there being no claims for lien registered against the Project, and the conditions of GC 5.4.5 have been satisfied, and subject to GC 5.5, pay to the *Contractor* the unpaid balance of the holdback amount when due together with such Value Added Taxes as may be applicable to such, and

2.2.3 Delete and insert new paragraph 5.3.1(1) to read as follows:

5.3.1(1) Royal Bank of Canada Prime Lending Rate plus two percent (2%), commencing the date that the payment was due.

2.2.4 Delete paragraph 5.3.1(2).

2.3 ARTICLE A-8 SUCCESSION

2.3.1 Amend paragraph 8.1 in line 4, insert “permitted” before “assigns”.

2.4 ARTICLE A-9 TIME OF THE ESSENCE

2.4.1 Insert new Article A-9 as follows:

9.1 It is agreed that one of the reasons why the *Contractor* was selected for the *Work* is the *Contractor’s* representation and warranty that it will attain *Substantial Performance of the Work* and the *Total Completion Date* by the date set out in Article A-1, paragraph 1.3 and the *Contractor* acknowledges that it has been advised by the *Owner* that it is critical to the *Owner* that *Substantial Performance of the Work* be achieved by the prescribed date and that time is of the essence of this *Contract*.

3. DEFINITIONS

3.1 Add the following new definitions 27, 28, 29, 30, 31 and 32:

3.1.1 27. Submittals

Submittals are documents or other forms of information which the *Contractor* is required to submit to the *Owner* or the *Consultant* and include, without limitation, *Shop Drawings*, samples, models, record drawings, test reports, certificates, diagrams and manuals.

28. Hazardous Substances

Hazardous Substances are any substances including, without limitation, any solid, liquid, gas, odour, heat, sound, vibration or radiation, mould, bacteria or any combination thereof which may impair the natural environment, injure or damage property, plant or animal life, or harm or impair the health of any person, and includes any substances recognized or characterized as hazardous or toxic under applicable law.

29. *OHSA*

The term "*OHSA*" shall refer to the *Occupational Health and Safety Act* R.S.O. 1990 c.0-.1. as amended, and all regulations passed thereunder.

30. Commissioning

Commissioning means the process of putting the *Work* or any part thereof into operation and includes Start-Up, Verification and Performance Testing as described in the *Contract Documents*.

31. Completion of Commissioning

Completion of Commissioning means the point in time at which the *Owner* and the *Consultant* are satisfied that the *Contractor* has successfully completed *Commissioning*.

32. Total Completion Date

Total Completion Date is the date stipulated in paragraph 1.3 of Article A – 1 of the Agreement – THE WORK and means the point in time when the *Work* is totally performed in accordance with the *Contract Documents* and certified as such by the *Consultant*. The date for *Total Completion Date* shall only be amended in writing by the Owner.

GC 1.1 GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

.1 Add new subparagraph 1.1.7.5:

1.1.7.5 in case of discrepancies, noted materials and annotations shall take precedence over graphic indications in the *Contract Documents.*

.2 Delete paragraph 1.1.8 in its entirety and substitute new paragraph 1.1.8:

1.1.8 The *Owner* shall provide the *Contractor*, without charge, five (5) sets of the *Contract Documents* to perform the *Work*.

.3 Delete paragraph 1.1.9 in its entirety and substitute new paragraph 1.1.9:

1.1.9 The design information furnished to the *Contractor* as part of the *Contract Documents*, including the *Drawings* and *Specifications*, are the property of the *Owner* and/or the *Consultant*, and are to be used by the *Contractor* only for the purposes of performing the *Work*. The *Contractor* shall not copy, alter or utilize the aforesaid design information for any purpose unrelated to the *Work* without written authorization from the *Owner* and the *Consultant*.

GC 1.5 PROJECT REQUIREMENTS

.1 Add new paragraph 1.5.1:

1.5.1 The *Contractor* represents, covenants and warrants to the *Owner* that:

.1 it has the necessary high degree of experience and expertise required to perform the *Work* and it will in the performance of the Work exercise a standard of care, skill and diligence that would normally be provided by an experienced and prudent *Contractor* providing similar services for hospital projects of a similar nature;

.2 the personnel it assigns to the *Project* are experienced and it has a sufficient staff of qualified and competent personnel to replace its designated *Contract* personnel referred to in GC 3.6, subject to the *Owner's* approval, in the event of death, incapacity, termination or resignation;

.3 there are no pending, threatened or anticipated claims or litigation involving the *Contractor* that would have a material adverse effect on the financial ability of the *Contractor* to perform the *Work*; and

.4 it will achieve *Substantial Performance of the Work* and the *Total Completion Date* by the date set out in Article A-1, paragraph 1.3.

GC 2.2 ROLE OF THE CONSULTANT

.1 Add the word "schedules" after the word "techniques" in paragraph 2.2.6.

.2 Add to the end of the second sentence of paragraph 2.2.6 "or to adhere to the construction schedule".

.3 Amend paragraph 2.2.7 by deleting "Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER" and capitalizing "the".

.4 Amend paragraph 2.2.8 by inserting "*Contractor* or *Owner* on its own behalf or on behalf of" after the word "by" in the second line.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

.1 Amend paragraph 2.3.2 by inserting in line 1 ", *Commissioning*" after "inspections,". Insert in line 3 "and *Commissioning*" after "inspection".

.2 Amend paragraph 2.3.3 by inserting in line 1 ", *Commissioning*" after "certificates.

.3 Amend paragraph 2.3.4 by inserting in line 2 "*Commissioning*" after "inspections,". Insert in line 3 "or *Commissioning*" after "tests".

.4 Amend paragraph 2.3.5 by inserting "Subject to paragraph 2.3.4" at the beginning of the third sentence.

.5 Amend paragraph 2.3.6 and paragraph 2.3.7 by inserting "or *Commissioning*" after "inspection" in all instances.

GC 2.4 DEFECTIVE WORK

.1 Amend paragraph 2.4.1 by adding the following to the end of the paragraph:

"2.4.1 The *Contractor* shall rectify in a manner acceptable to the *Owner* all other defective work and like deficiencies throughout the Work whether or not they are specifically identified by the *Consultant*."

.2 Add new paragraphs 2.4.4, 2.4.5 and 2.4.6:

2.4.4 The *Contractor* shall prioritize the correction of any defective work which, in the sole discretion of the *Owner*, adversely affects the day to day operation of the *Owner*.

2.4.5 Upon notification of a defect in the *Work*, the *Contractor* shall, within five working days, promptly provide a written statement outlining the proposed remedial measures and a schedule for implementation. Once approved by the *Consultant*, the *Contractor* shall proceed with the remedial measures without adversely affecting the construction schedule.

2.4.6 Notwithstanding any rejection of the *Work* by the *Consultant* or deduction of an amount otherwise due to the *Contractor* by the *Owner* as a result of defective work, the *Contractor* is required to continue the *Work* in accordance with the *Contract Documents*.

GC 3.1 CONTROL OF THE WORK

.1 Amend paragraph 3.1.2 by adding the word "schedules" after the word "techniques" and by adding the following to the end of the sentence "and shall coordinate the *Work* so as not to interfere with, interrupt, obstruct, delay, or otherwise affect, the work of others".

.2 Add new paragraph 3.1.3:

3.1.3 Prior to commencing procurement, or fabrication construction activities, the *Contractor* shall verify, at the *Place of the Work*, all relevant measurements and levels necessary for proper and complete fabrication, assembly and installation of the *Work* and shall further carefully compare such field measurements and conditions with the requirements of the *Contract Documents*. Where dimensions are not included or exact locations are not apparent, the *Contractor* shall immediately notify the *Consultant*, in writing, and obtain written instructions from the *Consultant* before proceeding with any part of the affected work.

GC 3.2 CONSTRUCTION BY OWNER OR OTHER CONTRACTORS

.1 Delete subparagraph 3.2.2.1 in its entirety

.2 Delete subparagraph 3.2.2.2 in its entirety

.3 Add new subparagraph 3.2.3.4:

3.2.3.4 Subject to GC 9.4 CONSTRUCTION SAFETY, for the *Owner's* own forces and for other contractors, assume overall responsibility for compliance with all aspects of the applicable health and safety legislation in the *Place of the Work*, including all of the responsibilities of the constructor under the *Occupational Health and Safety Act*.

.4 Add new subparagraphs 3.2.7 and 3.2.8:

3.2.7 Entry by the *Owner's* forces and by other contractors does not indicate acceptance of the *Work* and does not relieve the *Contractor* of any responsibility under the *Contract* including the responsibility to complete the *Work*.

3.2.8 Placing, installing, application and connection of work by the *Owner's* own forces or by other contractors, on and to the *Work* will not relieve the *Contractor's* responsibility to provide and maintain the specified warranties unless a defect has been created by the *Owner's* own forces or *Owner's* other contractors.

GC 3.4 DOCUMENT REVIEW

.1 Delete paragraph 3.4.1 in its entirety and substitute new paragraph 3.4.1:

3.4.1 Applying the standard of care described in paragraph 1.5.1, the *Contractor* shall review the *Contract Documents* and promptly report to the *Consultant* any error, inconsistency or omission the *Contractor* may discover or any doubt as to meaning or intent the *Contractor* may have. Except for its obligation to make such review and report the result, the *Contractor* does not assume any responsibility to the *Owner* or to the *Consultant* for the accuracy of the *Contract Documents*. If the *Contractor* does discover any error, inconsistency or omission in the *Contract Documents,* or if the *Contractor* has any doubt as to meaning or intent of any part thereof, the *Contractor* shall not proceed with the *Work* affected until the *Contractor* has received direction from the *Consultant*.

3.4.2 Neither the *Owner* nor the *Consultant* will be responsible for oral instructions.

GC 3.5 CONSTRUCTION SCHEDULE

.1 Delete paragraph 3.5.1 in its entirety and substitute new paragraph 3.5.1:

3.5.1 The *Contractor* shall,

.1 Unless it is required to be submitted earlier in accordance with Division 1 of the Specifications, then prior to submitting the first application for payment, submit to the *Owner* and the *Consultant* for their review and acceptance a construction schedule in electronic format and in hard copy, indicating the critical path for the *Project* demonstrating that the *Work* will be performed in conformity with the *Contract Time* and the *Contract Documents*. Once accepted by the *Owner* and the *Consultant*, the construction schedule submitted by the *Contractor* shall become the baseline construction schedule;

.2 Provide the necessary expertise and resources (including, without limitation, personnel and equipment) as are necessary to maintain progress under the accepted baseline construction schedule referred to in paragraph 3.5.1.1 or any successor or revised schedule accepted by the *Owner* pursuant to this GC 3.5;

.3 Monitor the progress of the *Work* on a weekly basis relative to the construction schedule, reviewed and accepted pursuant to paragraph 3.5.1.1, or any successor or revised schedule accepted in writing by the *Owner* pursuant to GC 3.5, update the construction schedule on a monthly basis and advise the *Consultant* and the *Owner* in writing of any variation from the baseline construction schedule or slippage in the baseline construction schedule; and

.4 If, after applying the expertise and resources required under paragraph 3.5.1.2, the *Contractor* forms the view that the slippage in baseline construction schedule reported in paragraph 3.5.1.3 cannot be recovered by the *Contractor*, it shall, in the same notice provided under paragraph 3.5.1.3, indicate to the *Consultant* and the *Owner* if the *Contractor* intends to apply for an extension of *Contract Time* as provided in PART 6 - CHANGES IN THE WORK.

.2 Add new paragraph 3.5.2:

3.5.2 If at any time it should appear to the *Owner* or the *Consultant* that the actual progress of the *Work* is behind schedule or is likely to become behind schedule, or if the *Contractor* has given notice to that effect to the *Owner* or the *Consultant* pursuant to 3.5.1.3, the *Contractor* shall take appropriate steps to cause the actual progress of the *Work* to conform to the schedule and shall produce and present to the *Owner* and the *Consultant* a recovery plan demonstrating how the *Contractor* will achieve the recovery of the schedule. The *Owner* may instruct the *Contractor*, at the *Contractor's* expense, to employ additional labour and equipment or work overtime or employ any other reasonable procedures, at no expense to the *Owner*, to bring the *Work* back to conform with the schedule.

GC 3.6 SUPERVISION

.1 Delete paragraph 3.6.1 in its entirety and substitute new paragraph 3.6.1:

3.6.1 The *Contractor* shall employ competent project managers, superintendents, coordinators and other personnel referred to in the Instructions to Bidders and Stipulated Price Bid Form who will not be removed or replaced during the course of the *Work* without the written consent of the *Owner*, which approval shall not be unreasonably withheld.

Should any of the *Contractor's* personnel prove to be unacceptable to the *Owner*, the *Owner* shall given written notice to the *Contractor* who shall, within seven days of receipt of the written notice, immediately make arrangements to appoint a replacement acceptable to the *Owner*.

.2 Add new paragraph 3.6.3:

3.6.3 The *Contractor's* site superintendent for the *Contract* shall devote their full time during working hours to the *Project* and remain at the *Place of the Work* until a final certificate of payment has been issued by the *Consultant* and all deficiencies in the *Work* have been rectified to the satisfaction of the *Owner*. The full-time site superintendent for the *Contract* named in the Stipulated Price Bid Form and any acceptable replacement shall represent the *Contractor* at the *Place of the Work* and notices and instructions given to the site superintendent for the *Contract* by the *Consultant* shall be held to have been received by the *Contractor*.

GC 3.7 SUBCONTRACTORS AND SUPPLIERS

.1 Amend paragraph 3.7.2 by inserting the following at the end of the paragraph "The *Contractor* agrees not to change *Subcontractors* without prior written approval of the *Owner*. Where the *Contractor* wishes to change identified *Subcontractors* or *Suppliers*, it shall set out in writing to the *Owner* sufficient reasons for the desired change. If the *Owner* is not satisfied with the *Contractor's* reason for wanting to change an identified *Subcontractor* or *Supplier*, it shall have the *Consultant* notify the *Contractor* that its request is not acceptable to the *Owner* and that the *Contractor* is required to proceed with the identified *Subcontractor* or *Supplier*."

.2 Amend 3.7.4 by inserting the following at the end of the paragraph "unless the request to change a proposed *Subcontractor* or Supplier is a result of issues with the ability of the *Subcontractor* or Supplier to complete the *Work* in which case the *Contractor* will not be entitled to any change in *Contract Price* or *Contract Time*".

GC 3.8 LABOUR AND PRODUCTS

.1 Add new paragraph 3.8.4:

3.8.4 The *Contractor* is responsible for the safe on-site storage of *Products* and their protection (including *Products* supplied by the *Owner* and other contractors to be installed under the *Contract*) in such ways as to avoid dangerous conditions or contamination to the *Products* or other persons or property and in locations at the *Place of the*

Work to the satisfaction of the *Owner* and the *Consultant*. The *Owner* shall provide all relevant information on the *Products* to be supplied by the *Owner*.

GC 3.9 DOCUMENTS AT THE SITE

.1 Delete paragraph 3.9.1 in its entirety and substitute new paragraph 3.9.1:

3.9.1 The *Contractor* shall keep one copy of the current *Contract Documents*, *Supplemental Instructions*, Contemplated *Change Orders*, *Change Orders*, *Change Directives*, reviewed *Shop Drawings*, *Submittals*, reports and records of meetings at the *Place of the Work*, in good order and available to the *Owner* and *Consultant*.

GC 3.10 SHOP DRAWINGS

.1 Add the words “AND OTHER SUBMITTALS” to the Title after SHOP DRAWINGS.

.2 Add “and *Submittals*” after the words “*Shop Drawings*” in clauses 3.10.1, 3.10.2, 3.10.4, 3.10.7, 3.10.8, 3.10.8.2, 3.10.9, 3.10.10, and 3.10.11.

.3 Delete paragraph 3.10.3 in its entirety and substitute new paragraph 3.10.3:

3.10.3 Prior to the first application for payment, the *Contractor* and the *Consultant* shall jointly prepare a schedule of the dates for submission and return of *Shop Drawings* and any *Submittals*.

.4 Amend paragraph 3.10.7 by adding the following to the end of the provision:

“For greater certainty, the *Contractor* shall be responsible for all costs associated with making any such submission and obtaining any associated permits or approvals, including costs associated with any review or inspection and any permit fees, trade or otherwise.”

.5 Delete subparagraph 3.10.8.1 in its entirety and substitute new subparagraph 3.10.8.1:

3.10.8.1 the *Contractor* has determined, verified and correlated all field measurements with the *Shop Drawings* and any *Submittals* and field construction conditions, *Product* requirements, catalogue numbers and similar data, or will do so if not possible at that time, and

.6 Delete paragraph 3.10.12 in its entirety and substitute new paragraph 3.10.12:

3.10.12 The *Consultant* will review and return *Shop Drawings* and *Submittals* in accordance with the schedule agreed upon in

3.10.3, or, in the absence of such schedule, within 15 business days. If, for any reason, the *Consultant* cannot process them within the agreed-upon schedule or within 15 business days, the *Consultant* shall notify the *Contractor* and they shall meet to review and arrive at an acceptable revised schedule for processing. The *Contractor* shall update the *Shop Drawings* and *Submittals* schedule to correspond to changes in the construction schedule.

GC 3.13 CLEANUP

.1 Add in paragraph 3.13.1 “on a daily basis” after “shall” in the first line.

GC 3.14 RIGHT OF ENTRY

.1 Add new GC 3.14 RIGHT OF ENTRY

3.14.1 The *Owner* shall have the right to enter or occupy the *Work* in whole or in part for the purpose of placing fittings and equipment or for other uses before *Substantial Performance of the Work*, if, in the opinion of the *Consultant* and *Owner*, such entry or occupation does not prevent or substantially interfere with the *Contractor* in completion of the *Contract* within the *Contract Time*. Such entry or occupation shall not be considered as acceptance of the *Work* or in any way relieve the *Contractor* from responsibility to complete the *Contract* or its obligations under the *Contract*.

3.14.2 The use or occupancy of the *Work* or any part thereof by the *Owner* shall not be taken in any manner as an acceptance by the *Owner* of any work or any other part or parts of the *Work* or *Products* not in accordance with the *Contract Documents* or to relieve the *Contractor* or his surety from liability in respect of the observance or performance of the *Contract* save to the extent that loss or damage is caused during such use or occupancy by the *Owner* or by persons for whom the *Owner* is responsible. In particular, without limiting the generality of the foregoing, the use or occupancy of the *Work* or any part thereof by the *Owner* shall not release the *Contract*or from liability, or waive or impair any rights of the *Owner*.

GC 4.1 CASH ALLOWANCES

.1

.1 Delete paragraph 4.1.5 in its entirety and substitute new paragraph 4.1.5

4.1.5 The net amount of any unexpended cash allowances, after providing for any reallocations as contemplated in paragraph 4.1.4, shall be deducted from the *Contract Price* by *Change Order*

without any adjustment for the *Contractor's* overhead and profit on such amount.

.2 Delete paragraph 4.1.7 in its entirety and substitute new paragraph 4.1.7.

4.1.7 The *Contractor* shall provide a schedule prior to the first application for progress payment that shows when the *Owner* must authorize ordering of items called for under cash allowances to avoid delaying the progress of the Work.

.3 Add new paragraph 4.1.8:

4.1.8 The *Owner* reserves the right to call, or to have the *Contractor* call, competitive bids for portions of the *Work*, to be paid for from cash allowances. If the *Owner* determines to proceed with competitive bids, the *Contractor* shall comply with the directions of the *Owner*.

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

.1 Amend the heading, **"GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER"** to read, **"GC 5.1 FINANCING INFORMATION REQUIRED"**.

.2 Delete paragraph 5.1.1 in its entirety and substitute a new paragraph 5.1.1:

5.1.1 The *Owner* and *Contractor* shall provide each other with timely *Notice in Writing* of any material change in their financial ability to fulfil their respective obligations under the *Contract*.

.4 Delete paragraph 5.1.2 in its entirety.

GC 5.2 APPLICATIONS FOR PROGRESS PAYMENT

.1 Delete paragraph 5.2.1 in its entirety and substitute a new paragraph 5.2.1:

5.2.1 Applications for payment on account as provided in Article A-5 of the Agreement – PAYMENT shall include a "Proper Invoice" (as that term is defined in the Construction Act). As a prerequisite to payment, a Proper invoice shall be delivered in accordance with the *Construction Act* to the *Owner* and *Consultant* by the first day of every month for the previous month's work.

.2 Amend paragraph 5.2.2 by deleting "Applications for payment" and substitute "A Proper Invoice".

.3 Amend paragraph 5.2.3 by deleting "delivered to" and substitute "incorporated into".

.4 Amend paragraph 5.2.4 by deleting "first application for payment" and substitute "the first Proper Invoice" and by inserting at the end of the paragraph the following:

5.2.4 The format of the schedule of values shall be in accordance with Section 01 32 26 of the *Contract Specifications*.

.5 Add to the end of paragraph 5.2.7 the following new sentence:

Any *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall remain at the risk of the *Contractor* until *Substantial Performance of the Work* notwithstanding that title has passed to the *Owner* pursuant to GC 13.1 OWNERSHIP OF MATERIALS.

.6 Add new paragraph 5.2.8, 5.2.9 and 5.2.10:

5.2.8 The *Contractor* shall submit, with each Proper Invoice, as a true conditions precedent to the *Contractor's* right to payment under this *Contract* after the first proper invoice, a Statutory Declaration, on an original form of CCDC Document 9A-2001, stating that payments in connection with the *Work*, as noted in the Statutory Declaration, have been made to the end of the period immediately preceding that covered by the current application.

5.2.9 The *Contractor* shall submit Workplace Safety & Insurance Board Clearance Certificate with each proper invoice (as that term is defined in the *Construction Act*).

5.2.10 The *Contractor* shall prepare and maintain current as-built *Drawings* which shall consist of the *Drawings* and *Specifications* revised by the *Contractor* during the *Work*, showing changes to the *Drawings* and *Specifications*, which current as-built *Drawings* shall be maintained by the *Contractor* and made available to the *Consultant* for review with each proper invoice (as that term is defined in the *Construction Act*). The *Consultant* reserves the right to retain a reasonable amount for the value of the as-built *Drawings* not presented for review.

GC 5.3 PROGRESS PAYMENT

.1 Amend paragraph 5.3.1 by adding the words "including a Proper Invoice" after "an application for payment".

.2 Delete from the first line of subparagraph 5.3.1.2, the words, "calendar days" and substitute the words "*Working Days*".

.2 Delete subparagraph 5.3.1.3 in its entirety and substitute new subparagraph:

5.3.1.3 Subject to any notice of non-payment delivered by the *Owner* under the Construction Act, the *Owner* shall make payment to the *Contractor* on account as provided in Article A-5 of the Agreement – PAYMENT no later than 28 days after receiving a Proper Invoice from the *Contractor*.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK

.1 Amend paragraph 5.4.2 by deleting the words "20 calendar days" and substituting the words "fifteen (15) *Working Days*" therefor.

.2 Delete paragraph 5.4.3 in its entirety and substitute new paragraph 5.4.3:

5.4.3 Immediately following the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor*, in consultation with the *Consultant*, shall establish reasonable dates for finishing the *Work* and correcting any deficient *Work*, which in any event shall be consistent with the scheduled Total Completion Date.

.3 Add new paragraph 5.4.4 and 5.4.5:

5.4.4 The *Contractor* shall publish, in a construction trade newspaper in the area of the location of the *Work,* a copy of the Certificate of *Substantial Performance of the Work* within seven (7) days of receiving a copy of the Certificate signed by the *Consultant*, and the *Contractor* shall provide suitable evidence of the publication to the *Consultant* and *Owner*. If the *Contractor* fails to publish such notice, the *Owner* shall be at liberty to publish and back charge the *Contractor* its costs for doing so.

5.4.5 For the purposes of *Substantial Performance of the Work* and subsection 2(1) of the Ontario *Construction Act* relating to the meaning of substantial performance, the *Contractor* acknowledges that the improvement required by this *Contract*, cannot be considered "ready for use" until all items listed in paragraphs a) through j) below have been completed and/or provided in full. The *Contractor* agrees that its failure to submit all of the listed materials and documentation in conformance with the *Contract Documents* shall constitute proper grounds for the *Consultant* to reject the *Contractor's* application for *Substantial Performance of the Work*.

(a) Submission of Warranties, Data Manuals and As-Built Drawings and Specifications in acceptable manner;

(b) Instruction of *Owner* in the operation of systems;

(c) Approval to occupy completed work, from authorities having jurisdiction;

(d) Insurance advisory organization approval of sprinkler system received by *Consultant*;

(e) Submission to and acceptance by the *Consultant* of interim accounts of the *Work* showing all additions and deletions to the *Contract Price*;

(f) Elevator inspection and approval by governing authority received by *Consultant*;

(g) All systems and equipment started up and tested including final balancing;

(h) All life safety systems verified by *Contractor* and *Consultant* as complying with the requirements of the *Contract Documents*;

(i) Local fire authority has inspected and confirmed that life safety systems are acceptable.

(j) All spare parts and maintenance materials.

and any other materials or documentation required to be submitted under the *Contract*, together with written proof acceptable to the *Owner* and the *Consultant* that the *Work* is substantially performed in accordance with the requirements of the *Contract Documents* and the municipal government, utilities and other authorities having jurisdiction.

GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

.1 Add new subparagraphs 5.5.1.3, 5.5.1.4 and 5.5.1.5:

5.5.1.3 Submit a written request for release of holdback including a declaration that no written notices of lien have been received by it.

5.5.1.4 Submit a Statutory Declaration CCDC 9A-2001

5.5.1.5 Submit Workplace Safety & Insurance Board Clearance Certificate.

.2 Delete from line 1 of paragraph 5.5.2, the words, “the statement” and substitute the words “the documents”.

.3 Delete paragraph 5.5.3.

.4 Delete paragraphs 5.5.4 and 5.5.5 and substitute new paragraph 5.5.4:

5.5.4 The holdback amount authorized by the certificate for payment of holdback referred to in paragraph 5.5.2 is due and payable, subject to paragraph 5.8, following the expiry of the applicable time period for the preservation of construction liens, provided that no construction liens or certificates of action have been registered against the title to the *Place of the Work*, and the *Owner* has not received any written notices of lien in respect of the *Work*.

GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

.1 Delete paragraphs 5.6.1, 5.6.2 and 5.6.3 in their entirety.

GC 5.7 FINAL PAYMENT

.1 Delete paragraph 5.7.1 in its entirety and substitute new paragraph 5.7.1:

5.7.1 When the *Contractor* considers that the *Work* is completed and satisfies the requirements of *Total Completion Date* and *Completion of Commissioning*, the *Contractor* shall submit an application for final payment. The *Contractor's* application for final payment shall be accompanied by a Proper Invoice and any documents or materials not yet delivered as agreed to in writing by the *Owner* pursuant to paragraph 5.4.5 together with fully complete as-built *Drawings*. Should the *Contractor* fail to deliver any of the said documents, or other documents required to be delivered pursuant to the *Contract Documents*, the *Owner* shall be at liberty to withhold from amounts otherwise payable to the *Contractor*, an amount, in the discretion of the *Owner*, up to the full amount otherwise payable to the *Contractor* as security for the obligation of the *Contractor* to deliver the undelivered documents.

.2 Delete from the first line of paragraph 5.7.2 the words, "calendar days" and substitute the words "*Working Days*".

.3 Delete paragraph 5.7.4 in its entirety and substitute new paragraph 5.7.4:

5.7.4 "Subject to the other requirements of the *Contract* and the requirements of the *Construction Act*, the unpaid balance of the *Contract Price* shall become payable to the *Contractor* on the later of: (i) the expiration of the statutory limitation period stipulated in the Ontario *Construction Act*; and (ii) the 10th *Working Day* following the issuance of the *Consultant*'s final certificate for payment; and; subject to the *Owner*'s right to withhold payment from the unpaid balance of the *Contract Price* for any amounts required pursuant to GC 5.8 WITHHOLDING OF PAYMENT, and any sums required to satisfy any lien or trust claims arising from the *Work*".

.4 Add new paragraph 5.7.5:

5.7.5 As additional preconditions for release of the final payment, the *Contractor* shall submit the following documentation:

.1 *Contractor's* written request for release of final payment, including a declaration that no written notices of lien have been received by it.

.2 *Contractor's* Statutory Declaration CCDC 9A-2001.

.3 *Contractor's* Workplace Safety & Insurance Board Clearance Certificate.

GC 5.8 WITHHOLDING OF PAYMENT

.1 Add new paragraph GC 5.8.2:

5.8.2 Notwithstanding the provisions of GC 5.3 PROGRESS PAYMENT, GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK and GC 5.7 FINAL PAYMENT, the *Owner* may withhold payment of any amounts otherwise due under the *Contract* on account of any costs or damages the *Owner* has incurred or, is likely to incur, by reason of:

.1 defective or incomplete portions of the *Work* or damage to the work of other contractors not rectified in accordance with the *Contract*;

.2 failure of the *Contractor* to indemnify the *Owner* in accordance with the terms of the *Contract*;

.3 failure of the *Contractor* to fulfil its obligations in respect of construction liens in accordance with GC 13.2;

.4 evidence of the *Contractor's* failure to make payments to *Subcontractors* or Suppliers;

.5 unsatisfactory prosecution of the *Work* by the *Contractor* or any *Subcontractor*; and

.6 failure to attain the *Contract Time*.

Add new paragraph GC 5.8.3:

5.8.3 Where the *Owner* has withheld payment of any portion of the *Contract Price* pursuant to the provision of paragraphs 5.8.2 or 5.8.2, the *Owner* shall be entitled to apply such withheld portion towards any costs or damages suffered by the *Owner*.

GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

.1 Add the following new paragraphs:

6.1.3 With respect to the valuation of any adjustment in the *Contract Price*, subject to any different or additional requirements contained in the *Specifications*, the following shall apply:

.1 If applicable, unit prices included in the *Contract*, or prices pro rata thereto, will be used to value changes;

.2 Proposed methods of adjustment should contain itemized breakdowns describing the net actual value of the *Work* (excluding *Value Added Taxes*), the *Contractor*'s mark-up for overhead and profit, the mark-up for overhead and profit of *Subcontractors*, and where appropriate, detailed quotations or cost vouchers from *Subcontractor* and *Suppliers*;

.3 All overhead costs are deemed to include both site and head office overhead costs, as well as any applicable insurance and bonding costs;

4. Labour costs shall be the actual labour costs based upon rates prevailing at the *Place of the Work* and payable to workers, plus applicable statutory charges such as WSIB, Employment Insurance, Canada Pension, vacation pay, and hospitalization and medical insurance;

.5 If a change involves both additions and deletions to the *Work*, the value of the change will be determined based upon the net difference to the *Work* occasioned by the change. For greater certainty, the *Contractor's* mark-up for overhead and profit only will be applied to the net value of the change.

6.1.4 The *Owner*, through the *Consultant*, reserves the right to authorize payment for a change in the *Work* by means of *Cash Allowance*. For greater certainty, the *Contractor* is not entitled to any mark-up for overhead and profit on such amounts.

6.1.5 In the event that any change to the *Work* results in a reduction in the *Contract Price*, the *Contractor* shall not be entitled to claim for any lost revenue, lost profit or loss of anticipated profit related thereto.

6.1.6 Where *Work* is added to the *Contract,* the *Contractor* shall only be entitled to an increase in the *Contract Price* by the cost of performing the *Work* as agreed or in accordance with GC 6.3.7 as amended including all applicable taxes, but excluding *Value Added Taxes*, plus the following, identified separately:

.1 *Contractor's* mark-up on its own work:

.1 Overhead: 10%

.2 Profit: 5%

.2 *Contractor's* mark-up on *Subcontractor's* work:

.1 Overhead: 5%

.2 Profit: 5%

.3 *Subcontractor's* mark-up on its own work:

.1 Overhead: 10%

.2 Profit: 5%

.4 If *Subcontractor* retains another subcontractor ("sub-subcontractor"), no additional mark-up shall be charged to the *Owner* for the sub-subcontractor's work.

GC 6.2 CHANGE ORDER

.1 Delete paragraph 6.2.1 insert new paragraph 6.2.1 as follows:

6.2.1 When a change in the *Work* is proposed or required, the *Consultant* shall provide a notice describing the proposed change in the *Work* to the *Contractor*. The *Contractor* shall provide the following:

.1 Quotations from the *Subcontractors* on the *Subcontractor's* letterhead and with *Subcontractor's* signature.

.2 Quotations from the *Subcontractors* and the *Contractor* shall have a complete breakdown for all items of material, a total number of hours for labour, and a dollar rate applied against individual material items and labour quantities.

.3 Quotation shall stipulate any adjustment in the *Contract Time*, if any, for the proposed change in the *Work*.

.4 Quotation shall indicate percentage values for overhead and profit by the *Contractor* and the *Subcontractors*.

.5 Ensure all mathematical calculations are complete.

.6 Quotations submitted with any of the above items missing or incorrect will be returned for revision.

GC 6.3 CHANGE DIRECTIVE

.1 Delete paragraph 6.3.7.1 (1), (2), (3) and (4) in their entirety and substitute new paragraph 6.3.7.1 (1) as follows:

"(1) carrying out the *Work*, including necessary supervisory services;"

.2 Delete paragraphs 6.3.7.7, 6.3.7.12, 6.3.7.15 and 6.3.7.17.

GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

.1 Delete paragraph 6.4.1 insert new paragraph 6.4.1 as follows:

6.4.1 The *Contractor* shall immediately, and in no event, later than 2 Working Days after first observance, notify the *Consultant* and the *Owner* in writing, if in its opinion, the subsurface or otherwise concealed physical conditions at the *Place of the Work* which existed before the commencements of the *Work* differ materially from those indicated in the *Contract Documents* or a reasonable assumption of probable conditions based thereon.

Add new paragraph 6.4.5:

6.4.5 The *Contractor* confirms that, prior to bidding the *Project*, applying the standard of care described in paragraph 1.5.1, it carefully investigated the *Place of the Work*. Notwithstanding any other provision in the Contract, the *Contractor* is not entitled to compensation or to an extension of the *Contract Time* for conditions which could reasonably have been ascertained by the *Contractor* by such investigation undertaken prior to the submission of the bid.

GC 6.5 DELAYS

.1 Add the following to the end of paragraph 6.5.1 and to the end of paragraph 6.5.2 "but excluding any special, indirect or consequential losses or damages, including but not limited to, loss of use, loss of productivity, loss of revenue, overhead and/or profit".

.2 Add the following to paragraph 6.5.3: "provided that such costs are reasonable (and, in any event, shall exclude any special, indirect or consequential losses or damages, including but not limited to, loss of use, loss of productivity, loss of revenue, overhead and/or profit)."

.3 Add new paragraphs 6.5.6 and 6.5.7.

6.5.6 The *Contractor* shall at all times perform the services required to perform the *Work* in accordance with the *Contract Documents* as diligently and expeditiously and to maintain an orderly progress of the *Work*, and in

accordance with the *Contract Time* and any revisions thereto. The *Contractor* shall at all times provide sufficient personnel to accomplish its services within the *Contract Time*.

6.5.7 If the *Contractor* is delayed in the performance of the *Work* by an act or omission of the *Contractor* or anyone employed or engaged by the *Contractor* directly or indirectly, or by any cause within the *Contractor's* control, then the *Contractor* shall take appropriate steps, in accordance with paragraph 3.5.2, to recover any lost time, and the costs of such recovery efforts shall be to the *Contractor's* account. To the extent that the *Contractor* caused delay results in the *Owner* incurring additional costs and expenses and/or a change in the *Contract Time*, the *Contractor* shall be liable to the *Owner* for the *Owner's* cost and damages arising therefrom, including but not limited to, all services required by the *Owner* from the *Consultant* as a result of such delay by the *Contractor* and, in particular, the cost of the *Consultant*'s services during the period between the date of *Substantial Performance of the Work* stated in Article A-1 herein as the same may be extended through the provision of these General Conditions and any later, actual date of *Substantial Performance of the Work* achieved by the *Contractor*.

GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

.1 In paragraph 6.6.5, delete "claim" in the second line and replace with "necessary claim information".

.2 Add new paragraph 6.6.7:

6.6.7. The *Owner* may make claims arising out of the costs incurred for additional services provided by the *Consultant* resulting from the *Contractor's* failure to perform the *Work* in accordance with the terms and conditions of the *Contract*, including the *Contractor's* issuance of unnecessary requests for information. The *Consultant* will notify the *Owner* and *Contractor* where it has been determined that additional services will be required or have been provided in order not to cause a delay. The *Owner* shall make claims against the Contractor based on the *Consultant's* invoices.

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

.1 Delete paragraph 7.1.5.2 and insert new paragraph 7.1.5.2 as follows:

7.1.5.2 withhold further payment to the *Contractor* until the *Owner* has completed all *Work* required by the *Contract Documents* and satisfied any of its costs or damages resulting from the *Contractor's* default; and

GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

.1 Delete subparagraph 7.2.3.1 in its entirety.

.2 Delete subparagraph 7.2.3.3 in its entirety and substitute new subparagraph 7.2.3.3:

7.2.3.3 the *Owner* fails to pay the *Contractor* when due the amount certified by the *Consultant* or awarded by arbitration or a Court, except where the *Owner* has a bona fide claim for set off, or

.3 Delete from line 2 of subparagraph 7.2.3.4, the words, "OF THE OWNER".

.4 Amend paragraph 7.2.4 by deleting "5" and substitute "15".

.5 Amend paragraph 7.2.5 by deleting the words "reasonable profile" in line 2 and deleting the word "damages" in line 3 and substitute the words "direct damages", and by deleting the period at the end of the paragraph and replacing it with a comma and then adding the following words: "but excluding any special, indirect or consequential losses or damages, including but not limited to, loss of use, loss of productivity, loss of revenue, overhead and/or profit".

.6 Add the following new paragraph 7.2.6:

7.2.6 The *Owner's* withholding of progress payments, holdback payment and/or final payments pursuant to GC 5.8 shall not constitute a default under GC7.2.3 permitting the *Contractor* to stop the *Work* or terminate the *Contract*.

GC 8.1 AUTHORITY OF THE CONSULTANT

.1 Delete 8.1.1, 8.1.2 and 8.1.3, and insert the following new paragraphs:

8.1.1 Differences between the parties to the *Contract* as to the interpretation, application or administration of this *Contract* or any failure to agree where agreement between the parties is called for, herein collectively called disputes, which are not resolved in the first instance by finding of the *Consultant* pursuant to the provisions of GC 2.2 ROLE OF THE CONSULTANT, paragraphs 2.2.7 and 2.2.8 shall be settled in accordance with the requirements of this General Condition.

8.1.2 The claimant shall give written notice of such dispute to the other party no later than 7 days after the receipt of the *Consultant*'s

finding given under GC 2.2 - ROLE OF THE CONSULTANT, paragraphs 2.2.7 or 2.2.8. Such notice shall set forth particulars of the matters in dispute, the probable extent and value of the damage and the relevant provisions of the *Contract Documents*. The other party shall reply within 7 days to such notice after he receives or is considered to have received it, setting out in such reply his grounds and relevant provisions of the *Contract Documents*.

8.1.3 If the matter in dispute is not resolved promptly the *Consultant* will give such instructions as in its opinion are necessary for the proper performance of the *Work* and to prevent delays pending settlement of the dispute. The parties shall act immediately according to such instructions, it being understood that by so doing neither party will jeopardize any claim they may have. If it is subsequently determined that such instructions were in error or at variance with the *Contract Documents*, the *Owner* shall pay the *Contractor* verifiable costs incurred by the *Contractor* in carrying out such instructions which the Contractor was required to do beyond what the *Contract Documents* correctly understood and interpreted would have required him to do including costs resulting from interruption of the *Work*.

8.1.4 It is agreed that no act by either party shall be construed as a renunciation or waiver of any of his rights or recourses, provided he has given the notices in accordance with paragraph 8.1.2 and has carried out the instructions as provided in paragraph 8.1.3.

8.1.5 If the parties have agreed to submit disputes to arbitration, then the dispute shall be submitted to arbitration in accordance with the provisions of the arbitration legislation of the *Place of the Work*.

8.1.6 If no agreement is made for arbitration, then either party may submit the dispute to such judicial tribunal as the circumstances may required.

8.1.7 In recognition of the obligation by the *Contractor* to perform the disputed work as provided in paragraph 8.1.3, it is agreed that settlement of dispute proceedings may be commenced immediately following the dispute in accordance with the foregoing settlement of dispute procedures.

GC 8.2 NEGOTIATION, MEDIATION AND ARBITRATION

.1 Delete 8.2 in its entirety.

GC 8.3 RETENTION OF RIGHTS

.1 Add new subparagraph 8.3.3:

8.3.3 If the Parties agree under paragraph 8.1.5 to have a dispute resolved by arbitration, the *Contractor* agrees that this paragraph 8.3.3 shall be construed as a formal consent to the stay of any lien proceedings until an award is rendered in the arbitration or such dispute is otherwise resolved between the parties; provided, however, that in no event shall the *Contractor* be deprived of its right to enforce its lien against the *Project* should the *Owner* fail to satisfy any arbitral award. For greater certainty, nothing in this paragraph 8.3.3 shall prevent the *Contractor* from taking the steps required by the *Construction Act* to preserve and/or perfect a lien to which it may be entitled.

GC 9.1 PROTECTION OF WORK AND PROPERTY

.1 Delete subparagraph 9.1.1.1 in its entirety and substitute new subparagraph 9.1.1.1:

9.1.1.1 errors in the *Contract Documents* which the *Contractor* could not have discovered applying the standard of care described in paragraph 1.5.1;

.2 Delete paragraph 9.1.2 in its entirety and substitute the following new paragraph 9.1.2:

9.1.2 Before commencing any *Work*, the *Contractor* shall determine the locations of all underground utilities and structures indicated in or reasonably determinable from the *Contract Documents* or that are discoverable by applying to an inspection of the *Place of the Work* the degree of care and skill described in paragraph 1.5.1.

.3 Add new paragraph 9.1.5:

9.1.5 The *Contractor* shall neither undertake to repair and/or replace any damage whatsoever to the *Work* of other contractors, or to adjoining property, nor acknowledge the same was caused or occasioned by the *Contractor*, without first consulting the *Owner* and receiving written instructions as to the course of action to be followed from either the *Owner* or the *Consultant*. However, where there is danger to life or public safety, the *Contractor* shall take such emergency action as it deems necessary to remove the danger.

GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

.1 Add to new paragraph 9.2.5 (5) as follows:

(5) comply with the *Owner's* requirements and specifications for *Hazardous Substances* contained in the *Contract Documents*.

.2 Add to paragraph 9.2.6 after the word "responsible", the following:

"or whether any toxic or *Hazardous Substances* or materials already at the *Place of the Work* (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damage to the property of the *Owner* or others,"

3. In paragraph 9.2.7 after "is responsible" add

"or that any toxic or *Hazardous Substances* or materials already at the *Place of the Work* prior to the Contractor commencing the Work (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does comply with legal and regulatory requirements,".

.4 Add to paragraph 9.2.8 after the word "responsible", the following:

"or that any toxic or *Hazardous Substances* or materials already at the *Place of the Work* prior to the Contractor commencing the *Work* (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damage to the property of the *Owner* or others,"

.5 Add "and the *Consultant*" after the word *"Owner"* in subparagraph 9.2.8.4.

GC 9.4 CONSTRUCTION SAFETY

.1 Delete paragraph 9.4.1 in its entirety and substitute new paragraph 9.4.1

9.4.1 The *Contractor* shall be solely responsible for construction safety at the *Place of the Work* and for compliance by it and its *Subcontractors* and Suppliers with the applicable construction health and safety legislation and the *Owner*'s Safety and Infection Control Regulations, Guidelines and Instructions for Contractors, a copy of which is found at Section 1 of the Specifications. The *Contractor* shall be

responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the *Work*. The *Contractor* hereby accepts the designation of "constructor" as defined under the *Occupational Health and Safety Act* for the *Project*, and responsibility for the obligations and liabilities associated therewith. Prior to the commencement of the *Work*, the *Contractor* shall submit to the *Owner* a copy of the Notice of Project filed with the Ministry of Labour in respect of the *Work.*

.2 Add new paragraphs 9.4.3, 9.4.4, 9.4.5, 9.4.6 and 9.4.7:

9.4.2 Prior to the commencement of the *Work*, the *Contractor* shall submit to the *Owne*r:

.1 a current WSIB clearance certificate;

.2 copies of the *Contractor's* insurance policies having application to the *Project* or certificates of insurance, at the option of the *Owner*;

.3 documentation of the *Contractor's* in-house safety-related programs;

.4 a copy of the Notice of Project filed with the Ministry of Labour naming itself as "constructor" under *OHSA*.

9.4.3 The *Contractor* hereby represents and warrants to the *Owner* that appropriate health and safety instruction and training have been provided and will be provided to the *Contractor's* employees and *Subcontractors*, *Suppliers* and any one for whom the *Contractor* is responsible, before the *Work* is commenced and agrees to provide to the *Owner*, if requested, proof of such instruction and training.

9.4.4 The *Contractor* shall tour the appropriate area to familiarize itself with the job site prior to commencement of the *Work*.

9.4.5 The *Contractor* shall never work in a manner that may endanger anyone.

9.4.6 The *Contractor* shall indemnify and save harmless the *Owner*, the *Consultant* and their respective agents, officers, directors, employees, consultants, successors and assigns from and against the consequences of any and all safety infractions committed by the *Contractor* under *OHSA*, including the payment of legal fees and disbursements on a solicitor and client basis. Such indemnity shall apply to the extent to which the *Owner* is not covered by insurance, provided that the indemnity

contained in this paragraph shall be limited to costs and damages resulting directly from such infractions and shall not extend to any consequential, indirect or special damages.

9.4.7 In the event that the *Owner* engages other contractors at the *Place of the Work* or performs work with its own forces,, the *Owner* undertakes to include in its contracts with other contractors and/or in its instructions to its own forces the requirement that the other *Contractor* or own forces, as the case may be, must comply with directions and instructions from the *Contractor* as "constructor" with respect to occupational health and safety and related matters.

GC 9.5 MOULD

.1 Add "and the *Consultant*" after the word "*Owner*" in subparagraph 9.5.2.4.

.2 Delete paragraph 9.5.3.3 in its entirety and substitute new paragraph 9.5.3.3 as follows:

9.5.3.3 extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. If, in the opinion of the *Consultant*, the *Contractor* has been delayed in performing the *Work* and / or has incurred additional costs under paragraph 9.5.1.2, the *Owner* shall reimburse the *Contractor* for its reasonable costs incurred as a result of the delay as certified by the *Consultant*, and

GC 10.1 TAXES AND DUTIES

.1 Add new paragraph 10.1.3:

10.1.3 The *Owner* shall be entitled to all available refunds or rebates of all taxes and custom duties applicable to the *Contract,* and the *Contractor* shall cooperate with the *Owner* in ascertaining the amount of such tax and custom duties and if necessary claim on its own behalf and transfer to the *Owner* or facilitate a direct claim by the *Owner* for any such available refund or rebate.

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

.1 Add to the end of paragraph 10.2.4, the following words:

"The *Contractor* shall notify the Chief Building Official or the registered code agency where applicable, of the readiness, substantial completion, and completion of the stages of construction set out in the Ontario Building Code. The *Contractor* shall be present at each site inspection by

an inspector or registered code agency as applicable under the Ontario Building Code."

.2 Delete from the first line of paragraph 10.2.5 the word, "The" and substitute the words "Subject to paragraphs 3.4.1 and 3.10.7, the".

GC 11.1 INSURANCE

.1 Delete from the first and second lines of paragraph 1 of CCDC 41 - CCDC INSURANCE REQUIREMENTS related to General Liability insurance the reference to "$5,000,000" and substitute "$10,000,000".

.2 Delete from the second line of paragraph 2 of CCDC 41 - CCDC INSURANCE REQUIREMENTS related to Automobile Liability insurance the reference to "$5,000,000" and substitute "$10,000,000".

.3 Delete from the third and fourth lines of paragraph 3 of CCDC 41 - CCDC INSURANCE REQUIREMENTS related to Aircraft and Watercraft Liability insurance the reference to "$5,000,000" and substitute "$10,000,000".

GC 12.1 INDEMNIFICATION

.1 Delete paragraph 12.1.1 in its entirety and substitute the following:

"12.1.1 The *Contractor* shall indemnify and hold harmless the *Owner*, the *Consultant* and their respective agents and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings (hereinafter called "claims"), by third parties that arise out of, or are attributable to, the *Contractor's* performance of the *Work* or anyone for whose acts the *Contractor* may be liable including *Subcontractor* and, Suppliers.

.2 Delete paragraph 12.1.2 in its entirety and substitute the following:

12.1.2 "The *Owner* shall indemnify and hold harmless the *Contractor*, the *Contractor*'s agents and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor*'s performance of the *Contract* which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the *Place of the Work*."

.3 Delete paragraph 12.1.5 in its entirety

GC 12.2 WAIVER OF CLAIMS

.1 Delete paragraphs 12.2.3, 12.2.4, 12.2.5 and 12.2.10.

GC 12.3 WARRANTY

.1 Delete from the first line of paragraph 12.3.2 the word, "The" and substitute the words "Subject to paragraph 3.4.1, the…"

.2 Insert new paragraph 12.3.9 as follows:

12.3.9 The time period for the warranty with respect to any item corrected shall commence from the date when the defect is corrected and the remedial work is accepted by the *Consultant*."

Add new PART 13 as follows:

PART 13 OTHER PROVISIONS

GC 13.1 OWNERSHIP OF MATERIALS

13.1.1 Unless otherwise specified, all materials existing at the *Place of the Work* at the time of execution of the *Contract* shall remain the property of the *Owner*. All *Work* and *Products* delivered to the *Place of the Work* by the *Contractor* shall be the property of the *Owner.* The *Contractor* shall remove all surplus or rejected materials as its property when notified in writing to do so by the *Consultant*.

GC 13.2 CONSTRUCTION LIENS

13.2.1 In the event that a construction lien is registered against the *Project* by or through a *Subcontractor* or *Supplier*, the *Contractor* shall, at its own expense:

.1 within seven (7) *Working Days*, ensure that any and all construction liens and certificates of action are discharged, released or vacated by the posting of security; and

.2 in the case of written notices of lien, ensure that such notices are withdrawn, in writing.

13.2.2 In the event that the *Contractor* fails to conform with the requirements of 13.2.1, the *Owner* may vacate or discharge the lien and then set off and deduct from any amount owing to the *Contractor*, all amounts posted as security or paid to the lien claimant and associated expenses, including the costs of borrowing the appropriate cash, letter of credit or bond as security and legal fees and disbursements. If there is no amount owing by the *Owner* to the *Contractor*, then the *Contractor* shall reimburse the *Owner* for all of the said costs and associated expenses."

GC 13.3 CONTRACTOR DISCHARGE OF LIABILITIES

13.3.1 In addition to the obligations assumed by the *Contractor* pursuant to GC 3.7, the *Contractor* agrees to discharge all liabilities incurred by it for labour, materials, services, *Subcontractors* and *Products*, used or

reasonably required for use in the performance of the *Work*, except for amounts withheld by reason of legitimate dispute which have been identified to the party or parties, from whom payment has been withheld.

GC 13.4 DAILY REPORTS/DAILY LOGS

13.5.1 The *Contractor* shall cause its supervisor, or such competent person as it may delegate, to prepare a daily log or diary reporting on weather conditions, work force of the *Contractor*, *Subcontractors*, *Suppliers* and any other forces on site and also record the general nature of *Project* activities. Such log or diary shall also include any extraordinary or emergency events which may occur and also the identities of any persons who visit the site who are not part of the day-to-day work force.

13.5.2 The *Contractor* shall also maintain records, either at its head office or at the job site, recording manpower and material resourcing on the *Project*, including records which document the activities of the *Contractor* in connection with GC 3.5, and comparing that resourcing to the resourcing anticipated when the most recent version of the schedule was prepared pursuant to GC 3.5.

GC 13.5 HOSPITAL RELATED PROVISIONS

13.6.1 The *Contractor* recognizes and understands that the Owner is a hospital approved under the *Public Hospitals Act* (Ontario) and is therefore subject to a highly regulated legal and operational environment. Without limiting the generality of any other provision in the Contract, the *Contractor* shall provide reasonable co-operation and assistance to the *Owner* during any evaluations of the Work (including, without limitation, any post-occupancy evaluation required by the Ministry of Health and Long Term Care) and in obtaining required regulatory approvals prior to using the Work (including, without limitation, approvals required by Section 4(2) of the *Public Hospitals Act*).

13.6.2 The *Contractor* acknowledges that the security and safety of the patients, employees and other occupants of the existing hospital is paramount. If any of the employees of the *Contractor* or the Sub*Contractor*s is determined by the *Owner* to be a concern for the security or safety of such patients, employees or occupants, the *Owner* may require that the *Contractor* replace such employee.

13.6.3 The *Contractor* recognizes that part of the *Work* may consists of the renovation of existing buildings and structures or the addition of a structure to an existing building and that the provision of patient care during construction is a priority for the *Owner*. The *Contractor* shall comply with the reasonable instructions provided by the *Owner* (including, without limitation, the *Owner*'s infection control practitioner) in regard to patient care and the operation and use of the hospital during the performance of the *Work*. Any costs incurred by the *Contractor* in complying with the said instructions shall be part of the *Contract Price*.

13.6.4 Notwithstanding any other provision in the *Contract*, paramountcy of access must be given to emergency vehicles and no claim may be made by the *Contractor* for any delay in the performance of the *Work* as a result of any temporary lack of access to the Place of *Work* resulting from this paramountcy of access by emergency vehicles, provided that the *Owner* will use commercially reasonable efforts to avoid and to limit the duration of any temporary lack of access for this reason.

13.6.5 The *Owner* has the authority, but without the obligation, to stop the *Work* in any circumstance affecting the safety of life or property or otherwise may cause an unsafe condition for the operation of the existing hospital. The *Contractor* shall abide by the *Owner*'s instructions to stop the *Work* and to any related instructions pertaining to the circumstance without any increase in the *Contract Price* and extension in the *Contract* Time if such circumstance was caused by the *Contractor*, *Subcontractors* or Suppliers.

13.6.6 The *Contractor* shall, and shall cause the *Subcontractors* and Suppliers to, comply with hospital policies and procedures including, without limitation, environmental requirements, infection control measures and safety and emergency preparedness guidelines which are or come into force (including, without limitation, those forming part of the *Contract* Documents) as such documents are amended by the *Owner* from time to time, provided that a material amendment to the hospital policies and procedures by the *Owner* after the date of the Agreement which gives rise to a significant change in the *Work* shall be dealt with in accordance PART 6 CHANGES IN THE *WORK*.

1 SUMMARY OF WORK

1.1 Work covered under this Contract

.1 Work of this Contract includes labour, materials, equipment, services and other related expenses to execute complete construction of facility specified under Contract Documents.

.2 It is the Contractor's sole responsibility to examine the Construction Documents, Specifications and Drawings issued to establish/determine total scope of work.

.3 In accepting award of this Contract, Contractor hereby reaffirms that it is fully informed regarding all conditions affecting Work including its company's provincial taxes are in good standing and further accepts to complete Work for purpose intended in accordance with Contract Documents. Contractor hereby reaffirms that it does not and will not have any conflict of interest in executing work of this Contract.

.4 Hybrid Operating Room Suite:

.1 Sunnybrook intends to expand and renovate an existing Operating Room (i.e. Operating Room #14) and convert the space into a new Hybrid Operating Room. This Room, will include the Surgical Room equipped with the state-of-the art Imaging equipment which combine Angiography and CT Scanner functionality. In addition to the Surgical Operating Room, an adjacent Control Room and dedicated Equipment Room will be constructed.

.2 The new Angio and CT Scanner Unit, the Azurion C20 FlexArm system, will be supplied and installed by Philips Healthcare, an industry leader in the delivery of advanced. The Philips gantry will be fed from a new Uninterruptible Power Supply (UPS) System and the new UPS room will be located in the existing M-Wing Third Floor Mechanical room directly above the Surgical OR Suite #14.

.3 New wall partitions enclosing the Hybrid Operation Room including the Control Room shall be equipped with heavy gauge steel studs to secure new 1/8" (3.2mm) thick leaded sheets to provide required radiation shielding protection and safe operation of the Azurion equipment system. All glazed window screens within hollow metal frames and glass vision panel within new doors shall meet the equivalent lead protection rating for the Operating Room.

.4 It is imperative that the occupied room areas adjacent to the rooms affected by the work for construction of the new Hybrid Operating Room are required to remain nominally functional throughout the course of the renovations.

.5 Structural Work:

.1 The existing structure of M Wing is generally comprised of reinforced cast-in-place concrete flat slabs with drop panels, supported by concrete columns which are founded on traditional spread footings. There is a reinforced concrete foundation wall around the perimeter of the building extending from the basement to the underside of the first floor. The primary lateral load resisting system is concrete shear walls and core walls at the perimeter stair towers and interior elevator shafts.

.2 The 2nd floor slab is 200 mm thick with 180 mm deep drop panels around the columns. The 3rd floor slab is 230 mm thick with 200 mm deep drop panels around the columns.

.3 The 2nd and 3rd floor slabs were both originally designed for a Live Load of 4.8 kPa and a superimposed dead load of 2.4 kPa (including 1.2 kPa for partitions).

.4 The majority of Philips Azurion C-Arm equipment is to be supported above the ceiling by engineered Unistrut framing systems that are anchored into the underside of the concrete slab above. Where required some additional structural steel framing is to be engineered by the Unistrut provider to trapeze around duct work or other interfering services.

.5 The renovation will include installation of 4x surgical lights, 1x articulating Nursing equipment boom, 1 articulating arm Anesthesia boom, 2x Injector Rad and 4x video monitors. Each articulating pendant arm will be supported by a suspended structural engineered steel frame system and anchored to the underside of the concrete slab above. The smaller pieces with lighter loads are typically supported by a single HSS monopole structure, while the larger and heavier pieces shall be supported using the common steel frame 'octopus' (mounting plate above ceiling with 4 vertical hangers and 4 diagonal braces).

.6 To accommodate for redundancy of the air handling systems it is expected that some significant openings is required to facilitate the installation of new ducts from the 3rd floor to the 2nd floor ceiling space. New duct openings shall be located away from columns and structural gridlines and ideally within the intersecting middle strips of the flat slab (i.e. within the 4.5 m x 4.5 m center of the framing bays).

.6 Mechanical Work:

.1 The new Hybrid OR Suite will be designed to the minimum of the CSA-Z317.1-10 which requires 20 ACHR. The existing area is ventilated from a single Central AHU located in the M-Wing Basement Mechanical Room.

.2 In conformance with CSA Standards for the Heating Ventilating and Air Conditioning Systems for Health Care Facilities, (CSA-Z317.2-2010), it is required for Type 1 Critical Care areas be served by an air system having 100% redundancy in air supply. The air supply for the existing M-Wing Operating Rooms currently do not have any redundancy. There are two air handling unit serving the block of 16 Operating Rooms on level 2 (each unit serves eight Operating Rooms and the two units are not interconnected). If an Operating Room Air handling unit were to break down, the Hospital would lose eight Operating Rooms.

.3 To provide the required redundancy per code, it is intended that a new 5,800cfm Air Handling Unit be installed within the existing 3rd floor Mechanical room. The new Unit shall be connected to existing Chilled Water, Steam and Glycol Services and Emergency Electrical Power available in the Basement Mechanical room.

.4 Exhaust Air from the redundant AHU shall be connected to an existing exhaust air plenum of the new Unit. However, Supply Air is much more difficult as it will need to be run thru an occupied, constrained low ceiling space (there is no ceiling, just exposed structure and Mechanical Services) to the south of the new Unit. A new Air Intake Plenum/ Louvre will need to be installed. Steam, glycol and chilled water piping will have to be extended up from the basement mechanical room.

.5 New duct connections from the new redundant AHU to the existing Operating Room duct work, to permit the redundancy, will be challenging and require long duct runs through sensitive occupied OR Sterile core. Considerable re-working of the duct installation in the existing 2nd Floor Operating Rooms is expected and Contractor shall coordinate access with the Hospital at least 2 weeks in advance.

.6 All existing ductwork, terminal boxes, grilles and diffusers shall be demolished from the areas of renovation. New ductwork and terminal boxes will be extended from the existing AHU System to new hybrid Operating Room and support areas. The terminal boxes for the 2nd Floor Operating Rooms are located in a Mechanical Room on the floor above. Ductwork drops through the third floor slab shall be protected with a fire rated enclosure until it reaches the operating room. New openings in the floor slab with new runs of fire rated ducting through the Sterile core is required to suit the new layout.

.7 The new hybrid Operating Room will be provided with stainless steel laminar flow ceiling supply diffusers with HEPA filters and low level return air grilles.

.8 As the existing Air Handling unit serving the new hybrid operating serves other existing Operating Rooms, it is required by the Contractor that the entire air system be balanced under the contract. Cleaning of the existing return and supply air systems shall also be provided as the duct system is over 20 years old.

.9 New On-floor heating shall be provided by reworking piping connections to the new local re-heat coils serving the new layout.

.10 The new dedicated Equipment Room and the 3rd floor UPS room will each be cooled by a split A/C unit, with a remote condenser.

.11 There is an existing plumbing stack (sanitary, storm, vent and domestic water supplies) located between Operating Rooms 1 and 2 is required to be relocated to suit the new layout. The existing scrub sinks and the sink in the common area between the two existing operating rooms shall be demolished to accommodate the new Work. A new Sunnybrook IP&C grade wall-hung stainless steel scrub sink will be provided for the new Operating Room with plumbing connections to existing area services.

.12 New medical gas piping, distribution, source systems, and alarms will be installed to the latest CSA Z7396.1 standards. New Medical Air, Medical Vacuum, Medical Oxygen, Nitrogen, nitrous oxide, carbon dioxide and scavenging piping shall be provided for the new Hybrid Operating Room c/w new Local Emergency Alarm and Zone Control Valves (LEA/ZCV).

.13 The existing pre-action sprinkler system shall be cut back and re-worked to suit the new renovation area. New piping, heads and heat detectors will be installed and connected to the existing pre-action sprinkler zone.

.14 Existing on-floor Building Controls will be demolished and replaced with new DDC Controls for the new redundant air handling unit, on floor re-heat coil valves, dampers, etc. All rooms will be provided with local zone control. The operating room will be equipped with a pressure, humidity and temperature monitor with local readout. A new high temperature alarm will be provided in both Equipment Room and UPS room.

.7 Electrical Work:

.1 There are existing Electrical Panels in the vicinity of the area to be renovated (one Normal Power and one Emergency Power). These Panels will be maintained and used for any new circuits required.

.2 There are three existing Isolated Power Electrical Panels in the existing Operating Room. It is expected that these existing Panels will need to be relocated to suit the architectural renovations (the relocation will need to include extending/ re-routing the existing feeders to the Panels). These Panels, both the Panels remaining in place and the relocated Panels, will be re-used for any circuits required. The Line Isolation Monitors (LIM's) in these Isolated Power Centres are of an older technology and will be replaced (ie Scope will include three new LIM's).

.3 The new Philips C20 FlexArm System requires a new 160kVA, 600 volt to 480 volt Uninterruptible Power Supply System. The new CT Scanner component of the Azurion system requires a new 100kVA, 600 volt to 480 volt Uninterruptible Power Supply System.

.4 The new UPS Systems will be electrically fed from two new 400 amp, air circuit breakers, one Normal Power and one Emergency Power, installed in existing Basement Level M- Wing 600 volt Normal Power and Emergency Power Electrical Switchboards. The Distribution will consist of two 400 amp, 600 volt feeds, one Normal Power and one Emergency Power, running from the two new air circuit breakers up to the new Third Floor UPS Room within the existing M-Wing Mechanical Room. With-in the UPS Room there will be two 400 amp, 600 volt Distribution Panels, one Normal Power and one Emergency Power with a feed from each Distribution Panel to a Source Selector Switch for each UPS System located in the UPS room.

.5 New feeds will be extended from the new Source Selector Switches to each of the two new 600 volt to 480 volt UPS Systems consisting of an in-put 600 volt Transformer, a 600 volt to 480 volt By-Pass Transformer, a UPS System with minimum of 30 minutes of Battery Back-up and an Out-put Breaker.

.6 The new Ventilation Unit will be fed from a new Disconnect Switch added to an existing Emergency Power Motor Control Centre in the 3rd Floor Mechanical Room.

.7 The new UPS Room air conditioning loads will be electrically fed from two new 30 amp, moulded case circuit breakers installed in the 600 volt Emergency Power Distribution Panel.

.8 Existing Fire Alarm will be maintained (existing in-room Smoke Detectors and EVAC Speakers will be removed for the construction and replaced in the new ceiling). New smoke detectors will be provided.

.9 A new duct type Smoke Detector will be added in the supply air duct work serving the new Scanner areas. The Detector will be connected to both the Fire Alarm System and to the Starter for the Fan for shut-down.

.10 An empty conduit system will be provided for new Telephone & Data System cabling (actual Cabling will be provided by the Hospital). The existing Network Hub Room is close to the renovated area.

.11 Extensive new local power services will be provided as required. Power circuits for the various receptacle/ power services in the Operating Room will comply with CSA Standards for "Critical Patient Care".

.12 The feeds for the Angio Equipment and CT Scanner will be brought down from the Third Floor UPS Room to new Main Disconnect Devices that will be located in the Equipment Room.

.13 Lighting in the expanded/ renovated Operating Room will be replaced with new, energy efficient LED luminaires combining both standard 2' x 4' Lights around the Operating Table and Pot Lights providing general room illumination. Lighting in the Operating Room and Control Room will include supplemental, dimmed LED Pot Lights.

.14 All Operating Room lighting luminaires will be totally sealed units to suit Infection Control guidelines and will have dimming capability.

.15 An Emergency Battery Lighting System will be provided in the new Operating Room and Control Room consisting of a central battery capable of maintaining the remote lighting heads for one hour.

1.2 Comply with Section 01 35 33 Infection Control Procedures.

1.3 Read specifications and Architectural, Structural, Mechanical and Electrical drawings in conjunction to understand the scope of work and any necessary sequencing of activities for the project.

1.4 Shut-down of the existing Air Handling unit to perform work for ventilation redundancy shall occur during the Hospital's summer ramp-down period in the summer. The Contractor shall coordinate with the Hospital and submit a shut-down schedule at least 3 weeks in advance of the work for approval in conjunction with securing all other IPAC approvals prior to commencement of any activity.

1.5 Designated Substances

.1 Refer to Appendices for project-specific Limited Designated Substance Survey Report (Renovation Areas) and prepare the Site for safe construction operations prior to engaging in other work, as required by governing legislation.

1.6 Work Provided by Owner or Performed Under Separate Contracts

.1 The term "NIC" means that work of this Project which is not being performed or provided by the Contract; the term means "Not in This Contract" or "Not a Part of The Work to be Performed or Provided by The Contractor".

.2 "NIC" work is specified and/or indicated on the Drawings as an aid to the Contractor in scheduling the amount of time and materials necessary for the completion of the Contract.

1.7 Equipment Schedule

.1 Refer to the Hybrid OR Equipment List, attached at the end of this specification section, containing information on the following:

.1 Owner Purchase/Owner Install Products;

.2 Owner Purchase/Contractor Install Products;

.3 Contractor Purchase/Contractor Install Products.

1.8 Owner Purchase / Contractor Install Products

.1 Owner Responsibilities:

.1 Order and pay for Owner-supplied Products not already in the Owner's possession.

.2 Arrange and pay for delivery of Owner-supplied Products F.O.B. the site, within time frames required by Contractor's progress schedule. If delivered sooner than required by Contractor's latest progress schedule submitted to the Owner, arrange and pay for delivery to a temporary storage location and subsequent delivery to the site.

.1 Contractor shall include the total value of the Owner's-supplied Products in the Contractor's insurance.

.3 Arrange and pay for delivery to Contractor of reviewed Shop Drawings, Product data, samples, and manufacturer's installation instructions.

.4 Inspect deliveries jointly with Contractor.

.5 Submit claims for transportation damage.

.6 Arrange for replacement of damaged, defective or missing items identified at time of delivery.

.7 Arrange for manufacturer's field services.

.8 Arrange for delivery of manufacturer's warranties to Contractor for inclusion in operation and maintenance manual.

.2 Contractor Responsibilities:

.1 Designate in progress schedule, time frames for delivery of Owner-supplied Products to the site and for receipt of related submittals. If the site is not ready to receive delivery of Owner-supplied Products within the time frame indicated in the latest progress schedule submitted to the Owner, arrange and pay for delivery to a temporary storage location and subsequent delivery to the site.

.2 Review all required submittals and notify Consultant of any observed discrepancies or anticipated problems.

.3 Ensure that course of construction insurance is adequate to cover Owner-supplied Products.

.4 Receive and unload Owner-supplied Products at the site.

.5 Inspect deliveries jointly with Owner. Record shortages and visibly damaged or defective items.

.6 Handle Owner-supplied Products at site, including uncrating and storage.

.7 Take appropriate precautions to protect Owner-supplied Products from loss or damage.

.8 Repair or replace items damaged on site.

.9 Assemble, install, connect, adjust, and finish Owner-supplied Products as specified.

.10 Arrange for inspections required by authorities having jurisdiction as specified.

.11 Arrange for or perform testing as specified.

.12 Workmanship warranty for installation.

2 OWNER SUPPLIED AND INSTALLED SPECIALTY EQUIPMENT (I.E. PHILIPS / GITENGE)

2.1 Specialty Equipment Responsibilities between Owner, Vendors and Contractor:

.1 Owner shall Order and pay for the Specialty Equipment.

.2 Owner shall arrange and pay for delivery of Specialty Equipment F.O.B. the site.

.3 The Specialty Equipment Vendors shall deliver within the time-frame required by the project's milestone completion schedule as agreed between the Owner, Vendor and Contractor at the head start of the construction.

.4 The Specialty Equipment Vendors shall install and commission their supplied equipment in accordance with the project schedule.

.5 If the Contractor's site is not ready to receive delivery of the Specialty Equipment within the time-frame indicated in the aforementioned project schedule, the Contractor shall arrange and pay for delivery to a temporary secured storage location including all costs associated with temporary storage and subsequent delivery back to the site. The storage location as determined by the Contractor shall be bonded and secured.

.6 The Contractor shall take all appropriate precautions to protect Owner-supplied equipment from loss or damage as stored within the construction site.

.7 The Contractor shall coordinate scheduling and installation with the Specialty Equipment Vendors.

2.2 Vendor's Specialty Equipment Catalogue Cuts are appended at the end of the Specifications

3 SPECIFICATIONS

3.1 Specifications are not intended as detailed description of installation methods but serve to indicate particular requirements in completed Work.

3.2 Where Contract Documents do not provide sufficient information for complete installation of item, then as supplement, comply with manufacturer's written instructions for quality of work.

3.3 Portions of Specifications are written in short form. Therefore, it shall be understood that where item of Work is stated in heading followed by material, equipment, component, or operation, words "shall be", "shall consist of" or similar words or phrases are implied which denote supply, fabricate and supply, install, provide or commission of such materials, equipment or operations for component of Work designated by heading.

3.4 Where the Contract Documents refer to the singular, provide as many as required to complete Work. Words used in one gender only shall mean females and as well as males and conversely.

3.5 Drawings, Lists or Schedules of Items are intended to show scope and arrangement of work. For location of item described refer to such Drawings, Lists or Schedules unless location stipulated in Specifications.

3.6 Wherever words "acceptable", "approved", "reviewed", "satisfactory", "selected", "directed", "designated", "permitted", "inspected", "instructed", "clarification", "required", "report", "submit", "obtain", "consult", "advise", or similar words or phrases are used in Standards or in Contract Documents, it shall be understood that, unless context provides otherwise words "by/to/with/from the Consultant" shall follow them as applicable.

4 DIVISION OF WORK

4.1 Work specified in the Specifications is divided into Sections for reference purposes only. Division of work between Contractor and Subcontractors is the Contractor's responsibility. The Owner and Consultant assume no responsibility to act as an arbitrator to establish subcontract limits between Sections or Divisions of the Work.

5 REFERENCE STANDARDS

5.1 Conform to latest date of issue of referenced standards in effect on date of submission of bids, except where a specific date or issue is specifically noted.

6 WORK RESTRICTIONS

6.1 Owner’s Policy and Procedural Requirements

.1 Comply with the Owner’s policies and procedural requirements prescribed in Sunnybrook Health and Sciences Centre Owner’s Rules and Regulations” and “Construction Policy”, including, but not limited to, personal conduct and behaviour, patient privacy, facility security, infection prevention and control, mechanical system interruptions, and work scheduling.

.2 Conduct all work in accordance with the most current version of CAN/CSA-Z317.13-17.

.3 All building materials and supplies must be in compliance with CSA Z8000-18, governing IPAC measures incorporated into the design and construction of a health care facility or any part thereof.

.4 As determined by the Owner’s policies, immediately correct all unsafe conditions that are identified within the active facility that are a result of, or related to, the construction work activities.

6.2 Occupancy

.1 Existing premises outside of the Area of Work will remain operational at all times during Work. Execute Work to cause minimum interference with activities in existing premises and maintain maximum safety to occupants. Take reasonable measures to minimize and control noise, dirt and dust during Work.

.1 Provide a methodology for phasing and staging of the Work, and indicating safety and fire escape routes for the occupants of the building during construction.

.2 All areas that are only available for demolition and construction activity after hospital operational hours are to be vacuumed and mopped at the end of each construction day for terminal clean by hospital to enable the hospital to resume regular business operations unimpeded each day.

.2 Access:

.1 Different areas of work within the hospital will be restricted to time frames indicated in phasing drawings.

.2 Before entering existing premises outside of the Area of Work to carry out Work or to obstruct or take out of use any area of existing premises, or to cause any other interference, request meeting with Consultant and Owner in order to reach agreement as to time and length of time Contractor may interfere, possess, obstruct or remove from use any such area or services.

6.3 Access to Area of Work

.1 Work shall be confined to Area of Work limits indicated on Drawings and/or within area defined by property lines.

.2 Assume responsibility for care, custody and control of Area of Work and perform work to extent covered in Contract Documents.

.3 Make good damage to existing Area of Work and existing building due to Work of this Contract within 24 to 48 hours of noted damage or defects to the satisfaction of the Owner.

.4 Maintain temporary entrances to areas of Work and provide enclosed hoardings as required. Maintain access to existing building service entrance(s) at all times.

.5 Work on Municipal property shall be carried out under regulations of respective Municipality and authorities having jurisdiction including without any limitations any associated fees, permits, insurance or bonding required.

.6 Access to the existing buildings, and access to the neighbouring properties, cannot be blocked or otherwise compromised. Provide a minimum of 14 days' notice to Owner and coordinate with Owner for any major disruptions that may impact access to hospital or surrounding community.

.7 Comply with the time frames/schedule of the hospital loading dock supervisor for all materials delivery to site and ensure loading bays are clear of materials/equipment.

6.4 Commencement of Work

.1 Make all required submittals, receive all reviewed submittals, and marshal all required materials off-site prior to commencing Work on-site.

.2 The first on-site Work shall be the construction of the hoarding.

6.5 No Smoking Policy

.1 Cooperate, respect and comply with the Owner's no smoking policy requirements.

.2 Ensure that Contractor's employees, sub-contractors and suppliers, performing work on Site on Contractor's behalf, are instructed to comply with the Owner's no smoking policy requirements.

.3 Comply with local By-Law and regulations or any authorities having jurisdiction.

7 SCHEDULE OF VALUES (VALUE OF SUBMITTALS)

7.1 Within seven Working Days of Contract award, submit a detailed Schedule of Values providing a breakdown of the cost of the Work in a form acceptable to Consultant.

.1 Show the cost (value) of the Work broken down by specification section. Identify each line item with number and title of the primary associated specification section, per month, and coincident with approved construction schedule. Identify site mobilization, bonds, insurance, and commissioning. Cost breakdowns when totalled, shall be same as Contract Price.

.1 Include in each line item, the amount of specified Allowances. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

7.2 Contractor shall identify general progress and commissioning payment line items for each of the following:

.1 1% of total Contract value for provision of as-built drawings, O&M manuals and warranties covering all sub-contracts.

.2 1% of Mechanical value for Commissioning process including completion and submission of testing forms and reports.

.3 Contractor shall submit all completed tests, reports and verification forms. The Consultant will use these documents to calculate a percentage completion.

.4 Contractor may claim up to 60% of the value for commissioning through monthly progress payment requests leading up to performance testing. The remaining 40% of the value for commissioning shall be paid-out after the performance testing and training have been completed.

7.3 Revise schedule to list approved Change Orders with each Application for Payment.

7.4 Purpose of the cost breakdown is to assist Consultant with evaluation of progress draws and to assist Owner with cash flow arrangements.

7.5 The Owner reserves the right to withhold the amounts allocated for Submittals indicated above pending their submission.

8 SPECIAL PROJECT PROCEDURES

8.1 Existing premises will maintain operation during scheduled Operating Room business hours

8.2 Carry out work in such a manner as to cause a minimum of noise and interference to the use of the existing operations, and do not interfere with the hospital operational requirements. Conform to the requirements of the building management. Be responsible for any overtime work required.

8.3 Co-ordinate construction activities and use of premises with Owner and building management.

8.4 Maintain operations of building services, data, telephone and alarm. Ensure no interruptions of these services during execution of the Work.

8.5 Coordinate all shutdowns with the Owner as per Look Ahead Schedule.

8.6 Do not proceed without written approval from Owner.

8.7 Provide adequate protection against dust, water and other damages to Owner's electronic and computer equipment, fittings and furniture. Use covers acceptable to the Owner. Remove protection after each work period.

8.8 Owner's Project Manager Hours of Operation:

.1 Owner's Project Manager business hours are 9am to 5pm, Monday to Friday.

.2 The Project Manager will not be available outside of the regular business hours, during vacation or Holidays. Vacation schedule will be provided to the Contractor in advance.

.3 Contractor to schedule all requirements and arrangements prior to and around these hours with the Owner's Project Manager, in accordance with the look ahead schedule.

9 INSTALLATIONS IN EXISTING HOSPITAL NETWORK HUB ROOMS

9.1 Access to Sunnybrook Hospital Network Rooms is severely restricted and Contractors will not be allowed to access these rooms un-escorted / un-supervised.

9.2 To complete this installation, the following applies:

.1 Contractor must provide to the Hospital a minimum of 7 working days' notice.

.2 Contractor must retain the Hospital's Security Department to allow access to and supervise activities of the Contractor while in the Hub Room for any Cable/ Equipment installation in the Hub Room (it is assumed Contractor can install services to a point outside of the Hub Room but cannot install any services into the Hub Room without Security Supervision) and to complete the installation in the Hub Room.

.3 Arrangements for Security Supervision is to be coordinated directly between Security and the Contractor with the Contractor providing a minimum seven days written request

.4 The Hospital's Security Department will charge the Contractor $50.00 (fifty dollars) per hour for a minimum four hours at any one time

9.3 As the Contractor is responsible to cover any/ all costs required to retain the Hospital's Security Group, it is strongly recommended the Contractor properly schedule the need to access Hub Rooms and that the times requiring access be accurately indicated on the Project Schedule.

9.4 Refer also to Sunnybrook 'Data Centre and Hub Room Access Policy' appended at the end of the Specifications.

10 PROTECTION AND SECURITY

10.1 Protect existing services, structures and other items required to remain and newly installed Work during construction with secure and durable coverings, barricades or guards suitable for the various conditions. Perform the Work in a manner to avoid damage. Remove and replace at no expense to the Owner, any work and materials damaged that cannot be repaired or restored to the Consultant's satisfaction.

10.2 Owner's personnel will be occupying the existing building(s) during construction and alterations. Provide for the safety of occupants and for the security of occupied areas. Provide protection and keep clear areas that are required for access to, and exit from, occupied areas. Maintain clear and safe fire exit routes.

10.3 Where construction operations must be executed or traffic routed over finished floors, lay minimum 6 mm thick plywood coverings tightly fitted over surface in such areas. Secure plywood to prevent movement in a manner which will not damage finished surfaces.

10.4 Keep floors dry. Keep floors free from oil or other contaminants at all times. Clean up all contaminating liquids where same are likely to damage surfaces.

10.5 Cover openings in equipment, ducts and pipes until final connections are made.

10.6 Protect exposed live electrical equipment during construction for personal safety.

10.7 Shield and mark live electrical parts with appropriate warnings.

10.8 Wherever practical lock or barricade finished areas.

10.9 As soon as construction is sufficiently advanced, enclose accessible openings to provide security. Provide temporary doors with security hardware.

10.10 Ensure continuous security of the Work and construction equipment.

10.11 Provide protection against the elements to maintain Products and installations from damage and deterioration.

11 CASH ALLOWANCES

11.1 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation and other authorized expenses incurred in performing the Work.

11.2 Include in the Contract Price, cash allowances for the following work:

.1	Structural - anchoring adjustments for the Articulating Arms equipment:	$65,000.00
.2	Architectural – rework of existing fire-rated shaft wall assembly affected by installation of new ventilation ductwork below Level 2 floor slab and Unforeseeable Building Conditions:	$65,000.00
.3	Mechanical - Unforeseeable Building Conditions:	$15,000.00
.4	Electrical - Unforeseeable Building Conditions:	$15,000.00
.5	Procurement & Commissioning of new IT Network Equipment:	$15,000.00
.6	Installation (under Division 27) of new IT Network Equipment:	$5,000.00
.7	Temporary Ventilation Ductwork	$30,000.00
.8	Mechanical and Electrical shutdown unforeseen circumstances resulting from the temporary duct installation:	$40,000.00
.9	Mechanical and Electrical rework issues created by the temporary duct installation:	$40,000.00
.10	Architectural unforeseen circumstances resulting from the temporary duct installation:	$25,000.00

.11 Third Party Agency Testing and Inspection for Owner's quality control.
Engage an Independent Third Party Agencies as directed by Owner to conduct inspections, verification and tests including but not necessarily limited to the following:

.1 Structural steel, hardware, lead shielding, floor level & flatness, security staff escort (but excluding the access to the Hospital Network Hub Room: $38,000.00

TOTAL $353,000.00

12 EXAMINATION OF EXISTING CONDITIONS

12.1 Submission of bid shall be deemed evidence that Contractor has examined the site and is familiar with conditions under which work will be done and obtained all information which may be necessary for proper execution of Contract.

12.2 Signing of Contract indicates acceptance by Contractor of conditions under which work will be done.

12.3 Extra payments will not be authorized for work that could have been determined by a careful examination of site and existing conditions.

13 EXAMINATION OF SURFACES DURING CONSTRUCTION

13.1 Before executing work against surfaces prepared by other Sections, examine such surfaces. Do not accept defective surfaces, or do any work to or on them, until the defects are remedied.

13.2 Commencement of work shall indicate acceptance of surfaces and responsibility concerning the conditions of same.

14 EXISTING SERVICES

14.1 Cut off, cap, divert or remove existing water, gas, electric and other services in areas being altered which are affected by the changes as required or as directed by the municipal authorities and the utility company concerned, and the Consultant. Protect and maintain active services to the existing building.

14.2 If required by the Consultant, prepare interference and/or installation drawings showing the work of the various Sections as well as the existing installation, and submit these drawings to the Consultant for review before the commencement of work.

15 LOCATION OF EQUIPMENT AND FIXTURES

15.1 Location of plumbing, heating and electrical fixtures and outlets, ducts, conduits and pipes shown or specified but not dimensioned shall be considered approximate.

15.2 Locate equipment, outlets, fixtures, devices and distribution systems to provide minimum interference and maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.

15.3 Consult with the Consultant to determine the actual location of items not dimensioned as may be required to suit the job conditions.

15.4 Obtain Consultant's acceptance for precise locations of fixtures, access panels, outlets, mechanical, electrical and security items. Relocation caused by failure to determine the actual locations shall be executed without charge to the Owner.

15.5 Consultant reserves the right to relocate fixtures, access panels, outlets, mechanical, electrical and security items at a later date, but prior to installation, without additional cost, provided that the relocation per outlet or fixture does not exceed 3050 mm (10 feet) from the original location

16 INTERFERENCE DRAWINGS

16.1 Prepare dimensioned interference drawings indicating relationship of new installations and existing and/or unforeseen conditions prior to commencement of work.

16.2 Before commencing installation, prepare interference drawings, based on the actual field measurements, showing relationship of new and existing ductwork, conduit, piping, sprinklers, partitions, ceiling supports and framing, partition framing, communication and specialized equipment located within ceiling and shaft spaces.

16.3 Indicate locations of visible items such as air handling outlets, light fixtures, smoke detectors, sprinkler heads, communication grilles, and access panels occurring at these locations.

16.4 Drawings shall be initialed by responsible person of each Sub-Contractor involved along with Contractor's signature and submitted to Consultant for review and record purposes.

17 DOCUMENTS ON SITE

17.1 Maintain at job site, one copy each document as follows:

.1 Permit Drawings and Building Permit Posters.

.2 Contract Drawings and Specifications.

.3 Addenda.

.4 Reviewed Shop Drawings.

.5 List of Outstanding Shop Drawings.

.6 Change Orders.

.7 Other Modifications to Contract.

.8 Field Test Reports.

.9 Copy of Approved Work Schedule.

.10 Site-Specific Health and Safety Plan and Other Safety Related Documents.

.11 Other documents as specified.

18 POWDER ACTUATED FASTENINGS

18.1 Powder actuated fastenings shall not be used on any portion of the Work, unless written consent for a specific use is obtained from the Consultant.

19 NOISE LIMITATIONS AND DUST CONTROL

19.1 Keep construction noise to a minimum.

19.2 No pneumatic or other noisy equipment will be permitted on the project site.

19.3 Noise generating equipment must be of the lowest noise level suitable for the application required for work.

19.4 All vehicles and equipment shall be equipped with efficient muffling devices to minimize noise levels in the project area. In particular, construction equipment such as compressors, gas and diesel driven engines shall be equipped with efficient mufflers.

19.5 Undertake dust control measures to prevent dust nuisances resulting from any phase of the construction operation.

19.6 Carry out dust control practices at all locations on site.

20 OVERLOADING

20.1 Take precautions to prevent the overloading of any part of the structure, false work, form work or scaffolding during the progress of the Work, and make good, at no expense to the Owner, all damage resulting from such overloading.

20.2 No load bearing members shall be cut, drilled or sleeved without the written consent of the Consultant.

21 HOLES THROUGH FLOORS AND WALLS

21.1 Where holes are made in floors for the passage of pipes, ducts and conduit or wires, the holes shall be sealed with cement grout after the pipes, ducts and conduit or wires have been placed.

21.2 Where holes are made in walls for the passage of pipes, ducts, conduit or wires, holes shall be filled with a suitable material, cement grout in masonry or concrete walls or plaster in plaster or drywall walls, regardless of whether or not the pipes have escutcheon plates. Grout or plaster around outside of sleeves where holes are sleeved.

21.3 In mechanical rooms above grade and in other rooms where faucets occur, the pipes, ducts, conduits or wires or all, which pass through floors, shall be enclosed in a 100 mm high metal sleeve and then grouted around pipes and ducts.

21.4 Above requirements shall apply to both exposed and concealed walls and floors.

22 MAKING GOOD

22.1 Make good materials and finishes which are damaged or disturbed during the process of additions and reconstruction under the Contract.

22.2 Where existing work is to be made good, match new work exactly with the old work in material, form, construction and finish unless otherwise noted or specified.

22.3 Protect work in the existing building, such as floors, finishes, trim, etc., as completely as possible to hold the replacing of damaged work to a minimum.

22.4 Preparation for new finishes:

.1 Remove existing finishes, including painting.

.2 Fill cracks and depressions with suitable filler and finish smooth, as recommended by the manufacturer of the new finishes.

.3 Grind protrusions level with substrates and finish smooth.

.4 Remove all evidences of existing adhesive, grease, oil, soil and other encrustations of foreign material by washing, scraping and grinding if necessary.

.5 Clean and prepare substrates to receive new work.

23 CUTTING AND PATCHING

23.1 Perform cutting, fitting, and patching to complete the Work. Do not cut, drill or sleeve load-bearing members without obtaining written approval for each condition.

23.2 Remove and replace defective and non-conforming work.

23.3 Perform work to avoid damage to other work.

23.4 Prepare proper surfaces to receive patching and finishing.

23.5 Cut rigid materials using power saw or core drill. Pneumatic or impact tools not allowed.

23.6 Restore work with new products to match existing in accordance with Contract Documents.

23.7 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces, and with suitable allowance for deflections, expansions, contractions, and firestopping.

23.8 Maintain fire ratings of fire rated assemblies where cutting and patching is performed. At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated material, full thickness of construction element.

23.9 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

24 SALVAGE AND DISPOSAL OF MATERIALS

24.1 Cut, disconnect and detach items and materials designated to be removed.

24.2 All materials resulting from the demolition work except as otherwise specified or directed shall become the property of the Contractor.

24.3 Remove all material and debris from the site as quickly as possible and dispose of legally.

24.4 Burning of debris or selling of materials on the site will not be permitted.

25 FIRE SAFETY DURING CONSTRUCTION

25.1 Provide fire prevention and protection measures to existing building as required by all authorities having jurisdiction.

25.2 Maintain exits, including stairways and exterior doors to the outside. Provide acceptable alternative exits where an existing exit is blocked off or deleted due to construction activities.

25.3 Where access to an exit through construction area is absolutely necessary, clearly define, protect and separate access from the construction area by a smoke tight fire separation equivalent to minimum 3/4 hour fire resistance rating.

26 SAFETY MEASURES

26.1 Comply with the safety regulations of the Occupational Health and Safety Act and authorities having jurisdiction for the safety of the Work.

27 PROJECT MEETINGS

27.1 Schedule and administer project progress meetings throughout progress of work.

27.2 Distribute written notice of each meeting four days in advance of meeting date to Consultant and Owner.

27.3 Provide physical space and make arrangements for meetings.

27.4 Record minutes. Include significant proceedings and decisions. Identify 'action by' parties.

27.5 Reproduce and distribute copies of minutes within three days after each meeting and transmit to meeting participants, affected parties not in attendance, Consultant and Owner.

28 SUBMITTALS

28.1 Administrative

.1 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in an orderly sequence so as to not cause delay in the Work.

.2 Work affected by submittal shall not proceed until review is complete.

.3 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of the Work and Contract Documents.

.4 Verify field measurements and affected adjacent Work is coordinated.

28.2 Shop Drawings and Product Data

.1 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connection, explanatory notes and other information necessary for completion of Work.

.2 Adjustments made on shop drawings by Consultant are not intended to change Contract Price.

.3 Make changes in shop drawings as Consultant may require.

.4 Submit one transparency and 4 white prints of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.

.5 Submit 4 copies, unless otherwise noted, of product data sheets or brochures for requirements requested in specification Sections and as Consultant may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.

28.3 Samples

.1 Submit samples for review as requested in respective specification Sections.

.2 Deliver samples prepaid to Consultant's business address.

28.4 Operating Maintenance Manuals

.1 Two weeks prior to Substantial Performance of the Work, submit to Consultant, three copies of operating and maintenance manuals.

.2 Manuals to contain operational information on equipment, cleaning and lubrication schedules, filters, overhaul and adjustment schedules and similar maintenance information.

.3 Bind contents in a three-ring, hard covered, plastic jacketed binder. Organize contents into applicable categories of work, parallel to specifications Sections.

29 AS BUILT DRAWINGS

29.1 After award of Contract, obtain a set of drawings for purpose of maintaining record drawings. Accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by Consultant.

29.2 Record locations of concealed components of mechanical and electrical services.

29.3 Identify drawings as "Project Record Copy". Maintain in new condition and make available for inspection on site by Consultant.

29.4 On completion of Work and prior to final inspection, submit record documents to Consultant.

30 QUALITY CONTROL

30.1 Owner's Quality Control

.1 The Owner may require during progress of the Work, testing and inspection by an independent testing agency as directed by the Consultant, or as required in these Specifications, to determine if materials provided for the Works meet the specified requirements. The cost of these services shall be paid by Cash Allowances.

.1 In this case, the Contractor shall pay independent inspection and testing agency charges authorized by the Consultant from the cash allowances included for these services.

.2 Employment of inspection/testing agencies does not relax Contractor’s responsibility to perform Work in accordance with Contract Documents.

.3 Contractor shall provide equipment required by testing agencies for executing inspection and testing.

.4 Re-Testing and Re-Inspection:

.1 If defects are revealed during inspection and testing, testing agency will request additional inspection and/or testing to ascertain full degree of defect. Re-testing and re-inspection shall be performed by the same testing agency as the initial tests.

.1 Contractor shall correct defects and irregularities at no cost to Owner;

.2 Contractor shall pay costs for re-testing and re-inspection.

30.2 Code Compliance and Contractor's Convenience Testing

.1 Code Compliance Testing: Inspection and tests required by codes or ordinances, or by an authority having jurisdiction shall be the responsibility of the Contractor and shall be paid for by the Contractor as part of the Contract Price.

.2 Contractor's Convenience Testing: Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor and paid for by Contractor as part of the Contractor's overhead expenses.

.3 Engage a qualified testing agency to perform these quality-control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

.4 Submit a certified written report, in triplicate, of each quality-control service.

.5 Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

.6 Re-testing/Re-inspecting: Provide quality-control services, including re-testing and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents. Pay costs for re-testing and re-inspection.

31 SITE SIGNS

31.1 Do not exhibit on the site advertisements or signs other than those required by authorities having jurisdiction, unless otherwise approved by the Consultant, in writing.

32 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

32.1 Co-ordination

.1 Co-ordinate with the building management use of temporary controls and facilities not provided under this Contract, including but not necessarily limited to material delivery, unloading and hoisting. Make prior arrangements and schedule use at times acceptable to the building management. Be responsible for payment for use of such facilities.

32.2 Installation/Removal

.1 Provide construction facilities and temporary controls in order to execute work expeditiously. Remove from site all such work after use.

32.3 Hoisting and Delivery

.1 Refer to General Notes on drawings for Loading Dock business hours of operation.

.2 Any deliveries to be made on weekends must be identified on the Contractor's 6-week look-ahead schedule

.3 Contractor shall furnish to the Owner, an emergency contact list of Contractor's personnel.

.4 Arrange for delivery and unloading of materials at areas designated by the building management. Do not interfere with vehicular traffic on the streets and pedestrian traffic on the sidewalks.

.5 One of the existing elevators, as designated by the building management, may be used for construction personnel and material hoisting. Do not overload the elevator beyond the rated capacity. Provide protective coverings for finish surfaces of cars and entrances. Be responsible for safe operation of the elevator and any damages resulted from its usage. Provide alternative means of hoisting if the elevator is of insufficient size and capacity for materials intended.

32.4 Security Provisions

.1 Maintain and conform to existing security provisions required by the building management. Do not compromise such provisions.

32.5 Hoarding and Barricades

.1 Erect hoarding and barricades to protect public, workers, and property from injury or damage. Provide lockable doors within hoarding for access to site by workers.

.2 Erect hoarding after hours, as discussed at the pre-construction conference, and as coordinated with the Owner.

32.6 Weather Enclosures

.1 Provide weathertight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

.2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work area for temporary heat.

32.7 Parking

.1 Parking will not be provided. It is the responsibility of the Contractor to arrange parking for its staff and deliveries.

32.8 Temporary Partitions / Dust-Proof Barriers

.1 Erect dust-proof barriers between occupied and construction areas to prevent dissemination of dust. Extend from floor to slab ceiling if suspended ceiling are to be removed.

.1 Vacuum the area above false ceilings, including duct work and pipes prior to construction.

.2 Establish traffic control patterns which prevent construction dust from being tracked into occupied areas. Provide adhesive strips on floors to catch dust on shoes.

.2 Follow Hoarding Details on drawings.

.3 Refer to Section 01 35 33 Infection Control Procedures for additional requirements.

.4 Maintain and relocate protection until Work is complete.

32.9 Site Storage/Loading

.1 Confine the Work and operations of employees to limits indicated by Contract Documents. Do not unreasonably encumber premises with Products.

.2 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the Work.

32.10 Sanitary Facilities

.1 Existing facilities as designated may be used during construction period.

.2 Maintain in clean condition.

32.11 Water and Power Supply

.1 The Owner will provide and pay for a continuous supply of water, power for construction use as available from the existing facilities. Provide hoses, extensions, connections, and transformers as required for execution of the Work. Provide extra supply if the existing facilities are insufficient or not suitable for construction use.

.2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.

32.12 Temporary Lighting

.1 Provide temporary lighting required during construction period, including attendance and maintenance.

.2 Maintain lighting at levels required by Sections doing the work.

32.13 Temporary Heating

.1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.

.2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders not permitted.

.3 Maintain temperatures at levels required by Sections doing the work.

.4 Ventilate heated areas and keep building free of exhaust or combustion gases.

32.14 Equipment/Tool/Materials Storage

.1 Provide and maintain, in clean and orderly condition, lockable areas for storage of tools, equipment and materials.

.2 Locate materials on site in manner to cause least interference with work activities.

32.15 Construction Signage

.1 Signage is the responsibility of the Contractor. Supply and install a minimum of one sign per floor. Furnish as many as required to ensure adequate visibility to all staff and patients.

.2 Signage construction - corrugated plastic, 2 ft x 4 ft, min 4 mm thick, professionally printed.

.3 Signage wording will be provided by the Owner.

32.16 Project Cleanliness

.1 Maintain the Work in tidy condition, free from accumulation of waste products and debris.

.2 Remove waste material and debris from site at end of each working day. Do not burn waste materials on site.

.3 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

.4 Refer to Section 01 74 00, Cleaning and drawings for additional requirements.

33 MATERIAL AND EQUIPMENT

33.1 Product and Material Quality

.1 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.2 Use only products containing Zero VOC.

.3 Whenever Products are specified exclusively by trade name, manufacturer's name or by catalogue reference, use only those items, unless written approval for substitution is obtained from Consultant.

.4 Proposed substitutions will be considered only under the following conditions:

.1 If the materials and products specified are not available; or

.2 If substitute materials and products to those specified, which are brought to the attention of and considered by the Consultant as equivalent to those specified, will offer Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Consultant for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

.5 Requests for substitutions must be fully documented and properly submitted, and must include the following statements:

.1 Description of proposed substitution.

.2 Respective costs of items originally specified and the proposed substitution.

.3 Compliance with the Building Codes and requirements of authorities having jurisdiction.

.4 Affect concerning compatibility and interface with adjacent building materials and components.

.5 Compliance with the intent of the Contract Documents.

.6 Reason for the request.

.6 There is no obligation on the part of the Consultant or Owner to accept proposed substitutions. Acceptance of proposed substitutions by Owner does not relieve the Contractor's responsibility under the Contract.

.7 Defective Products, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.

.8 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Consultant based upon requirements of Contract Documents.

33.2 Storage, Handling and Protection

.1 Handle and store Products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact.

33.3 Manufacturer's Instructions

.1 Unless otherwise indicated in specifications, install or erect Products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Consultant to require removal and reinstallation at no increase to Contract Price.

33.4 Workmanship

.1 Workmanship shall be best quality, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.

.2 Do not employ any unfit person or anyone unskilled in their required duties.

.3 Decisions as to quality or fitness of workmanship in cases of dispute rest solely with Consultant, whose decision is final.

33.5 Concealment

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Consultant if there is a contradictory situation. Install as directed by Consultant.

34 **NUMBER OF ITEMS**

34.1 In cases where an item or part of materials or equipment is referred to in the singular number, it is intended that such reference shall apply to as many items or parts as are required to complete the Work.

35 **RECONSTRUCTION, ALTERATIONS AND MAKING GOOD**

35.1 Where new work connects with existing work and where existing work is altered, carry out all necessary cutting and fitting required to make satisfactory connections with the existing work under this contract so as to leave the project in a finished and workmanlike condition.

35.2 Unless otherwise specified or required by codes or By-laws to meet a certain requirement or both, make good new work to match existing work.

35.3 Make good concrete, masonry, steel, plaster, drywall ceilings, walls, flooring and other materials and finishes which are damaged or disturbed during the progress of additions and re-construction under the Contract.

35.4 Existing services shall be disconnected and relocated, where necessary, and reconnected as required to complete the Work. This work shall include, without being limited to, plumbing, drainage, heating, ventilating, air conditioning and electrical services.

35.5 Where existing work is to be made good, the new work shall match exactly the old work in material, construction and finish, unless otherwise noted or specified.

35.6 Drilling or cutting of existing work shall be carefully executed, leaving a clean hole no larger than required.

35.7 Wherever it becomes necessary to cut or interfere in any manner with existing equipment or service lines for short periods of time, do such work at times agreed upon between the Owner, Consultant and the Contractor.

35.8 Coordinate the Work of the various trades, taking into account the existing installations to assure the best arrangement of pipes, conduit, ducts and mechanical, electrical and other equipment, in the available space.

35.9 If required, in critical locations, interference or installation drawings or both, shall be prepared showing the Work of the various trades as well as the existing installations, and shall be submitted to the Consultant for review before the commencement of the Work.

36 **CONTRACT CLOSEOUT**

36.1 Systems Demonstration

.1 Prior to final inspection, demonstrate operation of each system to Owner.

.2 Instruct personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as basis for instruction.

36.2 Documents

.1 Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers, and manufacturers.

.2 Submit material prior to final application for payment.

.3 Submit three copies of Project Record Manual consisting of operation and maintenance data and one set of record (as-built) drawings white prints.

.4 Provide warranties fully executed and notarized.

.5 Execute transition of Performance Bond to warranty period requirements.

36.3 Inspection/Takeover Procedures

.1 Prior to application for certificate of Substantial Performance, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete, defects are corrected and building is clean and in condition for occupancy. Notify Consultant in writing, of satisfactory completion of the Work and request an inspection.

.2 During Consultant inspection, a list of deficiencies and defects will be tabulated. Correct same.

.3 When Consultant considers deficiencies and defects have been corrected and it appears requirements of Contract have been performed, make application for certificate of Substantial Performance.

.4 Conform to OAA/OGCA Document No.100 for takeover procedures.

.5 Submit a final statement of accounting giving total adjusted Contract Price, previous payments, and monies remaining due.

.6 Consultant will issue a final change order reflecting approved adjustments to Contract Price not previously made.

End of Section

HYBRID OR EQUIPMENT LIST - Last Updated February 28 2020

ROOM DESCRIPTION	ITEM DESCRIPTION	NOTES	SPECIFICATIONS	VENDOR	QTY	OWNER PURCHASE/OWNER INSTALL	OWNER PURCHASE/CONTRACTOR INSTALL	CONTRACTOR PURCHASE/CONTRACTOR INSTALL
HYBRID OPERATING ROOM	ANGIOGRAPHY AZURION 7 C20 CLARITY	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
	CLARITY IQ	CORE RFP		PHILIPS	1		✓	
HYBRID OPERATING ROOM	COMPUTED TOMOGRAPHY XPER CT	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	FLAT PANEL MONITORS 58" FLEXVISION	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	27" PHILIPS FLAT PANEL MONITORS	CORE RFP - 2 on Boom 2 on Mobile cart	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	4		✓	
HYBRID OPERATING ROOM	IVUS INTEGRATED CORE, VASCULAR	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	EPIQ VIDEO COUPLING	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	VIDEO WCB on REAR SIDE 1st MCS	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	2		✓	
HYBRID OPERATING ROOM	VIDEO INPUT / OUTPUT	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	LIVE/REF SLAVING FOR ER	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	2		✓	
HYBRID OPERATING ROOM	ISOLATED WALL CONNECTION BOX	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	8		✓	
HYBRID OPERATING ROOM	HYBRID KIT FOR FLEX ARM	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	OPTIONAL REF FOR MONOPLANE	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	ROTATIONAL ANGIO	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	EXTENSION TO FLEX VISION PRO	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	WIRLESS FOOTSWITCH	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	SMARTMASK MONOPLANE	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	XL VIDEO SLAVING	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	VIDEO SLAVING TO FULL HD TV	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	TOUCH SCREEN MODULE PRO	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	CONTROL MODULE	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	DUAL FLUORO MONOPLANE	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	IW HARDWARE	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	FLEXVISION XL HD 3rd P MCS	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	INTEGRATION FOR 2F 3rd PARTY BOOM	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	VASC/NEURO/ONCO Essential	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	VASC ADVANCED	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	VASC PREMIUM	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	CABLE MNGT SYSTEM	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	WALL CONNECTION BOX	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	DVI CABLE SET	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	ANTI FATIGUE FLOOR MAT	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	TWO MONITOR CART	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	CVFULL TRAVEL PKG	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	4		✓	
HYBRID OPERATING ROOM	AZURION ESSENTIALS	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	2		✓	
HYBRID OPERATING ROOM	FLEX ARM RAILSET	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	MAQUET MAGNUS OR TABLE - SECOND TABLE - FLOOR MODEL	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	MAQUET MAGNUS OR TABLE - SECOND TABLE - ARTICULATING	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	ANAESTHESIA GAS & COMPUTER BOOM - ALL IN	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	NURSING BOOM - ALL IN	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	MON BOOM - ALL IN	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	2		✓	
HYBRID OPERATING ROOM	OR LIGHTS - ALL in	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	4		✓	
HYBRID OPERATING ROOM	HD CAMERA	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	X RAY SHIELDS	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	2		✓	
HYBRID OPERATING ROOM	LARGE MONITOR BOOM	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	POWER INJECTOR MEDRAD MARK 7 ARTERIOR PEDESTAL	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	

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ROOM DESCRIPTION	ITEM DESCRIPTION	NOTES	SPECIFICATIONS	VENDOR	QTY	OWNER PURCHASE/OWNER INSTALL	OWNER PURCHASE/CONTRACTOR INSTALL	CONTRACTOR PURCHASE/CONTRACTOR INSTALL
HYBRID OPERATING ROOM	OR TABLE, MAQUET MAGNUS	CORE RFP	PER PHILIPS PROPOSAL - Rev 3	PHILIPS	1		✓	
HYBRID OPERATING ROOM	HD TV MONITORS, ARMS, WALL MOUNTED, 4K CAPABLE	INCL AS VALUE ADD	PER PHILIPS PROPOSAL	3rd PARTY	1		✓	
HYBRID OPERATING ROOM	RADIOLUCENT HEADREST		Checking if same as line 30	MAQUET/GETINGE	1		✓	
HYBRID OPERATING ROOM	FLEXVISION PRO	SEE PHILIPS PROPOSAL - OPTIONS	OPTION PER PHILIPS PROPOSAL	PHILIPS	1		✓	
HYBRID OPERATING ROOM	PRESSURE RELIEVING MATTRESS OR TABLE #1		SAME DIMENSIONS AS OR TABLE	TBC	1		✓	
HYBRID OPERATING ROOM	REGULAR HEADFRAME (CRANIOTOMIES)	? Included in proposal	EXTRA OPTION WITHIN PHILIPS PROPOSAL	MAQUET/GETINGE	1		✓	
HYBRID OPERATING ROOM	OR TABLE, MAQUET MAGNUS #2 - SECOND TABLE	SEE PHILIPS PROPOSAL - INCLUDES - Carbon-fibre table tops for stationary columns, Catheter tray, Radiation	Ensuring captured in Philips proposal	MAQUET/GETINGE	1		✓	
	PRESSURE RELIEVING MATTRESS OR TABLE #2		SAME DIMENSIONS AS OR TABLE #2	MAQUET/GETINGE	1	✓		
HYBRID OPERATING ROOM	OR INSTRUMENTATION & CONTAINERS		MISC - NOT REQUIRED FOR PLANNING	TBC	1	✓		
HYBRID OPERATING ROOM	HEART LUNG MACHINE (CPB, OUTLETS INSTALLED AS WELL)		CONSOLE BASE: W x41" (TBC) PUMPS: Length: 22.1 in (56 cm), Width: 7.1 in (18 cm), Height: 13 in (33 cm)	MEDTRONIC	1	✓		
HYBRID OPERATING ROOM	DATA MANAGEMENT SYSTEM FOR PERFUSION with INTERFACE	QUANTUM	15" WORKSTATION	SPECTRUM / MEDTRONIC	1	✓		
HYBRID OPERATING ROOM	PERFUSION CART	SIMILAR TO ANAESTH CART	30" x 24"	MEDTRONIC	1	✓		
HYBRID OPERATING ROOM	HEATER / COOLER		H x 32" x W x 22" x D x 22"	MAQUET/GETINGE	1	✓		
HYBRID OPERATING ROOM	INVENTORY CABINETS, FREESTANDING		TWIN DESIGN - STAINLESS STEEL - Height: 60" (1524 mm), Width (exterior): 36", Depth: 18" (457 mm), Width of frame fitted edge: 1-1/4" (32 mm), Shelf flange: 1" (25mm) down Adjustable shelf increments: 1" (25 mm)	STERIS OR SURGMED	2	✓		
HYBRID OPERATING ROOM	STERILE TABLE	STAINLESS STEEL STANDARD	W x 24" x L x 36" x Hx34"	IMPERIAL	1	✓		
HYBRID OPERATING ROOM	STORAGE CABINETS, MOBILE	ROAM Mobile Supply Carts - Two carts -	Exterior dimensions: 37.5"w x 28.75"d x 75.25"h (glass doors) OR 37.5"w x 28.75"d x 81"h (roll-top door)	STERIS OR SOLAIREMEDICAL	2	✓		
HYBRID OPERATING ROOM	SCRUB SINKS	INCLUDED IN CONTRACT?	L x 36", W x 23", H x 38" - NORR TO UPDATE		1			✓
HYBRID OPERATING ROOM	CASE CART	STAINLESS STEEL	W x 38" x L x 21" x Hx39"	TBC FROM ABDOOL w/o 12/9	1	✓		
HYBRID OPERATING ROOM	LEAD GLOVES		N/R	ULTRARAY	2	✓		
HYBRID OPERATING ROOM	MOBILE XRAY PROTECTION SHIELD		SHIELD DIMENSIONS - W x 48"x Hx72"	ULTRARAY	2	✓		
HYBRID OPERATING ROOM	LEAD EYE GLASSES		N/R	ULTRARY	10	✓		
HYBRID OPERATING ROOM	LEAD SCREEN / SHIELD			TBC 10/28	0			✓
HYBRID OPERATING ROOM	UNDER TABLE LEAD SHIELDING	ASK FOR INCLUSION	23.6" wide x 28" below table	ULTRARY	2	✓	✓	
HYBRID OPERATING ROOM	LEAD APRON INCLUDING THYROID COLLARS		N/R	ULTRARAY	6	✓		
HYBRID OPERATING ROOM	SOFTWARE, SMARTPERFUSION IMAGE ANALYSIS	LIMB SALVAGE	N/R	PHILIPS - OPTION	1		✓	
HYBRID OPERATING ROOM	SERVER, PACS FOR DICOM IMAGES	EXISTING	N/A	DELL	1	✓		
HYBRID OPERATING ROOM	SITTING STOOLS (stainless steel)	NEW	23" BASE	TBC	3	✓		
HYBRID OPERATING ROOM	CHAIR with ARM	NEW	27" BASE	TBC	1	✓		
HYBRID OPERATING ROOM	OR PREP TABLE	NEW	20"Lx15"Wx32"H	IMPERIAL OR STERIS	2	✓		
HYBRID OPERATING ROOM	MICROSCOPE	NEW		ZEISS	1	✓		
HYBRID OPERATING ROOM	PACS	EXISTING	N/R	SOFTWARE	1	✓		
HYBRID OPERATING ROOM	GLIDESCOPE	EXISTING	VIDEO MONITOR: Height: 183.3 mm, Width: 223 mm, Depth: 79 mm MOBILE STAND: Height 12.5 cm	VERATHON	2	✓		
HYBRID OPERATING ROOM	ANESTHESIA GAS MACHINE	EXISTING	Height: 152 cm/59.8 in Width: 97.5 cm/38.4 in Depth: 83 cm/32.7 in	GE	1	✓		

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Sunnybrook HEALTH SCIENCES CENTRE

ROOM DESCRIPTION	ITEM DESCRIPTION	NOTES	SPECIFICATIONS	VENDOR	QTY	OWNER PURCHASE/OWNER INSTALL	OWNER PURCHASE/CONTRACTOR INSTALL	CONTRACTOR PURCHASE/CONTRACTOR INSTALL
HYBRID OPERATING ROOM	ANAESTHESIA CART	EXISTING	Approx. Assembled Dimensiosns 42.5" H x 32" W x 22" D (108 cm H x 81.3 W x 55.9 D)		1	✓		
HYBRID OPERATING ROOM	BRONCHOSCOPE + LIGHT SOURCE	EXISTING, 1 TOWER, 2 SCOPES	LIGHT SOURCE: 135 x 165 x 270 mm, TOWER:	PENTAX	1	✓		
HYBRID OPERATING ROOM	CRASH CART	EXISTING - LIVES IN STERILE CORE	Wx31" x Hx42" x Dx24" inches	GLOBAL / IMPERIAL	1	✓		
HYBRID OPERATING ROOM	TRANSFUSION PUMP, HIGH VOLUME	EXISTING	20.3 x 20.3 x 15.2 cm (WxHxD)		1	✓		
HYBRID OPERATING ROOM	PUMP, SYRINGE	EXISTING	N/A		1	✓		
HYBRID OPERATING ROOM	3D TRANSESOPHAGEAL ECHO MACHINE	EXISTING - 2 PROBES	Width x 60.6 cm, Height 146-171.5 cm, Depth 109.2 cm	PHILIPS	1	✓		
HYBRID OPERATING ROOM	TEE PROBES	NEW - PRICING PER PHILIPS RISK/ REWARD	N/R	PHILIPS	2	✓		
HYBRID OPERATING ROOM	GLUCOMETER	EXISTING	N/R		1	✓		
HYBRID OPERATING ROOM	ACT MACHINE	EXISTING	N/R		1	✓		
HYBRID OPERATING ROOM	ROTEM	EXISTING	N/R		1	✓		
HYBRID OPERATING ROOM	ULTRASOUND, POINT OF CARE	EXISTING	H STAND DIMENDSIONS - 23" L x 20" W x 33" H	SONOSITE	1	✓		
HYBRID OPERATING ROOM	WARMER, IV	EXISTING	W x12" x Hx 18"	SMITHS	1	✓		
HYBRID OPERATING ROOM	DOPPLER, HANDHELD	EXISTING	N/R	STEVENS	1	✓		
HYBRID OPERATING ROOM	BLANKET WARMER	EXISTING	N/R	STRYKER	1	✓		
HYBRID OPERATING ROOM	BLOOD PUMP	EXISTING	N/R		2	✓		
HYBRID OPERATING ROOM	HEADLIGHTS	EXISTING	N/R	INTEGRA	3	✓		
HYBRID OPERATING ROOM	INSTRUMENT BACK TABLE, LONG	EXISTING	D x 24" x W x 45" x H x 36"	MEDLINE?	1	✓		
HYBRID OPERATING ROOM	INSTRUMENT BACK TABLE, EVAR	EXISTING	D x 20" x W x 32" x H x 33"	MEDLINE?	1	✓		
HYBRID OPERATING ROOM	INSTRUMENT BACK TABLE, SHORT EXTRA	EXISTING	D x 20" x W x 36" x H x 33"	MEDLINE?	1	✓		
	HIGH TABLE, OPEN CASES	EXISTING	D x 34" x W x 45" x H x38" adjustable		1	✓		
HYBRID OPERATING ROOM	TABLE, GOWN	EXISTING	TBC		1	✓		
HYBRID OPERATING ROOM	SPONGE BUCKETS	EXISTING	N/R		2	✓		
HYBRID OPERATING ROOM	FLOOR STANDS	EXISTING	25" BASE, 72" HEIGHT		2	✓		
HYBRID OPERATING ROOM	SCALES, WEIGH	EXISTING	N/R		1	✓		
HYBRID OPERATING ROOM	RADIOLUCENT SUGITACLIPS	EXISTING	N/R		1	✓		
HYBRID OPERATING ROOM	VESSEL SEALING DEVICE	EXISTING	N/R	JNJ	1	✓		
HYBRID OPERATING ROOM	CASE CART	EXISTING	D x 21" x W x 38" x H x 39"		1	✓		
HYBRID OPERATING ROOM	TOURNIQUET	EXISTING	N/R		1	✓		
	IV POLES	EXISTING	BASE 25"-27"		2	✓		
HYBRID OPERATING ROOM	PORTABLE PATIENT LIFT	EXISTING	UNFOLDED DIMENSIONS: Maximum Height to Attachment Point 66.5 in, Legs Open Inside Dimension 39.3 in, Legs Closed Outside Dimension 26.3 in, Overall Height of Legs 4.5 in	HOYER - Stored outside	1	✓		
HYBRID OPERATING ROOM	EQUIPMENT CART, POSITIONING	EXISTING	W x 24" x L x 36" x H x 36"		1	✓		
HYBRID OPERATING ROOM	CAUTERY MACHINE, SMOKE EVACUATOR	EXISTING	ON BOOM SHELF		1	✓		
HYBRID OPERATING ROOM	COMPUTERS	EXISTING	TBC	TENET	2	✓		
HYBRID OPERATING ROOM	PRINTERS	EXISTING	TBC	TENET	2	✓		
HYBRID OPERATING ROOM	DESKS, COMPUTER, WALL MOUNTS	EXISTING	N/R	OFFICE SOURCE	3	✓		
HYBRID OPERATING ROOM	PPID BARCODE SCANNER	EXISTING	N/R		2	✓		
HYBRID OPERATING ROOM	GARBAGE, LINEN, RECYCLING	EXISTING	D x 17" x W x 18" x Hx 32"		3	✓		
HYBRID OPERATING ROOM	SHARPS BINS, MOBILE	EXISTING	17.6” (H) x 15.7” (W) x 8.3” (D)	DANIELS	2	✓		
HYBRID OPERATING ROOM	GARBAGE BIN	EXISTING	N/R		4	✓		
HYBRID OPERATING ROOM	FIRE EXTINGUISHER	EXISTING	N/R		1	✓		
HYBRID OPERATING ROOM	DIGITAL CLOCK	EXISTING	N/R		1	✓		
HYBRID OPERATING ROOM	TELEPHONES	EXISTING	N/R		2	✓		

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ROOM DESCRIPTION	ITEM DESCRIPTION	NOTES	SPECIFICATIONS	VENDOR	QTY	OWNER PURCHASE/OWNER INSTALL	OWNER PURCHASE/CONTRACTOR INSTALL	CONTRACTOR PURCHASE/CONTRACTOR INSTALL
HYBRID OPERATING ROOM	DISPENSERS, HAND SANITIZER	EXISTING	N/R		4	✓		
HYBRID OPERATING ROOM	RADIATION MONITORS, PERSONAL	EXISTING	N/R		0	✓		
HYBRID OPERATING ROOM	DOPPLER, CONTINUOUS WAVE - KC to Check with WD week of 12/9	EXISTING	W x 22" x H 55-64" x D x 43"	PHILIPS	1	✓		
HYBRID OPERATING ROOM	CONNEXALL	EXISTING	N/R - SOFTWARE		1		✓	
HYBRID OPERATING ROOM	ADU	EXISTING OR NEW?	Height from floor to work surface 40 in, Height from floor to top of monitor 55 in, Height to top of accessory rack 61 in, Depth: Drawers closed 28 in Depth: Drawers open 52 in, Width without return bin 37 in, Width with return bin 47.5 in	BD PIXYS	1		✓	
HYBRID OPERATING ROOM	NURSE CHARTING DESK	NEW			1		✓	
HYBRID OPERATING ROOM	SURGE PROTECTORS	EXISTING	N/R		1			
HYBRID OPERATING ROOM		NEW	Storage Carts for Decant to Sterile Core		2	✓		

1 COORDINATION

1.1 Coordinate scheduling, submittals, and Work of the various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

1.2 Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

1.3 Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

1.4 In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

1.5 Coordinate completion and clean up of Work of separate Sections in preparation for Substantial Performance and for portions of Work designated for Owners partial occupancy.

1.6 After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

2 ALTERATION PROJECT PROCEDURES

2.1 Materials: As specified in product Sections; match existing products and work for patching and extending work.

2.2 Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.

2.3 Remove, cut, and patch work in a manner to minimize damage and to provide a means of restoring products and finishes to original condition.

2.4 Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.

2.5 Where new work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent work in texture and appearance.

2.6 When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Consultant.

2.7 Where a change of plane of 6 mm or more occurs, submit recommendation for providing a smooth transition for Consultant’s review or request instructions from Consultant.

2.8 Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

2.9 Finish surfaces as specified in individual product Sections.

3 PRE-CONSTRUCTION CONFERENCE

3.1 Consultant will schedule a conference after Notice of Award and prior to Contractor occupancy of site.

3.2 Attendance Required: Owner, Consultant and Contractor.

3.3 Agenda:

.1 Submission of executed bonds and insurance certificates.

.2 Distribution of Contract Documents.

.3 Submission of list of Subcontractors, list of products, Schedule of Values, and progress schedule.

.4 Designation of personnel representing the parties in Contract, Owner, and Consultant.

.5 Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, contract changes and contract closeout procedures.

.6 Scheduling, including 6-week look-ahead schedule.

.7 Use of premises by Owner and Contractor.

.8 Infection Control Procedures

.9 Owner's requirements and partial occupancy.

.10 Construction facilities and controls.

.11 Temporary utilities.

.12 Security and housekeeping procedures.

.13 Procedures for maintaining record documents.

4 PROGRESS MEETINGS

4.1 Schedule and administer meetings throughout progress of the Work at maximum bi-weekly intervals. Coordinate timing and the exact location with the Owner.

4.2 Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within three business days to Consultant, Owner, participants, and those affected by decisions made.

4.3 Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Consultant as appropriate to agenda topics for each meeting.

4.4 Agenda:

.1 Review minutes of previous meetings.

.2 Review of Work progress.

.3 Field observations, problems, and decisions.

.4 Infection Control Procedures

.5 Identification of problems which impede planned progress.

.6 Review of submittals schedule and status of submittals.

.7 Review of off-site fabrication and delivery schedules.

.8 Maintenance of progress schedule.

.9 Corrective measures to regain projected schedules.

.10 Planned progress during succeeding work period.

.11 Coordination of projected progress.

.12 Maintenance of quality and work standards.

.13 Effect of proposed changes on progress schedule and coordination.

.14 Other business relating to Work.

5 PRE-INSTALLATION CONFERENCES

5.1 When required in individual specification Section, convene a pre-installation conference at work site prior to commencing work of the Section.

5.2 Attendance Required: Parties directly affecting, or affected by, work of the specific Section.

5.3 Notify Consultant four days in advance of meeting date.

5.4 Prepare agenda, preside at conference, record minutes, and distribute copies within two days after conference to participants, with two copies to Consultant.

5.5 Review conditions of installation, preparation and installation procedures, and coordination with related work.

End of Section

1 SCHEDULES REQUIRED

1.1 Submit the following schedules:

.1 Construction Progress Schedule.

.2 Look-ahead detailed construction schedule.

.3 Submittal Schedule for Shop Drawings and Product Data.

.4 Submittal Schedule for Samples.

.5 Product Delivery Schedule.

2 FORMAT

2.1 Prepare schedule in the form of a horizontal bar chart.

2.2 Provide a separate bar for each trade or operation.

2.3 Provide horizontal time scale identifying the first work day of each week.

2.4 Format for listings: the table of contents of this specification.

2.5 Identification of listings: by specification section numbers.

3 CONSTRUCTION PROGRESS SCHEDULE

3.1 Provide detailed Construction Progress Schedule in the form of a series of activities and milestones that are logically linked utilizing Critical Path Methodology. Identify in construction schedule early dates and late dates as well as the Project critical path of activities and completion milestones through the Project. Provide sufficient details of critical events and their inter-relationship for successful performance within the Contract Time.

3.2 Coordinate Construction Progress Schedule with the Owner.

.1 Regularly review the progress of the work with the Owner and Consultant and provide updates to the Construction Progress Schedule.

.2 Develop and submit to the Consultant and the Owner 6-weeks Look-ahead detailed construction schedule. Regularly review and provide updates.

.3 Allow for facilitating the work of the Consultant who will be monitoring the progress of activities and reporting to the Owner on a monthly basis the schedule status of the project.

4 SUBMISSION

4.1 Submit detailed Construction Progress Schedule within 7 days after award of contract

4.2 Submit other schedules within 15 days after award of contract.

4.3 Submit digital document in both PDF and Microsoft Project formats.

4.4 Consultant will review schedules and return review copy within 10 days after receipt.

4.5 Resubmit finalized schedule within 5 days after return of review copy.

4.6 Submit updated Construction Progress Schedule with each application for payment.

4.7 Distribute copies of all schedules to:

.1 Job site office.

.2 Subcontractors.

.3 Other concerned parties.

4.8 Instruct recipients to report to the Contractor within 10 days, any problems anticipated by the timetable shown in the schedule.

5 CONSTRUCTION PROGRESS SCHEDULE

5.1 Include the complete sequence of construction activities.

5.2 Include the dates for the commencement and completion of each major elements and phasing of construction including the following.

.1 Selective Demolition.

.2 Framing.

.3 Special procedures.

.4 Special Subcontractor work.

.5 Equipment Installations

.6 Specialty Equipment installations.

.7 Finishes.

5.3 Show projected percentage of completion of each item as of the first day of the month.

5.4 Indicate the following:

.1 Coordinated sequence of tasks following the contract documentation

.2 Linking of critical path

.3 Lead time of major items with delivery schedule

.4 Major inspections points

.5 Major milestone completion dates to include Each Phase construction completion, and partial occupancy Substantial Completion, occupancy, etc.

.6 Commissioning activities

.7 Deficiencies identification and clearance

.8 Phasing details

.9 Estimate dates for access and duration of Work outside of the Area of Work.

.10 Deliveries of materials, advance order dates, and lead times.

.11 Delivery of Owner’s Supplied Specialty Equipment

5.5 Indicate progress of each activity to date of submission schedule.

5.6 Show changes occurring since previous submission of schedule:

.1 Major changes in scope.

.2 Activities modified since previous submission.

.3 Revised projections of progress and completion.

.4 Other identifiable changes.

5.7 Provide a narrative report to define:

.1 Problem areas, anticipated delays, and the impact on the schedule.

.2 Corrective action recommended and its effect.

.3 The effect of changes on schedules of other prime contractors.

6 LOOK-AHEAD SCHEDULE

6.1 Submit up-to-date six-week look-ahead schedule at each Progress Meeting to provide the Owner with the required advanced notice for all events.

6.2 Any changes to already identified activities and events cannot be changed unless a minimum of 2–weeks' advance notice is provided to the Owner. The Owner has to agree to the proposed change to the 6-week look-ahead schedule prior Contractor proceeding with the change.

6.3 Six-week period shall commence on the first working day of the week following the Progress Meeting at which it is submitted.

6.4 Format: agenda style calendar, to fit 81/2" x 11" pages

6.5 Indicate each trade activity on each day, including deliveries, submittals, and coordination activities.

6.6 Include scheduled dates for sprinklers work, and required shutdown dates for all existing systems.

6.7 Include scheduled dates for any flooring work, in particular if odours will be a concern.

6.8 Indicate coordination activities with Owner, Consultant, Subcontractors.

6.9 Indicate the following:

.1 All required advance notice elements.

.2 Details on all testing and inspection.

.3 All work that is to be done during regular and after hours following the requirements of the construction documents.

.4 All tasks that require tie in to existing service within the building.

7 SCHEDULE OF VALUES (VALUE OF SUBMITTALS)

7.1 Refer to Section 01 00 00, General Requirements

8 SUBMITTALS SCHEDULE

8.1 Include schedule for submitting shop drawings, product data, and samples.

8.2 Indicate dates for submitting, review time, resubmission time, float time, last date for meeting fabrication schedule.

8.3 Include dates when submittals and delivery will be required for owner-furnished products.

8.4 Include dates when reviewed submittals will be required from the Consultant.

End of Section

1 SUMMARY OF WORK

1.1 Provide staff, Subcontractor, Suppliers, and own forces with training in infection prevention and control procedures. Design and implement training seminar by an environmental consultant with healthcare experience and whose educational program has been approved by the Owner. Acceptable firms are but not necessary limited to the following:

.1 Maple Environmental (Kyle Prosser, 905-601-6301).

.2 Safetech Environmental Ltd. (Romeo Milano, Tel: 905-624-2722).

.3 Golder Associates (Jason McGonigle, Tel 905-723-2727 Ext. 256).

1.2 Directly engage and enter into a contract with the approved environmental consultant. Coordinate with the environmental consultant and include in the Contract Price the required number of training sessions to adequately cover the duration of the Project.

1.3 Prior to commencement and during the course of the Work, as required, promptly provide the Owner with written confirmation of such training by way of a certificate issued by the environmental consultant.

1.4 Owner's Infection Prevention Control Services (IPCS) will investigate and advise on the risks of organisms that exist in the Project area. The goal will be to determine any infectious risks where possible and eliminate infection risks associated with construction activities in order to protect patients and staff occupying this building.

1.5 During the course of the Work, IPCS will assess the risks related to the Project utilizing the Risk Assessment and Preventive Measures Checklist (Appendix I). The determination of risk will guide the need for barriers during the Project. The Owner will communicate the assessment to the Contractor and advise on any additional measures to protect functional areas of the hospital.

1.6 Inspection of on-going infection control procedures shall be undertaken on a regular basis by the Owner's infection control representative and the Contractor. The Owner's monitoring checklist is found in Appendix II.

1.7 IPCS may stipulate changes in protocols and barrier configurations if required to ensure the safety of the patients and the clinical environments. Barriers and hoarding are shown on the Drawings diagrammatically and as intent only. IPCS and Contractor to review on site barrier requirements. Construct barriers as per final instruction on site by the Owner at no additional cost to the Owner.

1.8 Definitions:

.1 Final cleaning is defined as; post construction cleaning as provided by the Owner’s workforce or Owner’s contracted cleaning service.

1.9 Transportation of Equipment/Supplies: Prior to commencement of the Work, IPCS and the Project team and the Contractor will establish paths and procedure for the transportation of clean/sterile supplies, equipment and construction materials, including the removal of construction debris. Additional information as indicated.

1.10 Construction Personnel to wear Hospital identification at all times and display in a manner visible to any individual or passer-by.

1.11 Construction Personnel: Construction personnel shall not pass through clinical areas of the hospital that reside beyond the Contractor's Work limits without approval from the IPCS or Owner.

.1 Daily outer construction garments and PPE attire must be clean and maintained dust-free at all times.

.2 Daily construction footwear must be maintained clean and dust free at all times.

.3 Daily construction protective headgear shall be maintained clean and dust free at all times.

1.12 Protective Clothing when travelling through secured Operating Zones of the Hospital - Disposable Microporous Cleanroom Coveralls, Polypropylene Hair nets and Seamless polyethylene coated Boot covers

.1 Contractor to provide hospital-grade Protective Clothing comprising of disposable coveralls that include but are not limited to full body gowns, boot covers, safety hair nets and polyethene gloves for all construction personnel and visitors.

.2 Protective Clothing is required at any given time when entering the OR zones or exiting from the Contractor's hoarded work areas prior to leaving hospital premises.

.3 All Protective Clothing shall be stored in a secured self-ventilated unit within close proximity to the Operating Room Main Nursing station entrance located on Level 2 of M-Wing. The Contractor shall provide and keep on hand adequately stocked quantities of disposable Protective Clothing for the duration of construction. Provide separate storage compartment for collection of soiled disposable coveralls, boot covers, hair nets when exiting the floor area from the OR zone.

.4 Change Protective Clothing frequently and dispose immediately after every use or if they are ripped and not serviceable.

.5 Arrange with the Owner an area to store Contractor's supplied Protective Clothing / PPE.

.6 Prior to admittance into the Operating zones, all workers and Specialty Equipment vendors shall check-in with their Security identification badges at the Main OR Nursing Station before being fully gowned-up in protective coveralls. Upon inspection and approval by SHSC Nursing staff, Contractors may proceed through the Operating zones using the designated travel routes to the construction area as shown on drawings.

.7 Adequate space to allow workers to remove disposable protective coveralls, gloves, hair nets, boot covers shall be allocated within the Contractor's hoarded dust-down vestibule. Soiled disposable PPE articles shall be placed in large plastic garbage collection bag and stored in a neat manner to not impede on foot traffic.

.8 Storage of clean disposable protective coveralls, gloves, hair nets, boot covers shall also be stored in the Contractor's hoarded zone and made readily available for all workers when leaving the work site. Provide means and methods to prevent cross-contamination of clean and soiled disposable PPE attire.

.9 Disposable PPE shall be removed from the construction zone by the Contractor daily or as often as needed to suit requirements of hospital IP&C and Risk.

.10 All construction personnel leaving or exiting the work site at any given time of the day shall put on all required protective coveralls within the hoarded dust-down vestibule. Workers shall exercise and take appropriate steps to ensure compliance with CSA Z317.13-17 in conjunction with hospital dust contamination control and safety procedures prior to travelling through designated corridors within the OR zone.

.11 Proper use of the disposable coveralls, boot covers, hair nets, gloves and use of sticky mats shall be followed at all times for all workers without exception. At no time shall

workers are permitted to leave the construction area wearing regular construction PPE garments and footwear.

1.13 Surveillance: IPCS personnel will enhance surveillance as appropriate. Field review of the Work will be conducted on a regular basis with the Contractor as necessary.

2 REFERENCES

2.1 Canadian Standards Association (CSA Group):

.1 CAN/CSA-Z317.2-15, Special requirements for heating, ventilation, and air-conditioning (HVAC) systems in health care facilities.

.2 CAN/CSA-Z317.13-17, Infection control during construction, renovation, and maintenance of health care facilities.

3 WORK COVERED UNDER THIS CONTRACT

3.1 Any and all infection control procedures described in this Section and all such means, materials and methods that are required to contain and prevent Work environments from spreading infection to the adjacent Hospital environment.

3.2 Means, materials and methods include but are not limited to temporary hoardings and barriers, enclosures, containment capsules, vessels, and other air tight assemblies constructed to contain airborne particulate generated by the Work from/out of Hospital areas adjacent and outside the Work area. The employment of mobile HEPA filtered recirculation units will be required in Work areas such as inpatient areas, laboratories and other risk areas identified by the Owner or IPCS and also to maintain negative air pressure in general Work area(s) relative adjacent Hospital areas.

4 PRE-CONSTRUCTION

4.1 At Contract start-up meeting, at meetings convened prior to the start of the Work, at pre-installation meetings, and at regular progress meetings, review infection prevention and control procedures. The Owner's infection control representative will attend such meetings. Subjects to be reviewed include, but are not limited to, the following:

.1 General information on infection prevention measures are articulated in accordance with CAN/CSA-Z317.13.

.2 Project and/or phases are subjected to preventative measures assessment and categorization in accordance with CAN/CSA-Z317.13.

.3 Schedule mandatory infection control training for all construction trade staff. Only those trade staff that have successfully completed mandatory infection control training are permitted to work at Sunny brook Health Sciences. Trade staff without documented infection control training will be disqualified from the job site. Delays attributed to non-documented staff will be at the cost and responsibility of the Contractor.

.4 General information on infection prevention measures is articulated.

.5 Patient populations that may be at risk are identified.

.6 Prevention measures for essential services (e.g. water, ventilation systems, electricity) that may be disrupted are provided.

.7 Integrity of the facility's exterior structure, spatial separations, ventilation and water supplies for any penetrations and infection control problems are reviewed and assessed daily to ensure all services that supply clinical areas are provided.

.8 Measures to control dust and routes to safely remove construction debris must be outlined and altered as necessary to protect all clinical areas and patients of the hospital. Traffic routes shall be in accordance with cited CSA standard or requirements of the Owner whichever is more stringent.

.9 Traffic patterns for construction workers and supply delivery routes for construction materials will be established to minimize risks to patients, staff and visitors per the Owner's requirements and as indicated.

.10 Identify all critical areas of the ventilation system to ensure protection of the system from construction dust and debris including the need for increased filter changes during construction.

.11 Properly seal penetrations to mitigate dust and moisture travel between clinical areas and construction site including the need to close down dampers temporarily to reduce circulation of contaminated air or fumes is assessed.

.12 The systems can provide the correct air exchange rates and pressure relationships in critical areas near construction activity.

.13 Properly adjust exhaust and supply air flow in the construction area to ensure "negative pressure" gradient between construction (negative) and clinical (positive) areas.

.14 Properly protect all exterior air intakes as necessary to ensure optimal incoming "fresh air".

.15 Criteria of inspections by Owner's infection control representative.

.16 Ceiling/Wall/Floor Access permits requirements prior to opening concealed spaces.

4.2 Vacuum cleaners:

.1 Vacuums shall be commercial grade complete with HEPA filters.

.2 HEPA filter shall be changed as recommended by the manufacturer or required by use. Maintain a filter change log at the Place of the Work, available for review by the Consultant

5 CONSTRUCTION

5.1 Breaches in infection prevention containment measures, as outlined in Appendix I or as prescribed by CAN/CSA-Z317.13 or by the IPCS where negative outcome (s) that may place staff and/or patients of the Owner's facilities at risk will result in "stop" construction orders to the Contractor by IPCS.

5.2 Construction area and all related traffic routes shall be maintained in an "acceptable" state of cleanliness as specified by the IPCS during the project without exception.

5.3 Cleaning will be provided as categorized by IPCS as specified in Appendix I. The Place of the Work must also be cleaned prior to and at completion of work as follows:

.1 Undertaken by Contractor and included in the Contract Price:

.1 Construction cleaning prior to reopening a supply air duct during construction.

.2 Construction cleaning completed prior to the removal of any containment barriers.

.3 Construction cleaning completed after the removal of any barrier.

.4 Construction cleaning immediately after completion of minor work performed after the removal of barriers.

.2 Undertaken by Owner and not included in Contract Price:

.1 Final cleaning by Environmental Services must be completed prior to occupancy.

5.4 Construction Cleaning is defined as the complete removal of "daily" construction debris, dust containment and mitigation measures during construction activities. Measures to contain and mitigate dust during construction activities include but are not limited to, daily vacuuming of the work area with a HEPA filtered vacuum device, wet mopping, wrapping and/or bagging of debris, using vacuum equipped tools, etc. Area is to be inspected and approved as clean by IPCS.

5.5 Transportation of Equipment and Supplies: Prior to construction, IPCS, the Consultants, and the Contractor will establish delivery paths, time and procedures for the transportation of trade carts, equipment, materials, and "clean" install equipment. Movements and storage of equipment and supplies through the hospital may include but is not limited to:

.1 Daily maintenance of all trade carts so that they are kept in a clean and dust free condition.

.2 Daily wipe down of all trade carts with an approved "hospital disinfectant".

.3 Trade or supply carts of raw wood are NOT permitted. Exterior wood must be sealed to sustained daily cleaning and disinfection.

.4 Washdown of all waste carts after the disposal of any wastes and before the cart returns to the hospital.

.5 Removal of all packaging material from "final install" equipment prior to delivery through the hospital. Contractor shall consult with the IPCS or designate on packaging necessary to protect devices prior to final install

.6 Packaging materials permitted onto the construction site must be removed daily or as generated, whichever is more frequent.

.7 Transportation of equipment, materials/supplies and wastes is NOT permitted between the hours of 07:00 and 21:00 hrs. Owner or designate may grant limited exceptions in writing.

.1 For Project- specific delivery hours refer to Section 01 00 00, General Requirements.

.8 Incoming construction material must be handled in accordance with CAN/CSA-Z317.13. Materials must be protected from moisture and dirt.

.9 Oversized "new install" equipment must be delivered in accordance with measures outlined by the IPCS or designate. Procedures may include but is not limited to additional cleaning of "new equipment", cleaning of the hoarding to permit clear passage into the work area followed by immediate reinstatement of the hoarding.

5.6 Surveillance: IPCS or designate will determine frequency of site reviews of the construction area. Site review may include but is not limited to assessing the area for cleanliness and dust mitigation, worker compliance with measures as outlined, hospital approved workers/trades, etc.

.1 Security - site will have controlled access with appropriate signage to identify the area as a construction area and danger within.

.2 Security - access to site will be through a self-closing door that is locked at the conclusion of each day's activity. Keys to the site will be provided to the IPCS or the Owner.

.3 Contractor will conduct daily site reviews and document daily findings in a log book as specified by the IPCS or designate.

.4 Site cleaner will document frequency of cleaning as specified by the IPCS or designate.

5.7 Ventilation System and Negative Pressure Differential:

.1 Areas where work is being undertaken shall be isolated from occupied areas of the hospital using dust tight partitions and enclosures as described above.

.2 The Place of the Work will be maintained under negative pressure at all times in relation to the occupied areas of the existing building to prevent dust and airborne pathogens from entering the occupied areas of the existing building.

.3 Negative pressure shall be achieved through the use of dedicated (window or otherwise) exhaust units or, if direct access cannot be achieved, by HEPA filtered recirculation units that transfer filtered air from the Place of the Work into the occupied areas. Exhaust points will be reviewed with the Owner and the Consultant to ensure that the exhaust air from the Place of the Work is not affecting pedestrian routes and is not re-entrained back into the existing building through fresh air intakes.

.4 Provide construction exhaust/HEPA units and remove at the completion of the Work.

.5 Air systems serving only the Place of the Work will be shut down and all supply, return and exhaust openings shall be sealed to prevent dust and construction debris from entering the air system. As a further precaution, the air system will be reviewed at the end of the Work to determine if cleaning is required.

.6 Supply and return air ducts entering the Place of the Work are to be fitted with a pre-filter unit and sealed within the Place of the Work near point of entry or exit prior to the start of disruptive activity to prevent dust and construction debris from entering the air system. As a further precaution, the air system will be reviewed at the end of the Work to determine if c leaning is required.

.7 During construction, the seal only on the supply air duct may be removed after demolition and clean-up to permit ventilation within the construction area provided no other means is available.

.8 Areas adversely affected by changes in air flows outside the construction areas are to be re-balanced to comfortable levels as advised by the Consultant.

.9 Main HVAC infrastructure shall be protected from contamination in accordance with CAN/CSA-Z317.2 and CAN/CSA-Z317.13.

5.8 When constructing the hoarding, install a magnehelic digital gauge that will measure negative pressure. Take daily log of the readings of the gauge and record measurements in a report. Report shall be updated daily and be made available to the Consultant and Owner immediately upon request.

.1 Anything less accurate than digital gauges are not permitted. Owner will put STOP WORK until proper working magnehelic digital gauge is installed and meeting required readings.

5.9 Ensure that vacuuming and cleaning of Contractors and Subcontractors clothes is mandatory prior to leaving areas of the Work to prevent dispersion of dust.

5.10 Contractor to Provide their own mobile negative pressure enclosures in adequate numbers to align with the project schedule to do localized ceiling work. Use of Owner's mobile negative pressure enclosures is not permitted.

End of Section

Sunnybrook HEALTH SCIENCES CENTRE

Infection Prevention and Control
Risk Assessment and Preventive Measures Checklist **for**
Health Care Facility Construction & Renovation

Construction/Renovation Project Name/Identifier	

Project Manager and Contact Number	
Infection Prevention and Control Representative and Contact Number	
Constructor(s)	
Constructor's Contact Information	

Construction Activity Type		Population Risk Group	
Matrix Value		Proposed Project Start Date	

Part One: Types of Construction Activity

DEFINITIONS OF CONSTRUCTION ACTIVITY	
Type A	Inspections and General Upkeep Activities. Includes but is not limited to: removal of ceiling tiles for visual inspection (limited to 1 tile per 50 square feet); painting (but not sanding); installation of wall covering; electrical trim work; minor plumbing; and activities, which do not generate dust or require cutting into walls or access to ceilings other than for visual inspection
Type B	Small scale, short duration activities, which create minimal dust. Includes, but is not limited to, installation of telephone and computer cabling, access to chase spaces, cutting into walls or ceiling where dust migration can be controlled.
Type C	Any work that generates a moderate to high level of dust. Includes, but is not limited to, demolition or removal of built-in building components or assemblies, sanding of wall for painting or wall covering, removal of floor covering/wallpaper, ceiling tiles and casework, new wall construction, minor ductwork or electrical work above ceilings, major cabling activities.
Type D	Major demolition and construction projects. Includes, but is not limited to, heavy demolition, removal of a complete ceiling system, and new construction.

Sunnybrook HEALTH SCIENCES CENTRE

Infection Prevention and Control
Risk Assessment and Preventive Measures Checklist **for**
Health Care Facility Construction & Renovation

Part Two: Classification of Population Risk Group

POPULATION RISK GROUP BREAKDOWN			
GROUP 1 LOW	GROUP 2 MEDIUM	GROUP 3 MEDIUM to HIGH	GROUP 4 HIGHEST
• Private/Office areas • Areas operating outside or void of patient care	• Patient Care areas not identified in Group 3 or 4 • Laundry • Cafeteria • Dietary • Materials Management • PT/OT/Speech • Admission/Discharge • Echocardiography Laboratories not specified as Group 3 • Public Corridors through which patients, supplies, linen pass)	• Emergency Rooms • Radiology/Medical Imaging • Post-anaesthesia Care units or Same Day Surgery (MG, M2) • Labour and Delivery • Newborn Nurseries • Medical laboratories (Microbiology (B1), Transfusion Science (B2), Chemistry (CG), Pathology (E4, M2, B1), Haematology lab (CG), etc.) • Post Surgical/Trauma Patient Care Units (D5, C5, D3, D6) • Oncology Units (C2, C6) • General Medicine Units (D2, D4, B4, C4)	• Ross Tilley Burn Centre (D7) • Critical Care Unit (M2) • Cardiovascular Intensive Care Unit (M2) • B5 Intensive Care Unit • Operating rooms (M2/D7/MG) • Central Processing Department • Newborn Intensive Care Unit • Pharmacy Admixture • Cardiovascular Care Unit (B3) • Cardiac Catheterization Suites (C3) • Intensive Care Unit D4ICU

Part Three: Construction Activity and Risk Group Matrix

A copy of the Risk Assessment and Preventive Measures Checklist must be sent to the Infection Prevention and Control Department to determine the matrix and determine the preventive measures required Adaptations to the prevention measures can only be made after approval has been provided by the infection control personnel.

	Construction/Renovation/Maintenance Activity			
Risk Group	**Type A**	**Type B**	**Type C**	**Type D**
Group 1	**I**	**II**	**II**	**III/IV**
Group 2	**I**	**II**	**III**	**IV**
Group 3	**I**	**III**	**III/IV**	**IV**
Group 4	**I-III**	**III/IV**	**III/IV**	**IV**

Infection Prevention and Control
Risk Assessment and Preventive Measures Checklist **for**
Health Care Facility Construction & Renovation

Part Four: Recommendations for Infection Control Preventive Measures

Matrix Class I Requirements

Ia) C/R Activities - Dust Control

1	After visual inspection replace displaced tiles and close access panels
2	Work area HEPA vacuumed if dust created during activity
3	Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet

Ib) C/R Activities - Plumbing

4	Schedule water interruptions during periods of low user activity
5	Faucet aerators, gaskets and items made of materials that support the growth of Legionella are not installed or used
6	Water temperature meets standards set by Sunnybrook Health Sciences Centre
7	Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
8	Water lines flushed prior to re-use

Infection Prevention and Control
Risk Assessment and Preventive Measures Checklist **for**
Health Care Facility Construction & Renovation

Matrix Class II Requirements

IIa) C/R Activities - Dust Control

1. All constructors and sub constructors must follow the assigned traffic route to and from the C/R zone
2. After visual inspection replace displaced tiles and close access panels
3. Active means provided to minimize dust generated and migrated into the atmosphere
4. Use drop sheets and water misting during cutting to control dust
5. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
6. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
7. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
8. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
9. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group

IIb) C/R Activities – HVAC

10. Ventilation system disabled in the C/R area until project completed (where possible)
11. Need to change and/or clean filters in C/R area monitored
12. Air intake and exhaust vents in C/R zone sealed off with polyethylene

IIc) C/R Activities - Plumbing

13. Schedule water interruptions during periods of low user activity
14. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
15. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*
16. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
17. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

Infection Prevention and Control
Risk Assessment and Preventive Measures Checklist **for**
Health Care Facility Construction & Renovation

Matrix Class III Requirements

IIIa) C/R Activities – Dust Control

1. IP&C consultation completed and IP&C dust control measures approved
2. Impermeable solid dust barrier, from true ceiling to floor erected and inspected by IP&C before start of project (drywall/sheetrock/gypsum board)
3. Double layer of 6 mil fire retardant polyethylene is an alternative dust barrier, but IP&C must be consulted to determine optimal choice based on location, type and duration of project
4. Upper seals must be installed above the false ceiling to the true ceiling around all penetrations to complete the dust barrier
5. Sticky mat placed and maintained outside C/R zone to trap dust from workers shoes, equipment and debris that leaves the C/R zone
6. Constructors vacuum themselves with HEPA-filtered vacuum before leaving work site (alternatively constructors can wear cloth/paper coveralls that are removed each time they leave the work site)
7. Use drop sheets and water misting during cutting to minimize dust generated and migrated into the atmosphere
8. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
9. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
10. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
11. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
12. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group
13. Holes in walls repaired within 8 hours or temporarily sealed
14. Dust barrier shall remain in place until project complete, area has been thoroughly cleaned and inspected by IP&C
15. Dust barriers removed carefully to minimize the spreading of dust and other debris particles associated with the C/R project

Infection Prevention and Control
Risk Assessment and Preventive Measures Checklist **for**
Health Care Facility Construction & Renovation

Matrix Class III Requirements (cont'd)

IIIb) C/R Activities – HVAC

16. High-Efficiency Particulate Filters (HEPA) shall be used to obtain a negative pressure differential. Constructor responsible for providing appropriate number of units based on square footage of C/R zone
17. Filters shall be monitored and replaced if clogged or functioning below the manufacturer's specifications
18. Negative pressure differential with respect to adjacent areas is no less than 7.5 Pa (0.03 in wc)
19. Intake and exhaust vents/grills within C/R zone to be sealed off with poly for the duration of the project
20. Where possible air is to be exhausted directly outside and way from intake vents, alternatively air is to be filtered through HEPA filter before being re-circulated
21. Ventilation systems working properly in adjacent areas
22. Ventilation system is cleaned if contaminated by soil, water or dust after C/R project completion

IIIc) C/R Activities – Plumbing

23. An alternate source of potable water must be provided for users during prolonged plumbing shutdowns and/or after major plumbing installation/repairs until potable water has been cleared for signs of *Legionella*
24. Schedule water interruptions during periods of low user activity
25. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
26. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*
27. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
28. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

IIId) C/R Activities – Risk Reduction

29. High risk patients in/adjacent to C/R areas moved
30. Cleaning frequency of areas adjacent to C/R zone by cleaning by Hospital Environmental Services to be increased while project is underway
31. Traffic pattern designated for clean or sterile supplies and equipment that avoids C/R zone
32. Hospital medical allied health staff are not permitted to enter to then C/R zone for the duration of the project

Infection Prevention and Control
Risk Assessment and Preventive Measures Checklist **for**
Health Care Facility Construction & Renovation

Matrix Class IV Requirements

IVa) C/R Activities – Dust Control

1. IP&C consultation completed and IP&C dust control measures approved
2. Impermeable solid dust barrier with anteroom erected and inspected by IP&C before start of project
3. Upper seals must be installed above the false ceiling to the true ceiling around all penetrations to complete the dust barrier
4. Sticky mat placed and maintained fresh outside and inside anteroom to trap dust from workers shoes, equipment and debris that leaves the C/R zone
5. Construction workers leave C/R zone through anteroom to be vacuumed with HEPA-filtered vacuum before leaving work site (alternatively constructors can wear cloth/paper coveralls that are removed each time they leave the work site)
6. Impermeable solid dust barrier, from true ceiling to floor erected and inspected by IP&C before start of project (drywall/sheetrock/gypsum board)
7. Use drop sheets and water misting during cutting to minimize dust generated and migrated into the atmosphere
8. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
9. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
10. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
11. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
12. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group
13. Holes in walls repaired within 8 hours or temporarily sealed
14. Dust barrier to remain in place until project complete, area has been thoroughly cleaned and inspected by IP&C
15. Dust barriers removed carefully to minimize the spreading of dust and other debris particles associated with the C/R project

Infection Prevention and Control
Risk Assessment and Preventive Measures Checklist **for**
Health Care Facility Construction & Renovation

Matrix Class IV Requirements (cont'd)

IVb) C/R Activities – HVAC

16. High-Efficiency Particulate Filters (HEPA) shall be used to obtain a negative pressure differential. Constructor responsible for providing appropriate number of units based on square footage of C/R zone
17. Filters shall be monitored and replaced if clogged or functioning below the manufacturer's specifications
18. Negative pressure differential with respect to adjacent areas is to be maintained no less than 7.5 Pa (0.03 in wc)
19. Intake and exhaust vents/grills within C/R zone to be sealed off with poly for the duration of the project
20. Where possible air is to be exhausted directly outside and way from intake vents, alternatively air is to be filtered through HEPA filter before being re-circulated
21. Ventilation systems working properly in adjacent areas
22. Ventilation system is cleaned if contaminated by soil, water or dust after C/R project completion

IVc) C/R Activities – Plumbing

23. An alternate source of potable water must be provided for users during prolonged plumbing shutdowns and/or after major plumbing installation/repairs until potable water has been cleared for signs of *Legionella*
24. Schedule water interruptions during periods of low user activity
25. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
26. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*
27. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
28. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

IVd) C/R Activities – Risk Reduction

29. High risk patients in/adjacent to C/R areas moved
30. Cleaning frequency of areas adjacent to C/R zone by cleaning by Hospital Environmental Services to be increased while project is underway
31. Traffic pattern designated for clean or sterile supplies and equipment that avoids C/R zone
32. Hospital medical and/or allied health staff are not permitted to enter to then C/R zone for the duration of the project

Sunnybrook
HEALTH SCIENCES CENTRE

INFECTION PREVENTION AND CONTROL
APPENDIX II:
CONSTRUCTION/RENOVATION/REPAIR MONITORING CHECKLIST

Date: _____ **Time:** _____

Location: _____ ___ **Inspector:** _____

Construction/Renovation/Repair site has been checked for:

ITEM	COMPLIANCE?		
1. Construction Barriers	**Y**	**N**	**N/A**
Infection Control Permit/Sign off posted outside work area			
Airtight plastic or drywall barriers extend from floor to ceiling			
All airtight penetrations sealed with heavy tape			
All remaining hospital equipment, doors, holes, conduits, unused windows, outlets in work area covered with poly and sealed			
Doors to anteroom and work site remain securely closed			
Upper seals intact			
Portable containment cube intact, labeled and completely sealed			
Portable HEPA vacuum or HEPA filtration unit attached outside cube and turned on during ceiling/wall access			
2. Negative Air	**Y**	**N**	**N/A**
HVAC system has been isolated to prevent contamination of the duct system. Supply vents are blocked and return vents are filtered			
Equipment to prevent airborne particulates from escaping work area are used appropriately (e.g. portable HEPA filter units/filtered vacuums, exhaust fans)			
Doors to anteroom and work site remain securely closed			
Portable HEPA filtration unit is well secured (clamped hose) and ducted properly			
Work site is at negative pressure to surrounding areas (0.03kpa)			
Contractors properly attired (coveralls/booties put on over clothing) prior to entering work zone			

3. CLEANLINESS OF AREA	Y	N	N/A
Protective clothing properly removed and disposed of, or existing clothing properly vacuumed in ante-room prior to leaving work area			
Sticky mats or adhesive strips are clean and available at doorways for shoe dust collection			
No visible dust or footprints outside of work zone			
Anteroom is intact and free of debris/dust			
Sticky mats are fresh and available at doorways for dust collection			
Construction area cleaned daily.			
Demonstrated compliance with traffic patterns, both construction worker and supply/debris removal.			

COMMENTS/NOTES

_____

_____

_____

_____

_____

- Any major deficiencies should be addressed immediately. Non-compliance should be brought to the attention of the Project Manager (refer to Infection Control Risk Assessment Tool)
- This monitor checklist will be completed periodically for the duration of the construction/renovation/repair project
- A corrective action log for documented non-compliance will be maintained by Infection Prevention and Control

Created by Infection Prevention and Control: July 2006,
Updated: November 2017

Appendix III

Infection Control/Occupational Health and Safety Sign-off

Project Name/Location: ________________________________

Project Manager: ________________________________

Contractor: ________________________________

Initial sign-off (Infection Prevention and Control):

Date: ____________________ Signature: ____

Initial sign-off (Occupational Health and Safety):

Date: ____________________ Signature: ____

To be completed by IPC/OHS

Date	Walk-off (sticky) mats in place and in good condition	Negative pressure of 7.5 Pa (0.03 in wc) continuously monitored	Containment is well sealed	Comments/Correction actions	Initials
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		

(November 2017)

1 PROJECT CLEANLINESS

1.1 Maintain Work in tidy condition, free from accumulation of waste products and debris.

1.2 Clean interior areas daily to provide suitable conditions for Work and remove mud and dirty footprints. Remove debris from areas of work on a daily basis at a minimum, or more often as required to provide suitable conditions for work.

.1 Clean interior areas using vacuum cleaner and mop (no sweeping allowed).

1.3 Use wet cleaning methods and HEPA-filtered vacuum cleaners are required to minimize release of airborne contaminants.

1.4 Provide adhesive mat for project entrances and exits. Item to be of sufficient size to allow personnel exiting project site to clean debris and dust from shoes. Tracking dust and debris through working areas of hospital is not acceptable. Any dust or debris tracked out of construction site, either by foot traffic or by debris hauling vehicles, shall be cleaned and removed by Contractor at no additional cost to the Owner.

1.5 Provide mats at each entry point to the Work, and at other areas as directed by Owner. Replace mats daily or as requested by Owner.

1.6 Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to closing such spaces

1.7 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Owner.

1.8 Provide on-site covered containers for collection of waste materials and debris.

1.9 Provide and use marked separate bins for recycling.

1.10 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.

1.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

2 FINAL CLEANING

2.1 Execute a thorough cleaning prior application for Substantial Performance, and remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

2.2 Remove waste products and debris and leave Work clean and suitable for occupancy.

2.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

2.4 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

2.5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.

2.6 Clean lighting reflectors, lenses, and other lighting surfaces.

2.7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

2.8 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.

2.9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

2.10 Clean equipment and fixtures to sanitary condition; replace filters of mechanical equipment used for temporary heat and ventilation.

2.11 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

End of Section

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

.2 Related Requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 SECTION INCLUDES

.1 This Section of the Work covers the requirements for demolishing, salvaging, relocating and removing wholly or in part the various items designated on the drawings or required to be removed or partially removed for the receipt of the Work of this Contract.

.2 Selective demolition includes, but is not necessarily limited to:

.1 Alteration and renovations to existing building.

.2 Cutting and removing of walls, ceilings, floor finishes, etc., in the existing buildings as indicated on drawings.

.3 Patching, making good walls, floors and ceilings including painting, as required.

.4 Removal of rubbish, debris, demolished fixtures, fitments and items not scheduled to remain Owner's property, resulting from the demolition and preparatory work.

.5 Dust Control during the operations of the work of this section.

1.3 QUALITY ASSURANCE

.1 Comply with pertinent codes, regulations and insurance carriers providing coverage for this Work.

.2 Execute the work in strict accordance with 'The Occupational Health and Safety Act and Regulations for Construction Projects' latest addition. Keep copy of the Act at the place of the Work at all times.

.3 Carry out demolition work in accordance with CSA S350-M.

.4 Submit fire safety plan in accordance with requirements of Owner.

1.4 SUBMITTALS

.1 Submit demolition and cutting schedule to Consultant for review. Schedule to show timing and phasing of the Work in the various areas of the existing building. Deviation from schedule will not be permitted without approval.

.2 Submit drawings for demolition of structural elements bearing stamp of a professional engineer registered in the Place of Work.

1.5 PROTECTION

.1 Use all means necessary to protect existing objects designated to remain and in the event of damage, immediately make all repairs and replacements necessary to the approval of the Consultant and at no additional cost to Owner.

.2 Provide protection required to enable existing building and equipment to remain in continuous and normal operations, and maintain construction schedule.

.3 Erect barricades, covered ways, barriers, scaffolding, screens, notice and warning boards and maintain all lights, signals and protection of all kinds for the protection of workmen on the Work, for the protection of adjoining property and for the protection of public.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Demolished materials become Contractor's property. Remove materials from site daily, unless such materials are specified or shown on Contract Documents to be reused or turned over to Owner.

2.2 TEMPORARY PARTITIONS

.1 Erect Temporary Partitions / Dust-Proof Barriers / Hoarding prior to demolition. Adjust and relocate partitions as required for various operations of Work.

.2 Follow assembly descriptions and hoarding details on drawings and Section 01 00 00.

.3 Comply with Infection Control Procedures, Section 01 35 33.

PART - 3 EXECUTION

3.1 PREPARATION

.1 Notify the Consultant at least two full working days prior to commencing of the Work.

.2 The drawings do not purport to show all objects existing on the site.

.3 Before commencing the Work, carefully check drawings and verify with the Consultant regarding all objects to be removed and all objects to be preserved.

.4 Schedule all Work in a careful manner with all necessary consideration for the requirements of Owner, his employees and the public.

.5 Avoid interference with the use of, and passage to and from, adjacent buildings and facilities.

.6 Before starting the operations, arrange with the appropriate trade concerned for the disconnection of all utility services, affecting the work.

.7 Preserve in operating condition all active utilities to remain.

3.2 DEMOLITION AND PREPARATORY WORK

.1 In order to afford the least interference with the efficient operations of the existing building and to keep the risk of fire to a minimum at all times, ensure that demolished materials are continuously removed from the buildings and grounds as they accumulate, that no hazard condition is left during non-working hours and that full measures are taken by sprinkling and other means to keep dust to a minimum and to confine what dust there is within the working area.

.2 Maintain proper and safe means of fire exit from all zones of the existing building to the approval of the authorities having jurisdiction.

.3 Confine operation to those parts of the buildings which are to be altered or renovated. Do not damage existing construction beyond that necessary for performance of new work and repair such damage as required.

.4 Carefully remove in re-usable condition, transport and store on site where directed by Owner's representative and protect against damage all materials and equipment to be salvaged or relocated for reuse in the new work as directed by Owner's representative.

.5 Take possession of all other materials arising from the demolition work and remove from the site.

.6 Cut openings through existing walls, partitions and floors. Establish exact location of steel reinforcing in existing concrete slabs or walls before holes are made. Be responsible for damage to existing steel reinforcing and be liable for structural failure. Make good surfaces disturbed with materials to match existing.

.7 The use of pneumatic or electrical jack hammers is not permitted.

.8 Where items are to be removed from existing structure or surfaces that are to remain in place, remove those items complete with hangers, brackets and other readily removable supports and fastenings:

.1 Remove bolts, but not inserts embedded in concrete or masonry.

.2 Remove bolt and rivet fastenings from steel structure.

.9 Demolish work into sections of practical size for removal without alteration or damage to the existing building remaining in place.

.10 Upon completion of demolition, leave interior surfaces broom clean.

.11 New openings required in existing walls and partitions shall be carefully cut and formed to blend into existing work.

.12 Join and make good new work to existing in such a manner that the joint is structurally sound and inconspicuous.

.13 Cuts, breaks and other temporary openings into existing surfaces, which are required for installation or application of new fixtures, fitments, materials or services shall be, at completion of work, patched and/or made good and finished to blend with surrounding finishes. Openings to allow passage of ducts shall be closed tight to perimeters of duct at all locations where fire dampers are required.

.14 In areas where work is required to be performed over acoustic ceilings composed of lay-in panels in a supporting grid, carefully remove panels to avoid damage and replace when work is completed. If existing lay-in panels in a room are damaged and cannot be matched with new panels, then replace all the panels in that room with new units to the Engineer's approval at no additional expense to Owner.

.15 Where fireproofing membranes or coverings to existing structural steel members and open web steel joists are disturbed, restore the fire protection with materials and methods acceptable by the authorities having jurisdiction.

.16 Materials and other equipment not required for re-use shall not be stored or sold from the site.

.17 Burning of materials on site is prohibited.

.18 Maintain the existing building in a weather and watertight condition at all times.

.19 Maintain security of existing building.

3.3 **MAKING GOOD**

.1 Make good materials and finishes which are damaged or disturbed during the process of additions and reconstruction under the Contract.

.2 Where existing work is to be made good, match new work exactly with the old work in material, form, construction and finish unless otherwise noted or specified.

.3 Protect work in the existing building, such as floors, finishes, trim, etc., as completely as possible to hold the replacing of damaged work to a minimum.

.4 Preparation for new finishes:

.1 Remove existing finishes, including painting.

.2 Fill cracks and depressions with suitable filler and finish smooth, as recommended by the manufacturer of the new finishes.

.3 Grind protrusions level with substrates and finish smooth.

.4 Remove all evidences of existing adhesive, grease, oil, soil and other encrustations of foreign material by washing, scraping and grinding if necessary.

.5 Clean and prepare substrates to receive new work.

3.4 **CUTTING AND PATCHING**

.1 Perform cutting, fitting, and patching to complete the Work. Do not cut, drill or sleeve load-bearing members without obtaining written approval for each condition.

.2 Remove and replace defective and non-conforming work.

.3 Perform work to avoid damage to other work.

.4 Prepare proper surfaces to receive patching and finishing.

.5 Cut rigid materials using power saw or core drill. Pneumatic or impact tools not allowed.

.6 Restore work with new products to match existing in accordance with Contract Documents.

.7 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.8 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with fire rated material, full thickness of construction element.

.9 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 REFERENCES

.1 ASTM International (ASTM):

.1 ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars; Using 2 inch (50 mm) Cube Specimens.

.2 ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

1.3 SUBMITTALS

.1 Product Data: Manufacturer's technical information for each product specified.

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.2 Installation Instructions: Manufacturer's printed instructions for each product.

1.4 QUALITY ASSURANCE

.1 Ensure Single Source Warranty Requirements and Compatibility of Products: Provide underlayments, additives and accessories from the same manufacturer.

.2 Installer Qualifications:

.1 Engage an experienced installer who has completed installations similar in material and extent to that indicated for this Project and with a record of successful in-service performance. Installer to have a minimum five years' experience.

.3 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

1.5 PRE-INSTALLATION CONFERENCE

.1 Convene minimum 2 weeks prior to commencing work of this section.

.2 Require attendance of installation material manufacturer and the installer and installers of related work. Review installation procedures and coordination required with related work.

.3 Meeting agenda includes but is not limited to:

.1 Materials compatibility.

.2 Surface Preparation.

.3 Installation procedure.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

.2 Protect setting materials from freezing or overheating in accordance with manufacturer's instructions.

.3 Store materials on elevated platforms, under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

.4 Do not use frozen materials

.5 Deliver and store materials on site at least 24 hours before work begins.

1.7 **ENVIRONMENTAL REQUIREMENTS**

.1 Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

.2 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

.3 Protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

PART - 2 PRODUCTS

2.1 **MANUFACTURERS**

.1 Basis-of Design Manufacturer: MAPEI, 95 Walker Drive, Brampton, Ontario, Canada. L6T 5K5, Tel: 905-799-6884, Toll Free: 1-800-668-1212, Fax: 905-799-9870

2.2 **PRIMERS**

.1 Epoxy Primer: ASTM C 881/C 881M, high-performance, two-component, high-modulus, 100 percent solids epoxy primer, low-odor, VOC compliant; requires sand broadcast.

.1 Product: MAPEI’s Planibond EBA, applied by brush, roller, broom, or trowel, with sand broadcast to the point of refusal.

2.3 **SELF-LEVELING UNDERLAYMENTS**

.1 High-Performance, polymer-modified, calcium-aluminate-based, lightweight, self-drying, self-leveling underlayment

.1 Final dry density of about 67 lbs. per cu. ft. (1 073 kg per m3) at 28 days.

.2 Compressive strength to ASTM C-109 Modified: > 3,000 psi (20.7 MPa)

.3 Product: MAPEI’s Ultraplan Lite.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Examine substrates for compliance with requirements for conditions affecting performance of the work.

3.2 **PREPARATION**

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

.3 Subfloor shall be structurally sound. Shot blast or scarify steel trowel concrete, concrete with sealer or curing compound, slick or smooth concrete. Clean subfloor to remove mud, oil, grease, old adhesives, and other contaminating factors before application of work.

.4 Mechanically profile concrete surfaces to an International Concrete Repair Institute (ICRI) concrete surface profile (CSP) of #3.

3.3 **INSTALLATION**

.1 Mix proportions and methods shall be in strict accordance with product manufacturer recommendations.

.2 Install products in accordance with manufacturer's printed instructions and technical data sheets.

.3 Prime subfloor in accordance with manufacturer’s recommendations where self-levelling underlayment is applied directly to the concrete.

.4 Spread and screed underlayment to a smooth surface. Except at authorized joints, place underlayment as continuously as possible, to the tolerances required by the Specialty Equipment Manufacturer.

.5 Install in proper relationship with adjacent construction.

3.4 **FIELD QUALITY CONTROL**

.1 Slump Test: Test underlayment as it is being pumped using a 50 mm x 100 mm (2” x 4”) cylinder resulting in a patty size of 225 mm (9”) plus or minus 25 mm (1”) diameter.

.2 Take at least one set of 3 molded cube samples from each day's application. Test cubes in accordance with modified ASTM C109 and provide the test results to the Consultant.

3.5 **PROTECTION**

.1 Floors: Protect from all traffic for at least 72 hours after installation.

.2 Do not step on floor for at least 24 hours; if traffic is unavoidable after that, use plywood stepping boards.

.3 Protect from heavy traffic for at least 7 days after installation.

END OF SECTION

PART - 1 +GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A307: Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

.2 ASTM A325M: High-Strength Bolts for Structural Steel Joints [Metric]

.3 ASTM A653/A653M: Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

.4 ASTM F436: Hardened Steel Washers (for Use with High Strength Bolts)

.2 Canadian Standards Association (CSA):

.1 CAN/CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.

.2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CSA-S16, Consolidation: Consists of the CSA standard CAN/CSA-S16, Limit States Design of Steel Structures along with S16S1-05, Supplement #1, Update #1 and Update #2.

.4 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.5 CSA W59, Welded Steel Construction (Metal Arc Welding).

.3 Canadian General Standards Board (CGSB):

.1 CGSB 1-GP-40D, Specification for Primer: Structural Steel, Oil Alkyd Type.

.2 CGSB 85-GP-16M: Painting Galvanized Steel

.3 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

.4 CAN/CGSB 1.183, Zinc-Rich Epoxy Coating.

.4 Metal Framing Manufacturers Association

.1 Metal Framing Standards Publication

.5 CISC: Canadian Institute of Steel Construction, "Code of Standard Practice"

.6 CISC/CPMA 2.75: Canadian Institute of Steel Construction/Canadian Paint Manufacturers Association “A Quick-Drying Primer for Use on Structural Steel”

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.4 **SUBMITTALS**

.1 Shop Drawings

.1 Submit shop drawings for each item showing:

.1 Product and material identification, thicknesses, gauges, finishes.

.2 Dimensions and jointing details.

.3 Cuts and drilled holes.

.4 Anchorage and securement systems.

.5 Interfaces with the work of other Sections.

.2 Where structural or miscellaneous metal shapes and sizes, including shapes and sizes of hangers, bracing and anchors, are indicated on Architectural drawings it is the responsibility of the Metal Fabrications Subcontractor's structural engineer to review these shapes and sizes and confirm that they are adequate to support the loads anticipated. Consult with the Consultant regarding loading allowed by building structure. Subcontractor's structural engineer shall stamp and sign each shop drawing ensuring that the assemblies are provided in accordance with the engineer's design.

.3 Provide Engineered Shop drawings for all equipment support members, bearing seal and signature of a licensed Ontario Professional Structural Engineer responsible for their design.

.4 Clearly show and describe all items; sections, dimensions, erection details, anchors and fastenings, connection and jointing details.

.5 Clearly indicate any deviation from the specifications or drawings.

.2 Test Reports: Provide certified test reports showing compliance with specified performance characteristics and physical properties.

.3 Product Data: Submit manufacturer's printed product literature, specifications and data sheets.

.4 Samples: Duplicate samples of 300 mm square sheet, 300 mm long members of each finished architectural metal work. Show each combination of mechanical and chemical treatments to be used on alloy. Prepare samples on metal of same alloy and gauge to be used for work. Show typical welds, fasteners, screws, mitres, and anticipated joints for compatible finish.

1.5 **QUALITY ASSURANCE**

.1 Employ a professional structural engineer registered in the province of Place of the Work to review components and supporting systems for the Work of this Section requiring structural performance, to be responsible for determining sizes, joint spacing to allow thermal movement, and loading of components in accordance with applicable codes and regulations, and to consult with the Project structural Consultant regarding loading allowed by building structure.

.2 It is imperative that the Metal Fabrications Subcontractor's structural engineer review and coordinate shop drawings with respective Subcontractors specified to ensure proper interface of Work between both Subcontracts.

.3 Retain a firm certified in accordance with CSA W47.1 Division 1 or 2.1 to perform welding.

.4 For aluminum work retain a firm certified in accordance with CSA W47.2-M to perform welding.

.5 Employ welding operators licensed per CSA W47.1 for types of welding required by the Work.

1.6 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Coordinate deliveries to comply with construction schedule and arrange ahead for strategic off-the-ground, covered storage locations. Do not load areas beyond the designed limits.

.2 Handle and store metal materials at job site in a manner to prevent damage to other materials, to existing buildings or property.

.3 Handle components with care, and provide protection for surfaces against marring or other damage. Ship and store members with cardboard or other resilient spacers between surfaces. Use lifting chokers of material which will not damage surface of steel members.

.4 Use strippable coatings or wrappings to protect exposed surfaces of prefinished metal work which does not receive site finishing. Use materials recommended by finishers or manufacturers of metals, to ensure that method is sufficiently protective, easily removed, and harmless to the finish.

.5 Prevent the formation of wet storage stain on galvanized articles by complying with the following measures:

.1 Stack articles or bundle to allow air between the galvanized surfaces during transport from supplier. Load materials in such a manner that continuous drainage could occur.

.2 Raise articles from the ground and separate with strip spacers to provide free access of air to most parts of the surface. Incline in a manner which will allow continuous drainage. Do not lay galvanized steel on cinders, clinkers, wet soil or decaying vegetation.

.3 Handle galvanized articles in such a manner as to avoid any mechanical damage and to prevent distortion.

.6 Tag metal fabrications, including associated anchor bolts, sleeves, and bases, or otherwise mark for ease of identification at project site.

1.7 **COORDINATION**

.1 Supply to concrete, masonry and/or other Sections, materials requiring setting and/or building-in in concrete, masonry or other trades. This includes inserts, anchors, frames, sleeves, etc. Verify locations of said materials.

1.8 **PROJECT CONDITIONS**

.1 Field Measurements: Take measurements at the building to assure proper fitting, fabrication, and erection of the work. Check dimensions in the field, whether or not shown, upon which the accurate fitting together and building-in of the metal fabrication work may depend or which affects the proper installation of the work of others.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Metals - General: free from defects which impair strength or durability, or which are visible; new, of best quality and free from rust, waves or buckles, and clean, straight throughout entire length, of sharply defined profiles and true in web and flange.

.2 Steel - General:

.1 Structural Shapes, Plates: New material conforming to CSA-G40.20/G40.21-M, Grade 350W for W and H shapes, and Grade 300W for other shapes, and plates.

.2 Hollow Structural Sections: New material conforming to CSA-G40.20/G40.21-M Grade 350W, Class H.

.3 Steel Pipe: Conforming to ASTM A53, Type "S", bare, Schedule 40, Grade A steel pipe.

.3 Stainless Steel - General

.1 Stainless Steel Shapes: to ASTM A276, Type 304 for interior use; to AISI No. 4 (2B) finish.

.2 Stainless Steel Plate: to ASTM A167, Type 304 for interior use; to AISI No. 4 (2B) finish.

.3 Stainless Steel Sheet: to ASTM A167, Type 304 for interior use; to AISI No. 4 (2B) finish.

.4 Stainless steel pipe and pipe handrails: Sizes as shown on drawings, conforming to ASTM A269, Type 304, in X-L Blend 'S' finish by Excelsior Steel Processing Ltd., or acceptable equivalent.

.5 Stainless Steel Fasteners: Type 304 or Type 316 to suit.

.4 Aluminum - General

.1 Aluminum: Aluminum Association alloy AA-6063T5 for mill finish extruded sections and AA-1100 for mill finish sheet.

.2 Aluminum Rolled or Extruded Shapes: Structural quality to ASTM B308/B308M, Alloy 6061-T6.

.3 Aluminum Bar, Rod, Wire: to ASTM B221M.

.4 Aluminum Sheet or Plate: to ASTM B209M.

.5 Aluminum Checkered Plate: to ASTM B209M, Alloy 5086.

.6 Aluminum Drawn Tubes: to ASTM B210M.

.7 Aluminum Pipe: to ASTM B241/B241M, Schedule 40, 6061 alloy.

.5 Galvanizing, steel shapes: CSA G164 Table 1, hot dip galvanized and passivated after fabrication of individual components.

.6 Galvanzing, sheet steel: commercial quality to ASTM A653/A653M, Grade A, with zinc coating designation Z275, minimized spangle, in accordance with CSSBI Technical Bulletin No. 6. Galvanized sheets temper rolled and unpassivated zinc coating where required to receive paint or other applied finish.

.7 Welding Materials: Conforming to CSA W48.1-M and CSA W59-M.

.8 High Strength Bolts with Bolts, Nuts and Washers (for structural connections): Conforming to ASTM A325M with each type and size of bolt and nut sourced from same manufacture and of same lot. Use hot dipped galvanized where used in exterior connections or in unheated areas inside the building.

.1 Bolts: Heavy, hexagon head high strength structural bolts, of standard size, of lengths required for thickness of members joined and for type of connection.

.2 Nuts: Heavy hexagon semi-finished nuts.

.3 Washers: Flat and smooth hardened washers, quenched and tempered per ASTM F436.

.4 Stainless Steel Bolts: To suit applications and conforming to ASTM F738M.

.5 Stainless Steel Nuts: To suit applications and conforming to ASTM F836M.

.6 Lock Washers: Helical spring type steel “lock” washers to suit applications and conforms to Federal specification FF-W-84.

.7 Security Fasteners: Button head "Torx® Plus R" screw tamper resistant #10, 25 mm (1") long 2 per glass stop minimum stainless steel machine screws.

.9 Common or Ordinary Bolts and Anchor Bolts (for general applications): Unfinished bolts conforming with ASTM A307, Grade A, with hexagon heads and nuts where exposed in the finish work. Use hot dipped galvanized where used in exterior connections or in unheated areas inside the building.

.1 Common bolts: of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.

.2 Anchor bolts: of lengths noted, but projecting not less than 13 mm beyond nut unless otherwise noted.

.3 Washers: plain, unhardened, to ASTM F844.

.10 Drilled Inserts: Ramset "Mega" or Hilti "HSL" heavy-duty anchors installed in accordance with manufacturer's directions, to sizes shown. Load capacity when embedded in 25 MPa concrete shall not be less than:

Diameter	Pullout kN	Shear kN
8 mm	30.0	36.0
10 mm	43.6	57.2
12 mm	53.6	82.8
16 mm	83.6	149.6
20 mm	119.6	205.6

.11 Primer Paint: Solvent reducible alkyd, red oxide, in fast drying, lead and zinc-chromate free formulation conforming to CISC/CPMA 2.75. Use one brand of primer throughout the work.

.12 Galvanized Primer: Zinc rich conforming to CAN/CGSB-1.181 for new galvanized metal in compliance with CGSB 85-GP-16M. For galvanized fabrications touch-up to remain unpainted in finished work, use W.R. Meadows of Canada Ltd. "Galvafroid" or Kerry Industries "Z.R.C." or Niagara Paint Inc. "PL052898" zinc rich coating.

.13 Slotted Channel Framing: Cold-formed metal box channels (struts), complying with MFMA-4.

.1 Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with Z275 (G90) coating; minimum 2 mm (0.08”) nominal thickness.

.2 Size of Channels: As required.

.14 Anchor bolts: CAN/CSA-G40.21, Grade 260W, expansion type with expandable collar not requiring oversize holes, stainless steel for use with aluminum.

.15 Drilled concrete anchors: Kwik-Bolt by Hilti or Wedge Anchor by Ucan Fastening Products.

.16 Drilled masonry anchors: SVA Sleeve Anchor by Hilti or SLE Sleeve Anchor by Ucan Fastening Products.

.17 Wall brackets for pipe railings: primed for finish painting, Julius Blum cast steel Model 378 for use with painted handrails; Julius Blum stainless steel Model 275 for use with stainless steel handrails, or approved equivalent, complete with flanges tapped for bolting.

.18 Grout: V-3 Non-Metallic Grout by W.R. Meadows of Canada Ltd., or U. Set by U.S.E. Hickson Products Ltd.

.19 Grout for posts: Anchorite by C.C. Chemicals Limited or other epoxy grout of approved manufacturer.

2.2 **FABRICATION**

.1 Fabricate the work true to dimensions, square, plumb and level. Joints and intersecting members shall be accurately fitted with adequate fastenings.

.2 Finished work shall be free from distortion and defects detrimental to appearance and performance.

.3 Unless otherwise specified, noted or approved, all connections shall be welded.

.4 Where not possible connections shall be bolted or secured in an approved manner. Exposed fastenings shall be countersunk, bolts cut off flush with nuts and made as inconspicuous as possible. Exposed fastenings where approved shall be of the same material, colour and finishes as the base metal on which they occur.

.5 Shop and field connections shall comply with CSA S16.

.6 Connections to structural steel members shall be welded. No bolting or drilling of holes shall be done unless approved in writing by the Consultant.

.7 Fabricate items that are to be built into masonry or concrete and deliver to project site for setting; furnish items complete with bolts, anchors, clips, etc., ready to set. Furnish, completely install and connect other items. Erect items to proper lines and levels, plumb and true, and in correct relation to adjoining work. Secure parts in a rigid and substantial manner using concealed connections where practicable.

.8 Where necessary to secure work to the structure by means of expansion bolts, cinch anchors, and similar connections, lay out the work and install such connections, install the work and bolt up, unless otherwise noted.

.9 Provide bolts, shims, blocks, nuts, washers, wedging pieces, etc., required for complete installation, unless otherwise noted.

.10 Drill field holes for bolts or rivets. Do not burn holes.

.11 Furnish fitting-up bolts, drift pins, other tools and equipment and do necessary reaming of unfair holes found in field connections. New holes or enlargement of unfair holes by use of cutting torch is cause for rejection of the entire member. Replacement shall be made at Contractor's expense.

.12 Mill joints to a tight, hairline fit; cope or miter corners. Form joints exposed to weather to exclude water.

.13 Remove burrs from all exposed cut edges.

.14 Accurately cut, machine and fit joints so that finished work presents a neat appearance.

.15 Assemble members without twists or open joints.

.16 Drill properly sized holes for connecting the work of other trades where such can be determined prior to fabrication. Where possible, show such holes on shop drawings. Place holes so not to cause an appreciable reduction in strength of member.

.17 Metal members shall be isolated where necessary in an approved manner to prevent corrosion due to metal to metal contact, or contact between masonry and concrete and metal.

.18 Backpaint aluminum surfaces in contact with cement, concrete, masonry, plaster or dissimilar metals with heavy coat of zinc chromate or non-staining alkali resistant bitumious paint.

2.3 **WELDING**

.1 Execute welding to avoid damage or distortion to the Work. Should there be, in the opinion of Consultant or Inspection and Testing company, doubt as to adequacy of welds, such welds shall be tested for efficiency and any work not meeting specified Standards shall be removed and replaced with new work satisfactory to Consultant. Execute welding in accordance with the following standards:

.1 CSA W48: for Electrodes. If rods are used, only coated rods are allowed.

.2 CSA W59: for design of connections and workmanship.

.3 CAN/CSA-W117.2: for safety.

.2 Welding shall be done by a fabricator fully approved by the Canadian Welding Bureau under the requirements of CSA W47.1.

.3 Thoroughly clean welded joints and expose steel for a sufficient space to perform welding operations. Neatly finish welds. Where exposed to view and finish painted, apply weld continuously and grind to a uniformly smooth finish.

2.4 **PRIMING**

.1 Prime all steel, whether exposed in the finish work or not, except as indicated below:

.1 Do not prime stainless steel and non-ferrous metals.

.2 Do not paint surfaces embedded in concrete.

.3 Do not paint surfaces in friction connections.

.2 Clean but do not paint surfaces being welded in field.

.3 Clean steel to SSPC SP3 (SP6) and remove loose mill scale, weld flux and splatter.

.4 Shop prime with 1 coat of primer paint to dry film thickness of 0.025 mm . Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C (45°F). Paint items under cover and leave under cover until primer is dry. Follow paint manufacturer's recommendations regarding application methods, equipment, temperature, and humidity conditions.

.5 After installation make good primed coat.

2.5 **GALVANIZING**

.1 Unless otherwise specified galvanize ferrous metals including members exposed to exterior elements when in final location; members embedded on the exterior side of exterior walls; members built into roof construction; members imbedded in concrete; members specified in this Section or noted on Drawings.

.2 Hot-dip galvanize members in accordance with requirements of following ASTM standards with minimum coating weights or thicknesses as specified:

.1 Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123/A123M; average weight of zinc coating g/m^2 (oz/sq ft) of actual surface, for 4.8 mm (3/16") and less thickness members 460 g/m^2 (1.5 oz/sq ft), for 6 mm (1/4") and heavier members 705 g/m^2 (2.3 oz/sq ft).

.2 Iron and Steel Hardware: ASTM A153/A153M; minimum weight of zinc coating, in g/m^2 (oz/sq ft) of surface shall be in accordance with Table 1 of ASTM A153/A153M, for the various classes of materials used on the Project.

.3 Steel Sheet: ASTM A653/A653M; weight of zinc coating, per sq ft on both sides of sheet. Coating designation Z275 (G90), minimized spangle and chemically treated.

.3 Follow recommended precautions to avoid embrittlement of the base metal by overpickling, overheating or during galvanizing.

.4 Perform hot dip galvanizing after fabrication. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damaged galvanized surfaces with galvanize primer in accordance with manufacturer's printed directions.

.5 Pipe: Plug relief vents air tight. After galvanizing, remove plugs, ream holes to proper size and re-tap threads.

.6 Where the specification requires that material be zinc-coated it shall be zinc-coated after fabrication and in accordance with CGSB1-GP-181M (or) 1-GP-183M.

.7 Wet Storage Stain: Remove wet storage stain that may have developed in the coating before installation so that premature failure of the coating does not occur. Remove wet storage stain in accordance with galvanizer's recommendations.

.8 Repair of Galvanized Items: Repair coatings damaged by welding, cutting, or during handling, transport or erection using cold galvanizing compound specified, and as follows:

.1 Ensure surface is clean, dry, and free of oil, grease and corrosion.

.2 Power clean surface to near white metal condition, extending into undamaged galvanized coating.

.3 Apply touch up material to a dry film thickness of 0.203 mm minimum. If touched up work is to remain exposed in the finished work, apply a finish coat of aluminum paint to provide a colour blend with the surrounding galvanizing.

.4 Coating shall be continuous, adherent, as smooth and evenly distributed.

2.6 **FINISHES**

.1 Where stainless steel is specified in subsequent articles of this section it shall have an AISI No. 4 finish, unless another finish is specified in the particular article.

.2 Where aluminium is specified:

.1 Clear Anodized Finish: Ensure aluminum finish is clear anodized in accordance with Aluminum Association; www.aluminum.org .

.1 Finish Designation AA-M12C22A31, Class II, minimum 0.01 mm (0.4 mils) thick for interior exposure.

.2 Interior aluminum surfaces: One-coat system, factory applied by spray over properly cleaned and pre-treated aluminum substrate, pigmented organic coating meeting the physical test requirements of AAMA 2603.

.1 Acceptable Products: Duracron by PPG Canada Inc., Valspar Flurocryl, or equivalent.

.3 Powder Coating: to AAMA2605, pigmented, polyester based, thermosetting, powder coating. Provide coating system that complies with coating manufacturer's written instructions for pre-treatment, application, baking, and minimum dry film thickness.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Examine substrate surfaces to receive the work of this Section and ensure that work done as part of the work of other Sections is complete and that there are no conditions which will adversely affect the performance of this work.

.2 Verify the accuracy and alignment of structural framing to which work of this Section is connected.

.3 Do not proceed with work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of surfaces and conditions.

3.2 **ERECTION**

.1 Fit joints and intersecting members accurately. Make work in true planes with adequate fastenings. Build and erect work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.

.2 Fit door frames and jambs with temporary steel spreaders to prevent springing frames and jambs out of shape.

.3 Weld as specified herein.

.4 Take adequate care to prevent damage to any material such as weld burns, etc.

.5 Include all cutting and patching of walls where necessary. Obtain Contractor's approval of cut-outs in advance.

.6 Insulate where necessary to prevent electrolysis due to dissimilar metal to metal contact, or metal to masonry and concrete. Use bituminous paint, butyl tape, building paper or other approved means.

.7 Install materials in a good and workmanlike manner, cleaning and grinding all welding laitance and touching up primer where necessary.

3.3 **CONNECTIONS**

.1 Weld or high strength bolt main member connections. Use CISC double angle header connections wherever possible. High strength bolted connections shall be bearing type using 19mm dia. bolts conforming to ASTM A325M. Secondary members may be bolted with machine bolts.

.2 Perform high tensile bolted connections in accordance with CSA-S16.1. Accurately space holes of size 1.6 mm larger than the nominal diameter of the bolt. Install bearing type high tensile bolted connections unless shown otherwise on Drawings. Provide compressor or electrical equipment capable of supplying and maintaining required pressure at the wrench. Make connections without the use of erection bolts, some high tensile bolts will serve that purpose. Prevent nuts on bolts, except high tensile bolts, from becoming loose by burring bolt thread, by welding or by lock washers or lock nuts.

.3 Execute welding as specified under shop welding in Part 2 and as follows:

.1 Provide continuous welds on exterior work to provide proper weathering.

.2 Take necessary safety precautions in accordance with CSA Standards when welding is carried out in cold weather.

3.4 **FIELD TOUCH-UP**

.1 Paint bolt heads, washers, nuts, field welds and previously un-primed items. Touch up shop primer damaged during transit and installation with material to match shop primer or galvanize coating.

.2 Clean off dirt on installed miscellaneous metal surfaces.

3.5 **SCHEDULE OF METAL FABRICATION ITEMS**

.1 General

.1 Provide metal fabrication items specified herein and items not indicated to be supplied under other Sections.

.2 Refer to drawings for details of metal fabrication work and related items not specifically listed in this Section.

.3 Where work is required to be built into work of other Sections supply such members to respective Sections.

.4 Provide anchor bolts and expansion bolts or other means of anchorage required for building into floors, walls and ceilings, where it is necessary to secure metal and wood to concrete, masonry or steel work. Supply anchor bolts, nuts and similar hardware to the respective Sections for fastening.

.2 Stainless Steel Items

.1 Supply and install stainless steel items indicated on drawings, complete with fastenings and other incidentals required and as detailed.

.2 Stainless steel used in the Work shall be type as specified in each perspective Section, and shall be high quality and manufactured of non-rusting, virgin, and non-recycled materials.

.3 Use tools that are free of contaminants that will cause corrosion and rusting of stainless steel in the fabrication and finishing of stainless steel work.

.4 When requested by the Consultant, identify the names of the stainless steel manufacturers, fabricators and the finishing subcontractors.

.3 Steel Sections

.1 Supply and install steel sections which are:

.1 Not shown on structural drawings.

.2 Shown in outline, but not identified on structural drawings.

.3 Not noted on drawings to be supplied by another section.

.4 Not specified to be supplied under another section.

.2 Cutting of these steel sections in the field shall be done under this section and as directed. The cost of field cutting shall be borne by the trades requiring such cutting.

.3 Where sections are required to be built into masonry or concrete, supply such members to respective trades.

.4 Miscellaneous Steel Items: Supply and install the following items complete with fastenings and other incidentals required and as detailed.

.1 HSS Steel supports to counters.

.4 Brackets, Miscellaneous Steel

.1 Supply and install steel brackets and angles shown, detailed or required for completion of the project. Brackets shall be of sizes, shapes and at spacing shown.

.2 Drill for countersunk screws and anchor bolts.

.5 Concealed support elements and framing

.1 Construct concealed support elements and framing from rolled steel sections assembled by welding.

.2 Design work to withstand, within acceptable deflection limitations, their own weight, the weight of all items to be supported, loads imposed by the motion of supported

items, where applicable, and all live loads, static and dynamic which might be applied to the supported items in the course of their normal function.

.3 Provide accessories, inserts and fixings necessary for attachment of supports to building structure. Drill supports to receive attachment of supported items. Arrange supports to avoid conflicts with pipes, ducts, thermal and air/vapour barrier construction, framing provided under other Sections, and such that supports and their fixings are fully concealed from view within the finished work.

.4 Paint all supports unless galvanizing is specified.

.6 Slotted Channel Framing: Cold-formed metal box channels (struts), complying with MFMA-4.

.1 Material: Galvanized, commercial steel, with Z275 (G90) coating; minimum 1.6mm (0.064") nominal thickness.

.2 Size of Channels: as per Engineered Shop drawings, prepared by a licensed professional engineer, registered to practice in the Province of Ontario.

.7 Steel Frames for Miscellaneous Openings

.1 Connections: Connect built-up members of frames by means of plug welding. Miter or cope and join members with continuous welding beads.

.8 Anchors, Bolts and other Anchorages

.1 Provide all anchors, bolts and expansion bolts or other means of anchorage required for building into floors, walls and ceilings, where it is necessary to secure metal and wood to concrete, masonry or steel work, other than anchorages specified under other sections. Supply anchor bolts, nuts and similar hardware to the respective sections for fastenings.

3.6 **RECONSTRUCTION, ALTERATIONS AND MAKING GOOD**

.1 Perform all re-construction, alterations, fitting, patching and making good of the existing building and to join new work to existing.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 RELATED REQUIREMENTS

.1 Read and comply with Conditions of the Contract and Division 01 - General Requirements.

1.3 SUBMITTALS

.1 Product Data: Manufacturer’s specifications, data, and installation instructions for each manufactured product, hardware, and accessories.

.2 Shop Drawings:

.1 Show dimensioned plans and elevations joints, sections and connections to adjacent work;

.2 Show general arrangements, locations of service outlets; typical and special installation conditions; material being supplied and all connections, attachments, hardware, anchorage and sizes;

.3 Show locations and details of framing, blocking and furring and co-ordination for interface work at substrates: details and layout of cutouts for grommets, mechanical and electrical services;

.4 On countertop elevations show location of backing required for attachment within walls.

.3 Samples: Submit duplicate samples in each specified finish and material.

.1 Submit duplicate samples of solid surfacing for colour and finish selection.

.2 Cable grommets in colour selected by Consultant.

.4 Maintenance Instructions: Supply 3 copies of detailed instructions for maintaining, preserving and keeping work of this Section clean and give adequate warning of maintenance practices or materials detrimental to the factory work.

1.4 QUALITY ASSURANCE

.1 Applicators: Manufacturer’s certified and approved applicators for fabrication and installation.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Solid surfacing: Homogeneous filled acrylic sheets; not coated, laminated or of composite construction, superficial damage to a depth of 0.25 mm (0.01") shall be repairable by sanding and polishing, semi-gloss finish with a gloss rating of 25-50. Refer to Section 09 06 00, Finishes Schedule for manufacturer’s name, product and colours.

.2 Joint adhesive, solid surfacing: Manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints, with a chemical bond.

.3 Panel adhesive, solid surfacing: Manufacturer's standard neoprene-based panel adhesive.

.4 Sealant, solid surfacing: Manufacturer's standard mildew-resistant silicone sealant color formulated to match sheets.

.5 Fire retardant treated plywood: To ULC S102, flame spread, fuel contributed and smoke developed ratings of 25 or less, pressure treated.

.1 Products: FirePro FRTW by Osmose, or Dricon FRT by Arch Wood Products Inc., or other acceptable equivalents.

.6 Backing sheet (Melamine): NEMA LD-3, high pressure paper base laminates, minimum 1.2 mm thick, in colour to be selected by Consultant.

.7 Cable grommets: at computer terminals, minimum 65 mm dia., prefinished in colour selected by Consultant.

2.2 **FABRICATION – SOLID SURFACING**

.1 Shop fabricate work to greatest extent practical and to sizes and shapes indicated, in accordance with reviewed shop drawings and solid polymer manufacturer requirements.

.2 Form joints between work using manufacturer's joint adhesive. Make joints inconspicuous in appearance and without voids. Attach 50 mm wide reinforcing strip of solid polymer material under each joint or as recommended by the manufacturer.

.3 Cut holes and cutouts for items penetrating the work to templates. Reinforce holes and cutouts to manufacturer’s requirements.

.4 Provide edge details indicated. Rout and finish component edges to a smooth, uniform finish. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

PART - 3 EXECUTION

3.1 **INSTALLATION – SOLID SURFACING**

.1 Install work plumb and level, in accordance with reviewed shop drawings and product installation details.

.2 Adhere solid surfacing tops to support framing with panel adhesives or concealed fasteners. Install backing sheet to detail indicated on drawings.

.3 Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.

.4 Apply sealant at joints to adjacent construction, to requirements of Section 07 92 00.

.5 Keep components and hands clean during installation. Remove adhesives, sealants and other stains.

.6 Protect surfaces from damage until Substantial Performance. Replace damaged work that cannot be repaired to Consultant’s satisfaction.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section for fire stop systems intended to fill gaps between fire separations, between fire separations and other construction assemblies, or used in or around items which fully or partially penetrate a fire separation, to restrict the spread of fire and smoke, and to maintain the integrity of a fire separation.

.2 This Section includes firestopping work for entire Project including selection, installation and inspection of all required firestops and smoke seals.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

.2 ASTM E595, Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment.

.3 ASTM E2032, Standard Guide for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E119.

.4 ASTM E2174, Standard Practice for On-Site Inspection of Installed Fire Stops.

.5 ASTM E2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.2 Firestop Contractors International Association (FCIA)

.1 FCIA Firestop Manual of Practice, 6th Edition 2015.

.3 Factory Mutual Approvals (FM)

.1 FM 4991, Approval Standard for Firestop Contractors.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.5 International Accreditation Service (IAS)

.1 IAS AC291, Accreditation Criteria for Special Inspection Agencies.

.6 International Firestop Council (IFC)

.1 IFC Guidelines for Evaluating Engineering Judgments.

.2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems.

.3 IFC Handbook, Firestopping Inspection Manual.

.7 Intertek Testing Services/Warnock Hersey International Inc. (ITS/WH):

.1 Intertek Online Directory of Listed Products bearing the WH-ETL mark.

.8 Underwriters' Laboratories of Canada (UL Canada):

.1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S115, Standard Method of Fire Test of Firestop Systems.

1.3 **DEFINITIONS**

.1 Fire Blocking: materials, components or system installed in a concealed space in the building to restrict the spread of fire and smoke in that concealed space or from that concealed space to an adjacent space.

.2 Fire Stop: a material, component or system, and its means of support, used to protect gaps between fire separations, between fire separations and other construction assemblies, or used in openings where penetrating items wholly or partially penetrate fire separations, to restrict the spread of fire and smoke thus maintaining the fire-resistance continuity of a fire separation.

.3 Fire Stop System: the combination of specific materials and/or devices required with the penetrating item(s), the assembly and the opening to assemble the fire stop.

.4 Intumescent: materials that expand with heat to prevent fire spread through fire separations.

.5 Listed Fire Stop System: a specific field erected construction consisting of the assembly, fire stop materials, any penetrating items and their means of support which have met the requirements for an F, FT, FH, FTH and/or L rating when tested in a fire-resistance rated assembly in accordance with CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems.

.1 F-Rating: the amount of time a fire stop system can remain in place without the passage of flame through the opening or the occurrence of flaming on the unexposed face of the fire stop.

.2 FT-Rating: a fire stop system with an F-Rating for the required time period which can also resists the transmission of heat through the fire stop during the same period and limit the rise in temperature on the unexposed face and/or penetrating item of the fire stop.

.3 FH-Rating: a fire stop system with an F-Rating for the required time period which can also resists the force of a hose stream without developing openings for a prescribed period.

.4 FTH-Rating: a fire stop system with an FT-Rating for the required time period which also passed the hose stream test for a prescribed period.

.5 L-Rating: largest test sample leakage rate, determined in accordance with the optional air leakage test of CAN/ULC-S115.

.6 Multi-penetration: two or more service penetrations through an opening in the fire separation.

.7 Non-rated Fire Separation: fire separation acting as a barrier to the spread of smoke until a response is initiated such as the activation of a fire suppression system.

.8 Single-penetration: single service penetration through an opening in the fire separation.

.9 System Design Listing: document providing proof of testing with technical details, specifications and requirements that leads to the application of a specific listed fire stop system.

1.4 **PRE-INSTALLATION MEETINGS**

.1 Convene pre-installation meeting minimum two weeks prior to beginning work of this Section with Consultant, the Installer performing the work, manufacturer’s representative and Third-Party Inspection Firm to:

.1 Verify Project requirements.

.2 Review installation and substrate conditions.

.3 Coordinate with other building trades.

.4 Review system design listings, manufacturer's installation instructions and warranty requirements.

.5 Inspections and testing procedures

.2 Convene pre-installation meetings with other trades to review:

.1 Installation procedures and precautions.

.2 Location, scheduling and sequencing of other work around fire stops that can affect the outcome of the installation.

.3 Requirements for annular opening sizes.

.4 Requirements and preparations for wall/floor single and multi-penetrations.

.5 Requirements for construction and perimeter joints.

.3 Submit copies of applicable listed fire stop system details to each trade for opening preparation. Include installation details required for the listed system.

.4 Meeting minutes: Contractor to take minutes of pre-installation meetings and distribute to Consultant and each affected trades.

1.5 **SYSTEM DESCRIPTION**

.1 Work of this Section is inclusive of all firestopping specified herein and indicated on Drawings except for firestopping and smoke seal within mechanical assemblies (i.e. inside ducts, dampers, intumescent pipe sleeves) and electrical assemblies (i.e. inside bus ducts) shall be provided as part of work of the Mechanical and Electrical Divisions respectively. Firestopping and smoke seals around outside of such mechanical and electrical assemblies, where they penetrate fire rated separations, shall be part of work of this Section.

.2 Fire stopping materials and/or systems intended to act as firestop and smoke seal for any through-penetrating items, termination devices, receptacles or any cut-out openings or joints, including openings and spaces at perimeter edge conditions, with wall and floor assemblies having fire-resistance rating.

.3 Fire stop and seal (draft-tight) gaps, expansion joints and penetrations in fire separations and fire walls against passage of fire, smoke, gasses, fire fighter's hose stream and, where designated, passage of liquids. Smoke seal at angle support at fire dampers.

.4 Materials and systems capable of providing effective barrier against passage of fire, smoke, gasses, and where specifically indicated passage of liquids.

.5 Ensure firestopping system provides fire-resistance rating (flame and temperature) not less than fire resistance rating of surrounding floor, wall or assembly, in accordance with requirements of the Building Code.

.6 Firestop system rating: Comply with F, FH, FT, FTH or L ratings as required by authorities having jurisdiction.

.7 Firestopping seals except for wall joints in visible areas must be of easily identifiable colour, such as red or yellow to be clearly distinguished from other building materials.

.8 Supply asbestos-free and PCB-free materials and systems tested in accordance with CAN/ULC S115, be ULC listed, or be acceptable by authorities having jurisdiction.

.9 Ensure suitability of products for application and compatibility of materials with surfaces to which it will be applied.

.10 Site system assemblies shall be in accordance with ULC listed system design. If there are no listed systems available, submit an Engineering Judgment (EJ) in accordance with the requirements described in Article “Action and Informational Submittals”.

1.6 **ACTION AND INFORMATIONAL SUBMITTALS**

.1 Qualification Statement: Submit qualification statements and certificates demonstrating compliance with the qualification requirements of this Section, as described in Article “Quality Assurance”, within 10 working days after award of contract and before starting Work.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet prior to ordering materials. Submit data for materials and prefabricated devices, providing sufficient descriptions for identification on Site.

.2 Submit complete product data for each individual component and include the following information:

.1 Product name and product number.

.2 Product characteristics and performance criteria.

.3 Physical size, finish and limitations.

.4 Technical data on out-gassing, off-gassing and age testing.

.5 Curing time.

.6 Chemical compatibility to other construction materials.

.7 Shelf life.

.8 Life expectancy.

.9 Temperature range for installation.

.10 Humidity range for installation.

.11 Sound attenuation STC-Rating.

.3 Manufacture Product Certification:

.1 Submit certification by the manufacturer that products supplied comply with local regulations controlling use of Volatile Organic Compounds (VOC’s) and are non-toxic to building occupants.

.2 Submit test reports showing compliance to ASTM E595.

.4 For each individual component, Submit copies of WHMIS Safety Data Sheets (SDS).

.5 Submit a comprehensive list of all products and components included in submittal.

.3 Shop Drawings: Submit complete and detailed Shop Drawings for each condition encountered on Site. Indicate following:

.1 Submit shop drawings showing system design listings for Project including proposed materials, primers, reinforcement, anchorage, fastenings and method of installation.

.2 Construction details to accurately reflect actual job conditions for each product and assembly.

.3 Submit details for materials and prefabricated devices.

.4 Submit electronic copy of shop drawings and include:

.1 Title page, labelled “Fire and Smoke Stop System Listings”. Include project name, date and the names of the installation company and the manufacturer of proposed products.

.2 Table of Contents.

.3 List of each proposed listed fire stop system and corresponding service penetration type or joint type in a matrix spreadsheet schedule, indicating floor and wall system, including rating for each, size of opening, and adjacent materials.

.4 Indicate System Design Listings.

.5 In addition to ULC or Warnock Hersey listed assembly number, indicate the required temperature, hose stream and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primer, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.

.6 Designate on shop drawings both fixed and moving penetrants, relative positions, expansion and control joints in rated slabs and walls, firestopping details at receptacles and similar poke-through devices and surrounding permanent materials. Identify re-entry locations.

.7 Indicate location of penetrations.

.4 Samples:

.1 At the time of shop drawing submission, provide to Consultant duplicate samples of each type of label proposed for the identification of fire and smoke stop systems.

.2 Submit only as requested various types of firestopping and smoke seal material.

.5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, substrate preparation, installation sequence, and cleaning procedures.

.6 Engineering Judgments (EJ):

.1 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stop configuration, review systems from other manufacturers to obtain a listed fire stop system.

.2 Submit EJ from the system manufacturer if there are no listed systems available from other manufacturers.

.3 Prepare and submit an EJ in accordance with best practices established in the following documents:

.1 IFC Guidelines for Evaluating Engineering Judgments.

.2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems.

.4 For each EJ submitted, include:

.1 Project name, number and location.

.2 A description of the proposed system with detailed drawing.

.3 Installation instructions.

.4 Complete descriptions of critical elements for the fire stop configuration.

.5 Copies of all referenced system design listings on which the EJ is based on.

.6 EJ issuer's name and contact information.

.7 Date of issue of EJ with seal and signature of a registered Professional Engineer, licensed to practice in the Province of Ontario.

.8 Manufacturer letter stating their opinion, with supporting justification, that the EJ will perform as a fire stop system were it to be subjected to the appropriate standard fire test method for the required fire rating duration.

.5 Once the EJ has been reviewed by Consultant, submit the EJ to the authority having jurisdiction for final approval.

.6 Include the cost of EJ in the work of this Section.

.7 EJ shall be prepared only by fire stop manufacturer's qualified technical personnel or jointly with the manufacturer by a knowledgeable registered Professional Engineer, a Fire Protection Engineer or an independent testing agency that provides testing and listing services for fire stop systems similar to the EJ being contemplated.

.1 EJ must be stamped, signed and dated by a registered Professional Engineer, licensed to practice in the Province of Ontario.

.8 EJ shall be based upon interpolations of previously tested fire stop systems that are either sufficiently similar in nature or clearly bracket the conditions upon which the Engineering Judgment is to be given. Additional knowledge and technical interpretations based upon accepted engineering principles, fire science and fire testing guidelines (e.g.: ASTM E2032) may also be used as further support data.

.9 EJ shall be based upon knowledge of the elements of the construction to be protected and understanding of the probable behaviour of that construction and the recommended fire stop system protecting it were they to be subjected to the adequate standard fire test method for the required fire rating duration.

.10 EJ shall be limited to the specific conditions and configurations upon which EJ was rendered and should be based upon reasonable performance expectations for the recommended fire stop system under those conditions.

.11 EJ shall be accepted only for a single specific job and location and should not be transferred to any other job or location without thorough and appropriate review of all aspects of the next job or location's circumstances.

.7 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - Field Quality Control.

1.7 **CLOSEOUT SUBMITTALS**

.1 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual. Include:

.1 WHMIS Safety Data Sheets (SDS).

.2 Product data and manufacturer's installation and maintenance instructions for each product/system used on this project.

.3 Approved system design listings and Engineering Judgments.

.4 Matrix schedule listing all system design listings and Engineering Judgments with a description of their penetration or joint type.

.5 Certifications:

.1 Proof of training for each worker that performed installation on the Project.

.2 Proof of company as a FCIA - Member in Good Standing.

.3 Certification of company as a ULC Qualified or FM 4991 Approved Firestop Contractor, including the Designated Responsible Individual (DRI) certificate.

.4 Accreditation of third-party inspection firm.

.5 Submit manufacturer's certification that installed firestopping and smoke seal material comply with specified requirements.

.6 Manufacturer's field reports.

.7 Third-Party Inspection reports.

.8 Warranty information on fire stop installations.

.9 Life expectancy of each product installed as part of Project. For each system, list the installation date of products and the expected expiration date (month/year).

.2 Record Documentation:

.1 Maintain a daily log of all activities on site during the course of construction. Submit a copy of all daily logs after completion of fire stopping work.

.2 As-built Drawings:

.1 Submit marked-up set of drawings to provide referencing system identifying the location of each fire stop.

.2 Identify each penetration type fire stop with their penetration identification number.

.3 Provide detailed drawings of system design listings for each type of fire stop (i.e.: through-penetration, blank opening, construction joint, building perimeter).

.3 Fire Stop Schedules:

.1 Submit complete fire stop schedules for floors, walls and ceilings, and slab edge conditions.

.2 Indicate all penetration fire stops and joint fire stops through each reference wall, floor and ceiling in the schedules.

.3 Cross-reference fire stop schedules with as-built drawings and indicate design listing numbers associated to each penetration fire stop and joint fire stop.

1.8 **REGULATORY REQUIREMENTS**

.1 Firestop System installation must meet requirements of CAN/ULC-S115 tested assemblies that provide a fire rating equal to that of construction being penetrated.

.2 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction

1.9 **QUALITY ASSURANCE**

.1 Provide systems selection and analysis, installation and inspection of fire stop systems in accordance with the recommended practices detailed in the following guides:

.1 FCIA Firestop Manual of Practice (MOP).

.2 Installer Qualification Requirements:

.1 Installer specializing in selection and installation of fire stops, trained and approved by manufacturer of materials and systems being used.

.2 Installers shall have minimum 5 years' experience in installation of firestopping materials as systems for multiple trade projects. If requested, submit a list of five successfully completed projects of similar scale and type.

.3 Installer shall be a Company recognized as a Member in Good Standing with the Firestop Contractors International Association (FCIA). Submit written proof of current membership.

.4 Company shall have ULC accredited Designated Responsible Individual (DRI).

.1 Provide proof of the Company's DRI's ULC certificate with their bid.

.5 Certified Firestop Contractor: company certified with one of the following programs:

.1 ULC Qualified Firestop Contractor Program. Submit signed copy of ULC Qualified Firestop Contractor Program certificate.

.2 FM 4991 Approved Firestop Contractor. Submit signed copy of FM 4991 Approval certificate.

.6 Training:

.1 Workers engaged on the project, including project foreman, to have completed manufacturer's training on the products/systems installed as part of this Section.

.7 Third-Party Inspection Firm: IAS AC291 Accredited inspection agency with inspectors who have passed the ULC Firestop Exam or FM Firestop Exam.

.3 Manufacturer Site Visits: as part of Manufacturer's Services described in PART 3 - Field Quality Control, schedule site visits, to review Work, at stages listed below as a minimum. Confirm exact dates with Contractor.

.1 After delivery of products, and when preparatory work is complete, but before installation begins.

.2 At least one time during progress of Work.

.3 Upon completion of Work, after cleaning is carried out.

.4 Photography

.1 Provide digital photography of every fire separation penetration showing both the before and after installations. Picture must indicate day and time and be labelled to show exact location.

.2 Copies of digital photo records are to be submitted directly to the Owner at the completion of the installation in each building/ wing, with a copy to the Consultant.

1.10 **COORDINATION**

.1 Coordinate with trade work involved and advise dates where work will take place throughout various areas of Work.

1.11 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC/cUL or WH-ETL markings, manufacturing date, shelf life expiry date.

.3 Coordinate delivery of materials with scheduled installation dates to allow minimum storage time on site. Do not use damaged or expired materials.

.4 Storage and Protection:

.1 Store materials indoors for 24 hours minimum prior to use.

.2 Store indoors in clean, dry, well-ventilated area.

.3 Comply with recommended procedures, precautions and measures described in WHMIS Safety Data Sheets (SDS).

.5 Protect materials from damage and detrimental environmental conditions.

.6 Replace defective, expired or damaged materials with new as no extra cost to the Owner.

1.12 **ENVIRONMENTAL CONDITIONS**

.1 Install fire stops when ambient and substrate temperatures are within the limits prescribed by the manufacturer and when the substrate is dry and without risk of condensation.

.2 Maintain manufacturer's recommended ambient and substrate temperatures, and relative humidity for 48 hours before installation, during application and until application is fully cured.

.3 Ventilate fire stops in accordance with manufacturers' instructions by natural means or where this is inadequate using forced air circulation.

.4 Protect water-soluble material from wetting until fully cured.

1.13 **EXTENDED WARRANTY**

.1 Warrant work of this Section against defects and deficiencies for period of 5 years commencing at the date of Substantial Performance.

.1 Manufacturers shall warrant work of this section against defects and deficiencies in the product material. Promptly correct any defects or deficiencies, which become apparent within warranty period at no expense to the Owner.

.2 Contractor shall warrant workmanship on materials and installation. Promptly correct any defects or deficiencies which become apparent within warranty period at no expense to the Owner.

.2 Defects shall include but shall not be limited to cracking, breakdown of bond, failure to stay in place or bleeding.

PART - 2 PRODUCTS

2.1 **MANUFACTURERS**

.1 To maintain control and integrity of the firestop applications supply and install products from a single manufacturer, to the greatest extent possible, to perform all fire stopping work. Materials of different manufacturers will not be permitted without written authorization of Consultant.

.2 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stopping application, obtain authorization from Consultant to supply and install a listed system from an alternative manufacturer to avoid providing an Engineering Judgment.

.3 Acceptable Manufacturers – Standard of Acceptance:

.1 3M Fire Protection Products

.2 Hilti, Inc.

.3 Tremco

2.2 **DESIGN / PERFORMANCE CRITERIA**

.1 Fire stop and smoke stop systems and systems providing a barrier to smoke spread consisting of a material or combination of materials installed to maintain the integrity of the fire resistance rating of a fire separation in accordance with the requirements of the Ontario Building Code.

.2 Non-rated fire separations: provide L-Rated smoke protection firestop system for application on both sides of separation.

.3 Dynamic joints: where required, fire and smoke stop systems to be designed to accommodate a defined amount of movement to account for expansion or contraction in construction joints and mechanical piping, for movement in structural elements and to accommodate for movement and sound and vibration control in mechanical installations.

.4 Insulated pipes and ducts: listed fire stop system designed and tested with actual insulation materials penetrating the fire separation, as indicated on the system design listing.

.5 Use in wet areas: water based products are unacceptable in wet areas or areas that may be subject to occasional water exposure or flooding during and after construction.

.6 Architectural considerations: when exposed to view, fire stop system to consider architectural finish, potential traffic, and exposure to moisture and heat.

.7 Environment considerations: materials selected to consider the environment in which they will be used during and after curing as well as the intended use of space.

.1 Fire stop manufacturer to confirm compatibility of the proposed materials/products for the following cases:

.1 Spaces containing sensitive electronic equipment.

.2 Building perimeter firestop systems to be water-resistant.

2.3 **MATERIALS**

.1 Primer: As recommended by firestopping material manufacturer for specific substrate and use.

.2 Fire stop and smoke stop systems: in accordance with CAN/ULC-S115.

.1 Asbestos-free materials and systems capable of maintaining effective barrier against the passage of flame, smoke and water, and the transmission of heat in compliance with requirements of CAN/ULC-S115 and not to exceed opening sizes for which they are intended, as indicated on System Design Listing.

.2 Fire stop system rating: to match fire resistance rating of fire separation, in accordance with requirements of Ontario Building Code.

.3 Service penetration assemblies and fire stop components: certified by test laboratory to CAN/ULC-S115.

.3 Damming and backup materials, support and anchoring devices: Non-combustible, in accordance with tested assembly and as recommended by manufacturer. Combustible material for damming purpose may be permitted only if they are removed after permanent firestop materials are cured. Sheet steel covers over temporarily unused sleeves shall be minimum 0.8 mm thick galvanized steel sheet.

.4 Pipe and duct insulation and wrappings: Compatible with firestopping material; as recommended by manufacturer.

.5 Fire stopping and smoke seals at opening intended for ease of re-entry such as cable: Elastomeric seal. Do not use cementitious or rigid seal at such locations.

.6 Fire stopping and smoke seals at opening around penetrations for ductwork and other mechanical items requiring sound and vibration control: Elastomeric seal. Do not use cementitious or rigid seal at such locations.

.7 Firestop insulation: pre-formed, semi rigid, non-combustible mineral wool.

.8 Junction box / outlet sealing putty: intumescent putty, pre-formed in pads.

.9 Sealants: good adhesion without use of primer, high visibility safety colours.

.1 For vertical joints: non-sagging.

.2 For horizontal joints: single component, self-levelling.

.3 For building perimeter joints: to act as fire, smoke, gas, and water seal.

2.4 **FIRE STOP IDENTIFICATION**

.1 Identification labels and markings to be indelible for the expected service life of the installation.

.2 Fire Stopped Penetrations:

.1 Provide identification labels at each penetration.

.2 Identification labels: pressure-sensitive, self-adhesive, printed vinyl labels.

.3 Attach labels permanently to surfaces of penetrated construction on both sides of each firestopping system installation where labels will be visible to anyone seeking to remove penetrating items or firestopping and smoke seal systems.

.4 Labels must be visible from 5'-0" above the floor.

.5 Label shall state that the fill material around the penetration is a fire stop system and it shall not be disturbed except by authorized personnel.

.6 Labels must show the following the words “Warning: through-penetration firestopping system, Do not disturb”

.7 In addition, include the following information on labels:

.1 Penetration number.

.2 Floor number.

.3 Room number.

.4 Product name and number.

.5 Manufacturer’s name.

.6 System Design number or Engineering Judgment (EJ) number.

.7 Fire Rating Required: in hours.

.8 Fire Stop Contractor’s Name and phone number.

.9 Installer’s Name, address and telephone number.

.10 Date of Installation.

.11 Designation of applicable testing and inspection agency

.12 Re-penetrated by: Company, Installer and Date.

.8 Label shall state that the fill material around the penetration is a fire stop system and it shall not be disturbed except by authorized personnel.

.3 Fire Separation (Barrier) Markings:

.1 Provide identification for all vertical fire separations.

.2 Identification markings: adhesive stickers with lettering at least 75 mm in height with a minimum 10 mm stroke in contrasting colour.

.3 Marking to incorporate the assembly's fire-resistance rating and the following suggested wording, "FIRE AND/OR SMOKE BARRIER – PROTECT ALL OPENINGS", or other accepted wording.

PART - 3 EXECUTION

3.1 PREPARATION

.1 Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and approved system design listings for each condition.

.2 Submit typical photographic sample in printed and digital format to Consultant for review.

.3 Prior commencement of the work of this Section take photographs in digital format showing the conditions before installation.

.4 Remove combustible material and loose material detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.

.5 Verify that the proposed fire stop system is composed of components that are compatible with each other, the substrates forming the openings, and the items, if any, penetrating the fire stop under conditions of application and service, as demonstrated by the fire stop manufacturer based on testing and field experience.

.6 Do not apply firestop material to surfaces previously painted or treated with sealer, curing compound, water repellent or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.7 Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.

.8 Comply with manufacturer's recommended requirements for temperature, relative humidity, moisture content and presence of any sealer or release agents on substrate during application and curing of materials. Surfaces shall be dry, dust and frost free.

.9 Fully protect walls, windows, floors and other surfaces around areas to be firestopped from marring or damage.

.10 Prime surfaces in accordance with manufacturer's directions. Mask where necessary to avoid spillage on to adjoining surfaces. Remove stains on adjacent surfaces as required.

.11 Remove insulation from area of insulated pipe and duct where such pipes or ducts penetrate fire separation unless ULC certified assembly permits such insulation to remain within assembly.

.12 Provide temporary forming, packing and bracing materials necessary to contain firestopping. Upon completion, remove forming and damming materials not required to remain as part of system.

.13 Install damming and firestopping materials as per manufacturer's instructions.

.14 Mix materials at correct temperature and in strict accordance with manufacturer's directions.

3.2 **INSTALLATION**

.1 Seal penetrations through and gaps in fire rated separations. Fill gap in accordance with ULC details for tested system selected.

.2 Coordinate with other sub-trades to ensure that all pipes, conduits, cables, and other items, which penetrate fire separations, have been permanently installed before installation of fire stop systems.

.3 Schedule work to ensure that fire separations and all other construction that conceals penetrations are not erected before installation of fire and smoke stop systems

.4 Apply firestopping materials in strict accordance with manufacturer's written instructions and tested designs to provide required temperature and flame rated seal. Apply with sufficient pressure to properly fill and seal openings to ensure continuity and integrity of fire separation. Tool or trowel exposed surfaces as required.

.5 Remove excess compound promptly as work progresses and upon completion.

.6 Examine sizes, anticipated movement and conditions of opening and penetration to establish correct system and depth of backup materials and of firestopping material required. Use firestopping and smoke seals best suited for specific application as required, indicated or specified. Use only components specified in fire test of system. Do not eliminate any component for firestop system that was present in fire tests.

.7 Do not cover materials until full cure has taken place.

.8 Do not use damaged or expired material.

.9 Joint Fire Stops:

.1 For sealant applications, install joint fillers to support fire stop materials during application. Position joint fillers to ensure fire stop material cross-sectional shape and thickness relative to the joint width allows for optimum sealant movement, while developing the required fire-resistance rating.

.2 Install fire stops using techniques recommended by the manufacturer:

.1 Fully wetting joint substrates to optimize adhesion.

.2 Completely filling recesses provided for each joint configuration.

.3 Providing uniform, cross-sectional shapes and thickness relative to joint width that optimize movement capability.

.4 Tooling non-sag fire stop materials immediately after their application and prior to the time skinning begins. Form smooth, uniform beads of configuration indicated or required to:

.3 Joint Systems and Perimeter Fire Containment Systems:

.1 For systems with dynamic joints, ensure movement capabilities of the installation meet or exceed the movement expectations of the system design listing and manufacturer’s installation instructions.

.10 Provide firestop systems at following locations, without being limited to:

.1 At openings, voids and penetrations through floor slabs.

.2 At openings, voids and penetrations through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.

.3 At openings, voids and penetrations installed for future use through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.

.4 Joints at top and bottom of fire-resistance rated walls where they meet non-rated fire separation assemblies.

.5 Intersection of fire-resistance rated masonry, concrete and gypsum board partitions.

.6 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.7 Openings and sleeves installed for future use through fire separations.

.8 Around mechanical and electrical assemblies/devices penetrating fire separations.

.9 Mechanical and electrical recessed boxes in walls and partitions.

.10 Between tops of fire rated walls and partitions and underside of floor or roof slabs.

.11 At all expansion joints in fire-rated walls, floors, ceilings and roof assemblies.

.12 At building perimeter for the space between a fire-resistance rated floor assembly and the curtain wall or other exterior wall assembly (e.g.: safing slot gaps).

.11 Refer to all other sections of Specifications and the Drawings to ascertain where firestops are to be used and, if noted, type of firestop required.

.12 Cure materials in accordance with manufacturer's directions.

3.3 **IDENTIFICATION**

.1 General:

.1 Clean substrate prior to applying identification.

.2 Final location of identification to be determined on site.

.2 Fire Stopped Penetrations:

.1 Install identification label adjacent to each wall/floor service penetrations fire stopped. Provide one identification label per single opening or per grouping cluster.

.2 Securely apply identification to substrate by providing adequate adhesive.

.3 Identification shall be completely filled out and installed prior to requesting Substantial Performance.

.3 Fire Separations (Barriers):

.1 Provide identification at least 4500 mm of the end of each wall and at intervals not exceeding 9000 mm along wall/floor joint fire stops.

.2 Markings to be installed within ceiling spaces, 600 mm below horizontal fire separation or roof structure unless otherwise indicated.

.3 For occupied areas with exposed ceilings: review location of identification with Consultant before proceeding.

3.4 **REPAIRS AND MODIFICATIONS**

.1 Identify damaged or re-entered seals requiring repair or modification.

.2 Remove loose or damaged materials. If penetrating items are to be added, remove sufficient material to insert new elements and to avoid damaging the balance of the seal.

.3 Ensure that surfaces to be sealed are clean and dry.

.4 Use only materials that are suitable for repair of original seal, as approved by manufacturer. Do not mix products from different manufacturers.

.5 Repair all damage resulting from fire stop destructive testing.

3.5 **FIELD QUALITY CONTROL**

.1 Photography:

.1 Upon completion, take photographs in digital format showing the completed installation. Submit Copies to Owner and Consultant.

.2 Inspections: notify Consultant when ready for inspection and prior to concealing or enclosing fire stop materials and service penetration assemblies.

.3 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits to review Work as directed in PART 1 - QUALITY ASSURANCE.

3.6 **INSPECTIONS**

.1 Third-Party Inspection Firm carried by the Contractor: Contractor shall hire and pay for the services of a third-party inspection firm to conduct random inspections and direct exploratory review (i.e.: destructive testing) during the course of construction and prior to closing off any concealed areas. Inspections and destructive testing shall be performed in compliance with ASTM E2174 and ASTM E2393.

.1 Include for a minimum of 2% for each area of 900 square meters for exploratory reviews for each approved system design listing and each trade involved. Perform cut tests at perimeter joints every 15 meters. Perform cut test at bottom and top of wall joints and wall to wall joints and building expansion joints every 15 meters.

.2 Perform exploratory review as directed by Third-Party Inspection Firm. Cut out fire stop and remove to ensure fire stop system installation meets or exceeds the system design listing as identified.

.3 After review is completed and acceptance is obtained, replace fire stop system with new materials. Cover costs of repairing fire separations after destructive tests are performed.

.2 Progressively, provide the Consultant with the Inspection Reports.

.3 Upon completion of construction and before requesting Substantial Performance review, Contractor and manufacturer’s representative shall inspect all fire stopping work and prepare a deficiency list. Submit deficiency list to Consultant for review. Repair any deficiencies and re-inspect work to ensure that all deficiencies have been completed.

.4 Submit formal request for Substantial Performance review of work once all work is completed, deficiencies repaired, quality control has been performed and all fire stop installations have been inspected and identified with the approved fire stop identification labels.

.5 Third-Party Inspection Firm shall conduct the Substantial Performance review in the presence of the Contractor, and provide final report.

.6 At the end of the work, include all reports in the Close-out Documents.

3.7 **CLEANING**

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application to satisfaction of Consultant. Remove and/or correct staining and discolouring of adjacent surfaces as directed.

.2 Remove temporary combustible damming materials after initial set of firestopping materials. Such dams may be required to remain in place if flame spread rating is below 25, in accordance with CAN/ULC-S102.

.3 Protect fire stops during and after curing period from contact with contaminating substances. Repair all damage.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section for joint sealants as indicated on drawings and as required, including but not limited to:

.1 Silicone joint sealants.

.2 Urethane joint sealants.

.3 Polysulfide joint sealants.

.4 Acrylic joint sealants.

.5 Preformed joint sealants.

.2 This Section specifies sealing work not specified in other Sections. Refer to other Sections for other sealants.

.2 Related Requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 REFERNCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C719, Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)

.2 ASTM C834, Standard Specification for Latex Sealants

.3 ASTM C920, Standard Specification for Elastomeric Joint Sealants

.4 ASTM C1248, Standard Test Method for Staining of Porous Substrate by Joint Sealants

.5 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

1.3 ACTION SUBMITTALS

.1 Product Data: Submit to Consultant Product information from sealant manufacturer prior to commencement of work of this Section verifying:

.1 Selected sealant materials are from those specified.

.2 Composition and physical characteristics.

.3 Surface preparation requirements.

.4 Priming and application procedures.

.5 Suitability of sealants for purposes intended and joint design.

.6 Test report on adhesion, compatibility and staining effect on samples of adjacent materials used on Project.

.7 Sealants compatibility and adhesion with other materials and Products with which they come in contact including but not limited to sealants provided under other Sections, insulation adhesives, bitumens, membranes, stone, concrete, masonry, metals and metal finishes, ceramic tile, plastic laminates and paints.

.8 Suitability of sealants for temperature and humidity conditions at time of application

.2 Samples: Submit duplicate samples of each type of material and colour. Submit samples of primer, bond breaker tape and joint backing material, if requested.

1.4 **INFORMATION SUBMITTALS**

.1 Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.5 **ADMINISTRATIVE REQUIREMENTS**

.1 Pre-installation meeting:

.1 Two (2) weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review with installer preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section.

.2 Establish a procedure to maintain optimum working conditions and to coordinate this work with related and adjacent work.

.3 Advise the Consultant of the date and time of the meeting.

1.6 **QUALITY ASSURANCE**

.1 Applicators: Recognized and established sealant applicators with at least five years experience and having skilled mechanics thoroughly trained and competent in the use of sealant equipment and the specified materials.

.2 Single source responsibility: Use sealants from single manufacturer for each different product required to ensure compatibility.

.3 Pre-installation compatibility and adhesion testing: Provide sealant manufacturer samples of actual materials that will contact or affect their sealants in the Work for compatibility and adhesion testing. This testing will not be required where sealant manufacturer is able to furnish data acceptable to Consultant based on previous testing for adhesion and compatibility to materials matching those of the Work.

.4 Pre-installation field adhesion testing:

.1 Conduct site field-tests for adhesion of sealants to actual joint substrates using proposed preparation methods and materials recommended by manufacturer.

.2 Conduct tests for each type of sealant and substrate.

.3 Locate field-test joints where inconspicuous or as directed by Consultant. Include areas typical of those requiring removal of existing sealants and utilize methods proposed for sealant removal.

.4 Test method: Use manufacturer's standard field adhesion test methods and methods proposed for joint preparation to verify proper priming and joint preparation techniques required to obtain optimum adhesion of joint sealants to joint substrate.

.5 Evaluate and report results of field adhesion testing.

.6 Do not use joint preparation methods or sealants that produce less than satisfactory adhesion to joint substrates during testing.

.5 Standard of acceptance: Retain at least one 1500 mm long acceptable joint for each type of sealant and substrate installed during pre-installation field adhesion testing as standard of acceptability for the Work. Acceptable joints may form part of the Work.

.6 Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture and water.

1.8 **PROJECT CONDITIONS**

.1 Do not proceed with installation of joint sealants under the following conditions:

.1 When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer, or are below 5 deg C (40 deg F).

.2 When joint substrates are wet.

.3 Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

.4 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART - 2 PRODUCTS

2.1 **MATERIALS - GENERAL**

.1 Provide interior joint sealants establishing and maintaining water tight, water resistant and air tight continuous joint seals without staining or deteriorating joint substrates.

.2 Ensure joint sealants comply with specified type, grade, class and uses.

.3 Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

.4 Provide Products with capability, when tested, for adhesion and cohesion under maximum cyclic movement in accordance with ASTM C719, to withstand required percentage change in joint width existing at time of installation and remain in compliance with other requirements of ASTM C920 for uses indicated.

.5 VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

.1 Architectural Sealants: 250 g/L.

.2 Sealant Primers for Nonporous Substrates: 250 g/L.

.3 Sealant Primers for Porous Substrates: 775 g/L.

.6 Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

.7 Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

.8 Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

.9 Sealants, cleaning solvents and primers: Compatible with each other.

.10 Colours of Exposed Joint Sealants: As selected by Consultant from manufacturer's full range. Allow for special colours as selected by the Consultant.

2.2 **JOINT SEALANTS**

.1 **Sealant Type 1**: Single-component, non-sag, polyurethane joint sealant meeting specified requirements of ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

.1 Dymonic by Tremco (Canada),

.2 SikaFlex 1a by Sika Canada Inc.

.3 Sonolastic NP1 by BASF Construction Chemicals, LLC-Building Systems.

.2 **Sealant Type 2**: Acrylic latex or siliconized acrylic latex joint sealant meeting specified requirements of ASTM C 834, Type OP, Grade NF.

.1 Tremflex 834 by Tremco Incorporated,

.2 Sonolac by BASF Construction Chemicals, LLC-Building Systems.

.3 **Sealant Type 3**: Mildew-resistant, single-component, acid-curing silicone joint sealant, meeting specified requirements of ASTM C 920, Type S, Grade NS, Class 25, for Use NT, G, A and O.

.1 Tremsil 200 by Tremco (Canada).

.2 Dow Corning 786 by Dow Corning Corporation.

.3 GE SCS1700 Sanitary by Momentive Performance Materials Inc.

.4 OmniPlus by BASF Construction Chemicals, LLC-Building Systems.

.4 **Sealant Type 4**: Self-levelling, multi-component, chemically curing polyurethane joint sealant, meeting specified requirements of ASTM C920, Type M, Grade P, Class 25, Use T, M, and O.

.1 THC-900 (for slopes less than 5%) or THC-901 (for slopes up to 10%) by Tremco (Canada).

.2 SikaFlex 2c SL by Sika Canada Inc.

.3 Sonolastic SL2 by BASF Construction Chemicals, LLC-Building Systems.

2.3 **MISCELLANEOUS MATERIALS**

.1 Joint primer: As recommended by sealant manufacturer for substrates, conditions and exposures indicated.

.2 Bond breaker: Polyethylene tape or other adhesive faced tape as recommended by sealant manufacturer to prevent sealant contact where it would be detrimental to sealant performance.

.3 Joint backer: Polyethylene foam rod or other compatible non-waxing, non-extruding, non-staining resilient material in dimension 25 percent to 50 percent wider than joint width as recommended by sealant manufacturer for conditions and exposures indicated. Ensure backing is compatible with sealant, primer and substrate.

.4 Masking tape: Non-staining, non-absorbent tape product compatible with sealants and adjacent joint surfaces that is suitable for masking.

.5 Cleaning Material: Non-corrosive, non-staining, solvent type, xylol, MEK, toluol, IPA or as recommended by sealant manufacturer and acceptable to material or finish manufacturers for surfaces adjacent to sealed areas free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants with joint substrates.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Prepare surfaces to receive work in accordance with sealant manufacturer's instructions and recommendations except where more stringent requirements are indicated.

.2 Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer whether primers are required or not.

.3 Remove all traces of previous sealant and joint backer by mechanical methods, such as by cutting, grinding and wire brushing, in manner not damaging to surrounding surfaces.

.4 Remove paints from joint surfaces except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.

.5 Remove wax, oil, grease, dirt film residues, temporary protective coatings and other residues by wiping with cleaner recommended for that purpose. Use clean, white, lint-free cloths and change cloths frequently.

.6 Remove dust by blowing clean with oil-free, compressed air.

.7 Joint backer: Provide joint backer uniformly to depth required for proper joint design using a blunt instrument. Fit securely by compressing backer material 25 percent to 50 percent so no displacement occurs during tooling. Avoid stretching or twisting joint backer.

.8 Bond breaker: Provide bond-breaker recommended by sealant manufacturer, adhering strictly to the manufacturer’s installation requirements.

.9 Priming: Prime joint substrates where required. Use and apply primer to sealant manufacturers recommendations. Confine primers to sealant bond surfaces; do not allow spillage or migration onto adjoining surfaces.

.10 Taping: Use masking tape, where required, to prevent sealant or primer contact with adjoining surfaces that would be permanently stained or otherwise damaged by such contact or the cleaning methods required for removal. Apply tape so as not to shift readily, and remove tape immediately after tooling without disturbing joint seal.

3.3 **INSTALLATION**

.1 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.2 Install sealants immediately after joint preparation.

.3 Mix, apply and cure sealants in accordance with manufacturer's printed instructions.

.4 Install sealants to fill joints completely, without voids or entrapped air, using proven techniques, proper nozzles and sufficient force that result in sealants directly contacting and fully wetting joint surfaces.

.5 Install sealants to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.

.6 Dry tool sealants in manner that forces sealant against back of joint, ensures firm, continuous full contact at joint interfaces and leaves a finish that is smooth, uniform and free of ridges, wrinkles, sags, air pockets and embedded impurities.

.1 Tooling liquids that are non-staining, non-damaging to adjacent surfaces and approved by sealant manufacturer may be used if necessary when care is taken to ensure that the liquid does not contact joint surfaces before the sealant.

.2 Provide concave tooled joints unless otherwise indicated to provide flush tooling or recessed tooling.

.3 Provide recessed tooled joints where the outer face of substrate is irregular.

.7 Remove sealant from adjacent surfaces in accordance with sealant and substrate manufacturer recommendations as work progresses.

.8 Do not cover up sealants until proper curing has taken place.

.9 Protect joint sealants from contact with contaminating substances and from damages. Cut out, remove and replace contaminated or damaged sealants immediately, so that they are without contamination or damage at time of Substantial Performance.

3.4 **LOCATION SCHEDULE**

.1 Refer to Drawings for sealing work not specifically listed in this Section.

.2 Use one of the sealants specified for each type in following locations. Ensure sealant chosen from several specified types listed under Part 2 Materials, and recommended by manufacturer for use for conditions encountered:

.3 Seal following joints with Sealant Type 3 mildew resistant silicone sealant:

.1 Typically used in joints between around washrooms accessories, at corners of walls, between splash backs and walls, in shower, damp or wet areas, at ceramic tiles where mildew resistant sealant is required.

.2 Underside of rims of sinks between sink rims and counters.

.3 Around pipes and conduits passing through walls and ceilings in washrooms. Conceal sealant with escutcheons.

.4 Joints between counters/vanities and walls in washrooms.

.5 Joints between water closets and walls in washrooms.

.6 Joints between wall mounted lavatories and walls in washrooms.

.4 Seal following joints with Sealant Type 2 acrylic sealant:

.1 Joints between interior metal and/or wood frames and adjacent construction in interior partitions.

.2 Joints between interior aluminum door, window and screen frames and adjacent construction in interior partitions.

.3 Interior joints to receive paint finish.

.5 Seal following joints with Sealant Type 1 one component modified polyurethane sealant:

.1 Interior gypsum board control joints.

.6 Seal following joints with Sealant Type 4 self-levelling sealants:

.1 Static joints in horizontal surfaces where self-levelling sealants are required.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes: Labour, Products, equipment and services necessary to complete the work of this Section, including but not limited to:

.1 Hollow metal doors, non-rated and fire rated types.

.2 Non-rated and fire rated steel frames.

.3 Interior glazed sidelight steel frames.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

.2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 Canadian Standards Association (CSA):

.1 CSA-W59: Welded Steel Construction (Metal Arc Welding).

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.40: Anti-corrosive Structural Steel Alkyd Primer.

.2 CAN/CGSB-82.5: Insulated Steel Doors.

.4 Underwriters' Laboratories of Canada (ULC):

.1 CAN4 S104M: Standard Method for Fire Tests of Door Assemblies

.2 CAN4 S105M: Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104

.3 CAN/ULC-S702: Standard for Thermal Insulation, Mineral Fibre, for Buildings.

.4 CAN/ULC-S704: Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

.5 Underwriters Laboratories of Canada, List of Equipment and Materials.

.5 DHI (Door Hardware Institute) - The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.

.1 ANSI/DHI A115.IG-1994: Installation Guide for Doors and Hardware.

.6 CSDFMA (Canadian Steel Door and Frame Manufacturers Association).

.7 NFPA 80 - Fire Doors, Fire Windows.

.8 NFPA 252 - Fire Tests for Door Assemblies.

.9 SDI-100 - Standard Steel Doors and Frames.

.10 NAAMM HMMA 802-07: Manufacturing of Hollow Metal Doors and Frames.

.11 NAAMM HMMA 840-07: Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

1.3 **REQUIREMENTS OF REGULATORY AGENCIES**

.1 Fire rated assemblies: Labelled and listed by a nationally recognized testing agency having factory inspection service in conformance with CAN4 S104M and CAN4 S105M for ratings indicated.

.2 Install fire rated assemblies to NFPA 80 except where specified otherwise.

1.4 **SUBMITTALS**

.1 Shop drawings: Indicate each type of door and frame, door and frame elevations, configurations, material, steel core thicknesses, mortises, reinforcements, anchor types and spacing, location of exposed fasteners, openings, arrangement of hardware, cut-outs for hardware, glazing, louvers, finishes, and fire rating.

.2 Product Data: manufacturer's standard data sheet illustrating standard door and frame construction.

.3 Samples: Submit samples indicating 1 cut-away corner sample and minimum 300 mm square for each type of door to indicated following:

.1 Core.

.2 Reinforcing.

.3 Facing.

.4 Frame.

.4 Submit a copy of NAMMA-HMMA 840 to the contractor responsible for the storage and installation of hollow metal doors and frames.

1.5 **QUALITY ASSURANCE**

.1 Qualifications: Provide evidence that the:

.1 Manufacturer has fabricated product of types under this Section, for projects of similar size and scope, for a continuous period of not less than five (5) years prior to award off Subcontract, has personnel and plant equipment capable of fabricating steel door and frame product of the types specified and has a written quality control system in place.

.2 Product supplier is a qualified direct distributor of the products to be furnished, and has in his regular employ, an AHC, CDC, or person of equivalent experience, available at reasonable times to consult with the Consultant, Subcontractor and/or Owner.

.3 Installer is a firm with five (5) years continuous experience prior to the award of Subcontract, in installing product covered by this Section and specification for the Door Hardware, and is knowledgeable of the manufacturers' and ANSI/NFPA 80 requirements relating to the installation of labelled fire rated products covered by this section and specification for the Door Hardware.

.2 Quality Criteria:

.1 All door and frame Products shall meet the performance requirements specified herein. Fabricate assemblies on strict accordance with approved submittal drawings.

.3 Conform to Canadian Steel Door and Frame Manufacturers Association standards.

.4 Welding: to CSA W59.

.5 Performance/Design Criteria:

.1 Ensure door and frame assembly meets acceptance criteria of ANSI A224.1 and is certified as Level “A” (1,000,000 cycles) and Twist Test Acceptance Criteria (deflection not to exceed 6 mm/13.6 kg (1/4"/30 lb) force, total deflection at 136 kg (300 lb) force not to exceed 64 mm (2-1/2") and permanent deflection not to exceed 3 mm (1/8")) when tested in accordance with ANSI A250.4. Ensure tests are conducted by an independent nationally recognized accredited laboratory.

.2 Test fire rated doors and frames assemblies in accordance with requirements of CAN4-S104-M and NFPA 252. Test borrowed lights and screens in accordance with CAN4-S106-M and NFPA 257. Ensure Products are listed by a nationally recognized testing agency acceptable to authorities having jurisdiction and having factory inspection services.

.3 Ensure core materials for exterior doors attains a minimum thermal resistance of RSI 1.06 (R6) when tested in accordance with ASTM C177 or ASTM C518.

.4 Provide thermally broken assemblies as indicated on Drawings and noted on Door Schedule tested in accordance with requirements of CAN/CGSB-82.5-M.

.5 Ensure Product quality meets standards set by CSDMA.

1.6 **DELIVERY, STORAGE, AND HANDLING**

.1 Brace and protect assemblies to prevent distortion during shipment. Store in a secure dry location.

.2 Store doors vertically, resting on planks, with blocking between to allow air to circulate.

1.7 **WARRANTY**

.1 Steel door and frame Products provided under this Section, touched up only with zinc-rich rust inhibitive primer where coating has been removed during its manufacture, shall be warranted by the manufacturer for a period of ten (10) years from the date of supply:

.1 Against rust perforation, when stored, installed and finish painted in accordance with manufacturer’s published instructions.

.2 For finish paint adhesion, when stored and cleaned in accordance with manufacturer’s application recommendation, and finish painted with commercial quality paint in accordance with Section 09 91 00 and to paint manufacturer’s application recommendations.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Sheet Steel: Commercial grade steel to ASTM A568/A568M, Class 1, hot-dip galvanized to ASTM A653/A653M, ZF120 (A40), known commercially as "Colourbond", "Satincoat", or "Galvanneal". Steel sheet thicknesses specified are base metal thicknesses prior to galvanizing.

.2 Exterior Hollow Metal Doors:

.1 Face Sheets: 1.519 mm thick (16 ga) minimum, commercial quality steel sheet faces, flush design, paintable galvanneal finish.

.2 Vertical Stiffeners: 0.912 mm thick (20 ga) minimum.

.3 Exterior Top Caps: minimum 0.912 mm thick (20 ga) steel.

.4 Core: rigid polyisocyanurate insulation of CAN/ULC-S704; closed cell board with a density of 32 kg/m^3 (2.0 pcf) and minimum R-value of RSI 1.9 (R11).

.3 Standard Duty Interior Hollow Metal Doors:

.1 1.2 mm thick (18 ga) minimum commercial quality steel sheet faces, flush design, paintable galvanneal finish.

.2 Vertical Stiffeners: 0.912 mm thick (20 ga) minimum steel sheet.

.3 Glazing Stops: 0.912 mm thick (20 ga) minimum steel sheet, formed, drilled and countersunk for fastenings.

.4 Standard Duty Interior Fire Rated Hollow Metal Doors:

.1 Face Sheets: 1.2 mm thick (18 ga) minimum steel sheet.

.2 Vertical Stiffeners: 0.912 mm thick (20 ga) minimum steel sheet.

.5 Core - Interior Doors:

.1 Steel Stiffened: vertically stiffened with 0.912 mm steel ribs at 152mm o.c. maximum, with all voids filled completely with semi-rigid mineral wool insulation. Fabricate door faces with a single sheet of steel welded to steel stiffeners.

.6 Exterior Hollow Metal Frames: Minimum 1.98 mm (0.078") 14 gauge thick steel, cold-rolled commercial quality steel; paintable galvanneal finish; sizes as indicated on Door Schedule and Drawings.

.7 Interior Hollow Metal Door Frames: 1.6mm thick, cold-rolled commercial quality steel; paintable galvanneal finish; sizes as indicated on Door Schedule and Drawings.

.8 Fire Rated Door and Frame Assemblies: Conform to CAN4-S104-M, CAN4-S105-M, NFPA 80 and NFPA 252.

2.2 **ACCESSORIES**

.1 Glazing Stops: rolled steel channel shape, 0.9 mm minimum thickness, butted corners; prepared for countersink style tamper-proof screws.

.2 Reinforcements: regular galvanneal steel, thicknesses as follows:

.1 Flush Bolt, Lock and Strike Reinforcement: minimum 1.6 mm (16 ga).

.2 Hinge Reinforcements: minimum 3.5 mm (10 ga).

.3 Door Closer and Holder Reinforcements: minimum 2.6 mm thick (12 ga) steel.

.4 Reinforcement for Surface Applied Hardware: minimum 1.2 mm thick (18 ga) steel.

.5 Concealed Door Closer or Holder Reinforcements: minimum 2.6 mm thick (12 ga) steel.

.6 Top and Bottom End Channels: minimum 1.2 mm thick (18 ga) steel.

.7 Jamb Spreaders: minimum 0.912 mm thick (20 ga) steel

.3 Anchors: regular galvanneal steel, as follow:

.1 T-Strap Type: 1.2 mm thick.

.2 Stirrup-strap Type: 50 x 250mm size, 1.6 mm thick.

.3 Jamb Floor Type: 1.6 mm thick.

.4 Stud Type: 1.0mm thick.

.4 Conduit and Fittings: 20 mm o.d. EMT conduit and fittings, as specified in Division 26.

.5 Bituminous Coating: fibrous asphalt emulsion.

.6 Mortar Guard Boxes: regular galvanneal steel, 0.8 mm thick.

.7 Joint Sealer: as specified in Section 07 90 00.

.8 Frame thermal break: Rigid PVC extrusion to CGSB 41-GP-19Ma.

.9 Fasteners for Stops: Cadmium plated steel, counter sunk flat or oval head sheet metal Phillips screws.

.10 Adhesives:

.1 Steel Components: Heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.2 Polyisocyanurate Cores: Heat resistant, epoxy resin based, low viscosity, contact cement.

.3 Lock-Seam Doors: Fire resistant, RRPC, fire resistant, high viscosity sealant/adhesive.

.11 Resilient bumpers: Round, black rubber, stud mount.

.12 Primer: Zinc rich primer.

2.3 **FABRICATION - GENERAL**

.1 Blank, reinforce, drill and tap doors and frames for mortised hardware. Reinforce doors and frames for surface mounted hardware.

.2 Apply, at factory, touch up primer to doors and frames manufactured from galvanized steel where coating has been removed during fabrication.

.3 Make provisions in doors and frames to suit requirements of Section providing security devices.

.4 Fabricate fire rated assemblies to ULC requirements and bearing ULC, ULI or Warnock-Hersey International Ltd., label, as acceptable to authorities having jurisdiction.

.5 Locate fire rating labels on the inside of the frame hinge jamb and door hinge edge midway between the top hinge and the head of the door.

2.4 **FABRICATION - DOORS**

.1 Fabricate doors to HMMA 802, and to the standards and specifications published by the Canadian Steel Door and Frame Manufacturer's Association.

.2 Provide continuous faces free from joints, tool markings and abrasions; with hardware reinforcement plates welded in place.

.3 Welding: to CSA W59. Grind exposed welds smooth and flush. Fill open joints, seams, and depressions with filler or by continuous brazing or welding. Grind and sand to a smooth, true, uniform finish.

.4 Fabricate fire-rated doors in accordance with Canadian Fire Labelling Guide for Steel Doors and Frames as published by the Canadian Steel Door and Frame Manufacturer's Association.

.5 Fabricate doors to accommodate scheduled glazing. Secure glazing stops to doors with counter sunk oval head sheet metal screws.

.6 Attach fire rated label to each fire rated door unit.

.7 Completely fill door cores with specified core materials.

.8 Preparation for hardware:

.1 Prepare doors for heavy weight oversize butt hinges, mortise locksets, rim and surface vertical rod exit devices, surface door closers and concealed overhead stops.

.2 Conform to approved finish hardware schedule.

.3 Blank, mortise, reinforce, and drill doors to receive template hardware, as required. Coordinate with Section 08 71 00.

.4 Reinforce and undersize doors for continuous hinges as per the manufacturers templates.

.5 Doors are to have wire channels (Conduit) for electronic hardware requiring power to go through the door (Electric Locks, Electric Panic Bars, Electric Strikes) from the power transfer location to the hardware item.

.9 Reinforce door edges with channel reinforcing.

.10 Door faces of all steel doors shall be fabricated without visible seams, free of scale, pitting, coil brakes, buckles and waves.

.11 Longitudinal edges of doors shall be mechanically interlocked and adhesive assisted.

.12 Tack weld and fill seam between faces and door edges of doors

.13 Bevel stiles minimum 3mm.

.14 Coordinate louvre openings with Division 23.

.15 Fabrication Tolerances:

.1 Fabricated door deformation (bow, cup, twist, warp) shall not exceed 3 mm when measured with a straight edge placed diagonally across door extending from top to bottom.

.2 Widths of door openings shall be measured from inside of frame jamb rebates with a tolerance of +1.5 mm, -1 mm.

.3 Unless builders' hardware requirements dictate otherwise, doors shall be sized so as to fit openings and allow a 3 mm clearance at jambs and head. Provide 19 mm clearance between bottom of door and finished floor (exclusive of floor coverings). Tolerances on door sizes shall be 1.2 mm.

.4 Provide doors with 1.5 mm clearance at heads and jambs, and no more than 3 mm door and threshold.

2.5 **FABRICATION - FRAMES**

.1 Fabricate frames as welded unit. Knock down frames will not be allowed.

.2 Conform to HMMA 802.

.3 Welding: to CSA W59. Grind exposed welds smooth and flush. Fill open joints, seams, and depressions with filler or by continuous brazing or welding. Grind and sand to a smooth, true, uniform finish.

.4 Mitre corners of frames. Cut frame mitres accurately and weld continuously on inside of frame.

.5 Protect strike and hinge reinforcements and other openings with mortar guard boxes welded to frame.

.6 Reinforce frames wider than 1.2 metres with roll formed steel channels fitted tightly into frame head, flush with top.

.7 Reinforce frames for continuous hinges

.8 Fit frames with channel or angle spreaders, minimum two per frame, to ensure proper frame alignment. Install stiffener plates to spreaders between frame trim where required to prevent bending of trim and to maintain alignment when setting and during construction.

.1 Channel or angle spreaders are to be removed prior to installation and are not to be used as part of the installation process.

.9 Attach fire rated label to each fire rated unit.

.10 Fabricate frames to accommodate scheduled glazing. Secure glazing stops to frames with counter sunk oval head sheet metal screws.

.11 Provide 3 bumpers on strike jamb for each single door.

.12 Fabricate thermally broken frames for exterior doors using steel core, separating exterior portion of frame from interior portion with polyvinyl chloride thermal breaks.

.13 Preparation for hardware:

.1 Prepare frames for heavy weight oversize butt hinges, mortise locksets, rim and surface vertical rod exit devices, surface door closers and concealed overhead stops.

.2 Conform to approved finish hardware schedule.

.3 Blank, mortise, reinforce, drill and tap frames to receive template hardware, as required. Coordinate with Hardware specification.

.14 Fabrication Tolerances:

.1 Widths of door openings shall be measured from inside of frame jamb rebates with a tolerance of +1.5 mm, -1 mm.

.2 Manufacturing tolerances on formed frame profiles shall be 1 mm for faces, stop heights and jamb depths. Tolerances for throat openings and door rebates shall be 1.5 mm and 0.5 mm respectively. Hardware cutout dimensions shall be as per template dimensions, +0.38 mm, -0.

PART - 3 EXECUTION

3.1 INSTALLATION - GENERAL

.1 Touch up with primer galvanized finish damaged during installation.

3.2 INSTALLATION - FRAMES

.1 Install frames plumb, square, aligned, without twist at correct elevation, to HMMA 840, ANSI/DHI A115.IG, Canadian Steel Door and Frame Manufacturers Association standards and manufacturer's instructions and templates.

.2 Provide suitable anchors to suit construction. Use one base anchor and two wall anchors per jamb side for frames up to 1500 mm and one additional wall anchor per jamb side for each additional height of 750 mm or fraction thereof.

.3 Secure anchorages and connections to adjacent construction.

.4 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Remove temporary spreaders after frames are built-in.

.5 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.6 Seal openings between frames and walls as specified in Section 07 92 00.

3.3 **INSTALLATION - DOORS**

.1 Install doors to HMMA 840, ANSI/DHI A115.IG, Canadian Steel Door and Frame Manufacturers Association standards and manufacturer's instructions and templates.

.2 Coordinate installation of finish hardware.

.3 Coordinate installation of glass and glazing.

.4 Install louvres.

.5 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:

.1 Hinge side: 3 mm.

.2 Latchside and head: 3 mm.

.3 Finished floor for non-rated assemblies: 12 mm.

.4 Finished floor for rated assemblies: 6 mm.

3.4 **ADJUSTING**

.1 Adjust door for smooth and balanced door movement.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 SUBMITTALS

.1 Shop Drawings:

.1 The hardware specialist shall prepare and submit shop drawings containing a completely itemized schedule of hardware for review. The schedule of hardware shall list all doors by number (in sequence) and location with complete details of the hardware to be supplied, including installation, location and mounting heights of each type of hardware, and special instructions. Format of schedule to be approved.

.2 The schedule of hardware shall incorporate the catalogue numbers of hardware as specified.

.3 The Contractor shall furnish copies of final reviewed shop drawings to the doors and frames fabricators and to the door and hardware installers.

.2 Product Data:

.1 Manufacturer's specifications and technical data including catalogue cut sheets on each item of hardware. Annotate manufacturer's model numbering systems to explain meaning.

.3 Wiring Diagrams: Include complete wiring diagrams indicating all component parts, disconnect switches, conduit, and voltage requirements provided under other Sections, and required to operate assembly.

.4 Samples: The hardware specialist shall submit complete samples of hardware items for review.

.5 Templates: The hardware specialist promptly furnishes templates and information necessary for proper preparation or doors and frames and for the installation of hardware to the doors and frames fabricator and to the doors and hardware installer, in ample time to facilitate the progress of the work.

.6 Furnish manufacturers' instructions for proper installation of each hardware component.

.7 Closeout Submittals:

.1 Warranty documents executed by manufacturer’s authorized official.

.2 Operation and Maintenance data: Prior to Date of Substantial Performance, hand over to the Owner, a manual containing a final "as built" hardware schedule, full instructions for the adjustment, maintenance, spare part list etc. of all hardware items, together with special keys, wrenches etc. required to carry out normal adjustments to hardware. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

.8 Certification: Prior to date of Substantial Performance, have the hardware specialist provide a letter which certifies that the hardware has been furnished and installed in accordance with hardware manufacturer’s instructions and in accordance with requirements of Contract Documents.

1.3 **QUALITY ASSURANCE**

.1 Conduct pre-installation meeting to verify project requirements, manufacture's installation instructions and manufacturer's warranty requirements.

.2 Have the supervision, administration and servicing of the work of this Section performed by a hardware specialist certified as an Architectural Hardware Consultant (AHC) or person of equivalent experience.

.3 Installer's Qualifications: Firm experienced in installation of systems similar in complexity to those required for this Project, plus the following.

.1 Not less than 3 years experience with systems.

.2 Successfully completed not less than 5 comparable scale projects using this system.

.4 Have the hardware installer fully cooperate with the hardware specialist to ensure doors and hardware are properly and securely installed and that the installed doors and hardware are functioning properly.

1.4 **INSPECTION AND SUPERVISION**

.1 The hardware specialist shall examine the Drawings, Hardware Schedules and shop drawings to determine final dimensions, sizes and quantity of the hardware items required, ensure that the hardware listed shall fit and operate properly and make adjustments to the hardware at no extra cost to the Owner.

.2 The hardware specialist shall obtain electrical characteristics of the security and fire alarm systems from the electrical Subcontractor and furnish electrically operated hardware which suits the electrical characteristics and wiring connection requirements at no extra cost to the Owner.

.3 The hardware specialist shall obtain and examine shop drawings for doors and frames to ensure proper provisions and preparations for hardware are made.

.4 The hardware specialist shall make periodic inspections of the hardware and door installations, report improper and unsatisfactory conditions and expedite the replacement or correction of faulty hardware.

.5 The hardware specialist and the door and hardware installer shall attend job site meetings when so requested.

1.5 **LABELLING, PACKAGING, DELIVERY AND STORAGE**

.1 Deliver and store each hardware item in the manufacturers' original containers. The containers shall be clearly labelled as to content and door on which the hardware is to be installed, in accordance with the shop drawing schedule of hardware.

.2 The hardware specialist shall be responsible for ensuring the timely delivery of hardware so that all on site work progresses without delay and interruptions.

.3 Store hardware in a locked storage room in the building. Lay out all hardware in an organized manner on shelves.

.4 Stockpile items sufficiently in advance to ensure their availability and make all necessary deliveries in a timely manner to ensure orderly progress of the total Work.

.5 Store items in such a manner to allow easy access to each hardware item/group as needed without significantly disrupting storage arrangement.

.6 Review shipments at time of arrival on the site to ensure agreement with respect to items shipped and received, quantity, back ordered or short-shipped items, and adherence to hardware schedule.

1.6 **PROJECT CONDITIONS**

.1 Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install product under environmental conditions outside manufacturer's absolute limits.

1.7 **EXTENDED WARRANTY**

.1 Fully warrant exit devices, locksets, latchsets and door closers for a period of five (5) years from the date of Substantial Performance of the Project.

.2 The warranty shall state expressly that all hardware will be replaced on the doors and frames at no cost to the Owner in the event of breakage or other defect occurring, willful damage excluded.

PART - 2 PRODUCTS

2.1 **HARDWARE SCHEDULE AND ALTERNATIVES**

.1 Door Hardware schedule is appended to this Section.

.2 While certain manufacturer's catalogue numbers are used in the schedule of finishing hardware, it is not the intent that these items are specified exclusively. The manufacturer's numbers are used to denote minimum quality, style, design function, finish. Specified items that must be supplied without substitution are electrical strikes, locksets and latchsets, automatic door operators, security contracts, and alarms.

.3 Other manufacturer's products may be used providing the items are equal in all respects to the items specified, except as noted above.

.4 If requested, the Hardware Contractor shall submit a complete physical sample of each hardware type for review prior to the preparation of shop drawings. All hardware delivered to the job sites shall be equal in all respects to the accepted sample.

.5 List all manufacturer's names and complete catalogue number of all alternative hardware types proposed for supply and submit this list for review before preparing shop drawings.

.6 The Consultant's decision on the quality of proposed alternative products shall be final.

.7 Any proposed item that in the opinion of the Consultant is not equal to the item specified will be rejected and the supplier shall be required to supply items equal to the one specified at no extra cost.

2.2 **MATERIALS**

.1 General:

.1 Hardware shall be as specified in the Door Hardware Schedule prepared under the direction of the Consultant and as specified in this Section.

.2 Installed hardware shall comply with applicable fire and building codes and requirements of local authorities having jurisdiction over doors and hardware.

.3 All hardware applied to metal doors and frames shall be made to template.

.4 Supply hardware complete with all necessary screws, bolts and other fastening of suitable size and type to anchor the hardware in position neatly and properly in accordance with the best practices and to the Consultant's approval.

.5 All fastenings shall harmonize with the hardware as to materials and finishes.

.6 Hardware for fire rated and labelled door and frame assemblies: ULC listed or as accepted by authorities having jurisdiction.

.7 Finish on all stainless steel items (C32D) shall be equal to No. 4 finish.

.2 Hinges:

.1 Hinges for exterior doors shall be non-ferrous metal parts so that rust will not bleed from the bearing or other parts. Screws shall be provided in stainless steel.

.2 Where specified, provide hinges with non-removable pins or with safety stud feature to prevent doors being removed from frames even if pins are removed.

.3 Stamp hinge catalogue numbers on face of leaf of each hinge at factory to enable easy recognition of hinge material and manufacture after doors are hung.

.4 Where doors are required to swing to 180 degrees, furnish hinges of sufficient throw to clear trim.

.5 Furnish non-removable pins at out-swinging exterior doors.

.6 Supply concealed wired electric hinges with ULC label. Hinges to have 8 wires.

.7 Supply continuous hinges as indicated in the Hardware Schedule.

.3 Locks and Latches:

.1 Provide and install all locks and latches exactly as specified, complete with cylinders.

.2 Strikes shall be ANSI standard size with curved lip strikes for latch bolts and no lip strikes for dead locks. Provide complete with wrought boxes finished to match strike.

.3 Electric locks: as indicated in the Hardware Schedule.

.4 Exit Devices:

.1 All exit devices installed on labelled fire doors shall bear the ULC Label.

.2 Through bolts complete with sleeves for mineral core doors.

.3 Coordinate exit devices with astragals, coordinators, carry open bars and thresholds for correct and safe operation.

.5 Keying:

.1 All locks and exit devices with cylinder operation shall be keyed alike for construction. Provide 4 change keys for each lock.

.2 Permanent keying by Owner at project completion.

.6 Closers:

.1 All door closers shall be hydraulically controlled and full rack and pinion in operation.

.2 Each closer shall have adjustable general speed, latch speed and back check control.

.3 The swing power of door closers shall be adjustable.

.4 Supply to the Owner special closer keys and wrenches as usually packed with closers.

.5 Install all necessary attaching brackets, mounting channels, cover plates, etc. where necessary for correct application of door closers.

.6 Closers to have parallel arms at out swinging exterior doors and at interior doors where specified.

.7 Coordinate closers with overhead holders.

.8 Through bolts complete with sleeves for mineral core doors.

.7 Thresholds:

.1 Provide and install thresholds exactly as specified in required widths and lengths to suit door openings.

.2 The ends of the thresholds shall be cut to follow exactly the door frame profile.

.3 All thresholds shall be supplied in aluminum and installed complete with lead shields and stainless steel screws.

.8 Push Plates and Kickplates

.1 Provide and install stainless steel plates in C32D finish and install secure with screw fastening.

.2 Length of kick plates shall be 40 mm less than door width for single doors and 19 mm less than door width for doors in pairs.

.3 All stainless steel plates are to be 1.3 mm thick, free of rough or sharp edges. Corners and edges to be slightly radiuses. Install kick plates and armor plates on both sides of the door with 3M tape.

.4 Engrave pushplates with pictographs as noted in hardware schedule.

.9 Door Push/Pulls:

.1 Where door pulls are scheduled on one side of door and push plates on other side issue installations instructions to ensure that the pull is secured through door from reverse side and countersunk flush with door installation of push plate. Locate push plate to cover fasteners for door pulls.

.10 Door Stops:

.1 Wall stops shall not be installed on drywall partitions.

.2 Floor stops shall be installed so as not to create a tripping hazard and allows maximum opening of doors.

.3 Furnish door stops of height to engage doors.

.11 Door Seals:

.1 Provide and install door seals, top door sweeps and astragals.

.12 Electronic Hardware Items:

.1 Ensure electrical characteristics are compatible with card readers and related security systems provided by other Sections.

.2 Obtain electrical power and wiring characteristics from the Electrical Subcontractor and provide the hardware to suit.

.3 Power Door Operators: Install operators by skilled trade persons who have been specifically trained in the installation and operation of these devices by a manufacturer's factory representative.

.4 All wiring shall be supplied and installed by Division 26 including conduit, boxes and other electrical appurtenances, including connection and termination.

.5 Be responsible for ensuring that all wiring work is performed at appropriate times to coordinate with installation of frames, doors and finish hardware. It is also responsible for ensuring that all electrical work is done in accordance with electronic hardware manufacturer's wiring diagrams and directions and that boxes, cut-outs, connections etc. are installed properly.

.6 Arrange for testing and commissioning of electronic finish hardware by manufacturer or system. Submit a copy of reports to Consultant.

.13 Miscellaneous Accessories:

.1 All other items, not specifically described in this Section or in the Hardware Schedule but required for complete and proper installation of finish hardware, shall be as selected by Hardware Supplier subject to approval of the Consultant.

.14 Hardware Finish Codes:

	BHMA	Canadian Code	US Code	Description
.1	600	CP	USP	Primed for Paint
.2	602	C2C	US2C	Cadmium Plated
.3	603	C2G	US2G	Zinc Plated
.4	605	C3	US3	Brightened Brass, Clear Coated
.5	606	C4	US4	Satin Brass, Clear Coated
.6	612	C10	US10B	Satin Bronze, Clear Coated
.7	613	C10B	US10B	Oxidized Satin Bronze Oil Rub
.8	619	C15	US15	Satin Nickel Plate, Clear Coat
.9	625	C26	US26	Bright Chromium Plated
.10	626	C26D	US26D	Satin Chromium Plated
.11	627	C27	US27	Satin Aluminum Clear Coated
.12	628	C28	US28	Satin Aluminum Clear Anodize
.13	629	C32	US32	Polished Stainless Steel
.14	630	C32D	US32D	Satin Stainless Steel
.15	671	AL		Black Anodized
.16	689	SBL, AL	US28	Aluminum Paint
.17	690	DBL, STAT	US20	Dark Bronze Paint
.18	691	ES, SB		Bronze Lacquer
.19	692	TAN		Tan Lacquer
.20	693	KPD, BLACK		Black Lacquer
.21	696	EAB, SB		Satin Brass Lacquer

.15 Keying symbol/codes:

.1	GMK	Grand Master Keyed
.2	MK	Master Keyed
.3	KA	Keyed Alike
.4	KD	Keyed Different
.5	SK	Separate Key (no masters)

.16 Hardware codes:

.1	LH	Left Hand

,2	RH	Right Hand
.3	LHR	Left Hand Reverse
.4	RHR	Right Hand Reverse
.5	LHA	Left Hand Active
.6	RHA	Right Hand Active
.7	LHRA	Left Hand Reverse Active
.8	RHRA	Right Hand Reverse Active
.9	SGL,SGLE	Single
.10	PR	Pair
.11	D/A	Double Acting
.12	O/S	Opposite Swing
.13	D/E	Double Egress
.14	DR	Door
.15	FR	Frame
.16	HM	Hollow Metal
.17	AL	Aluminum
.18	PS	Pressed Steel
.19	P/LAM	Plastic Laminate
.20	KAL	Kalamein
.21	HMD	Hollow Metal Door
.22	HMF	Hollow Metal Frame
.23	CIF	Channel Iron Frame
.24	PSF	Pressed Steel Frame
.25	WD	Wood
.26	WD/DR	Wood Door
.27	WD/FR	Wood Frame
.28	CYL	Cylinder
.29	H/O	Hold Open
.30	O/H	Overhead
.31	U/C	Undercut
.32	B/S	Back Set
.33	NRP	Not Removable Pin
.34	TB	Thru Bolts
.35	CTB	Countersunk Thru Bolts
.36	TMS	Template Machine Screws
.37	MS	Machine Screws

.38	STS	Self Tapping Screws
.39	WS/LS	Wood Screws & Lead Shields
.40	TRR	Labeled for Temperature Rise Rating.
.41	A Label, 3 Hour Label or 180MFR	Labeled for 180 minutes (3 hour) Fire Protection Rating.
.42	B Label, 1-1/2 Hour Label or 90 MFR	Labeled for 90 minutes (1-1/2hour) Fire Protection Rating.
.43	C Label, 3/4 Hour Label or 45 MFR	Labeled for 45 minutes (3/4 hour) Fire Protection Rating.
.44	20 MIN Label or 20 MFR	Labeled for 20 minutes Fire Protection Rating.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Examine doors, frames, related items and conditions under which work of this section is to be performed and identify conditions detrimental to proper and timely completion.

.1 Do not proceed until unsatisfactory conditions have been corrected.

.2 Confirm kickplate and threshold sizes before ordering.

3.2 INSTALLATION

.1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide to Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association, except as otherwise indicated in this Section and elsewhere in the Contract Document.

.2 Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

.3 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.4 Barrier Free Access: Mount all hardware in full conformity with authorities having jurisdiction. Confirm mounting heights with Consultant prior to commencement of frame and door preparation.

.5 Install all miscellaneous hardware as shown on details and specified.

.6 Do not use wall stops on gypsum board and moveable partitions.

.7 Mineral core doors: Pre-drill 3 mm diameter pilot holes for all hardware items. Manually turn fasteners into pilot holes. If installer does not follow this method, it may void door manufacturer warranty.

.8 Provide even margins between doors and jambs and doors and flooring and/or thresholds as follows:

.1 Hinge side: 1.6 mm.

.2 Latchside and head: 1.6 mm.

.3 Flooring and/or thresholds: 12 mm.

.4 Flooring, fire rated assemblies: 6 mm.

3.3 **HARDWARE MOUNTING HEIGHTS**

.1 Install and mount hardware as follows:

.1 Door knobs and lever: 965 mm centre line from finish floor

.2 Deadlock cylinder: 1370 mm centre line from finish floor

.3 Deadlatch cylinders: 1370 mm centre line from finish floor

.4 Door pulls: 1069 mm centre line from finish floor

.5 Push plates: 1090 mm centre line from finish floor

.6 Push bars: 1069 mm centre line from finish floor

.7 Top hinges: 125 mm down from top of door to top of hinge

.8 Bottom hinges: 250 mm up from finish floor to bottom of hinge

.9 Intermediate hinges: equally spaced between top and bottom hinges

.10 Floor stops: maximum 150 mm from lock edge when door is in fully open position

.11 Exit devices: to manufacturer's instructions

.12 Kickplates: maximum 3 mm from bottom of door to bottom of kickplate

3.4 **ADJUSTING AND CLEANING**

.1 Clean hardware with materials and methods as recommended by hardware manufacturer. Repair or replace defective hardware.

.2 Remove protective material where present.

.3 Adjust operable parts for correct function.

.4 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DOOR HARDWARE
08 71 10

PROJECT: Sunnybrook HEALTH SCIENCES CENTRE
2075 Bayview Ave
Toronto, Ontario, Canada

ARCHITECT: NORR
175 Bloor St. East. North Tower, 15th floor
Toronto, Ontario, Canada

Prepared By: Cameron Gibson
Date: February 24, 2020
Revised: March 27, 2020

Architectural Hardware Finishes

Steel	Stainless Steel	Brass/Bronze	Aluminum	Painted/Powder Coat	US/CAN#
Clear Anodized / Painted Aluminum					
			628	689	US28
Satin Nickel					
646		619	670		US15
Polished Nickel					
645		618	669		US14
Satin Stainless Steel					
	630				US32D
Polished Stainless Steel					
	629				US32
Satin Chrome					
652		626	702		US26D
Polished Chrome					
651		625	672		US26
Satin Brass					
633		606	667	678	US4
Polished Brass					
632		605	666	677	US5
Satin Bronze					
639		612	668	680	US10
Oil Rubbed Bronze					
640		613	703	695	US10B
Flat Black / Anodized Black					
631		622	671	693	US19

Door Types & Handing

Abbreviations

RH – Right Hand

LH – Left Hand

RHR – Right Hand Reverse

LHR – Left Hand Reverse

RHRA – Right Hand Reverse Active

LHRA – Left Hand Reverse Active

RHA – Right Hand Active

LHA – Left Hand Active

RHRA/LHRA – Right & Left Hand Reverse Active

RHA/LHA – Right & Left Hand Active

DA- Double Acting

DE – Double Egress

SS- Single Slider

BP – Bi-Parting Slider

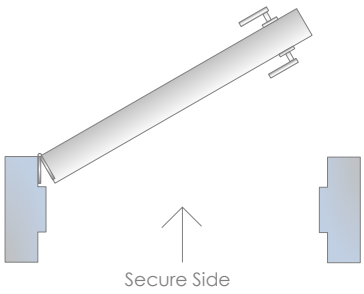
BP – Bi-Passing Slider

BF – Bi-Folding Slider

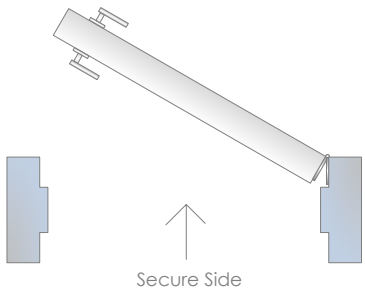
TS – Telescopic Slider

PKT – Pocket Slider

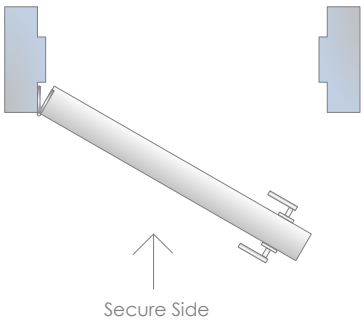
Note: The handing on a swing door is determined by placing yourself on the secure side or keyed side of the door.



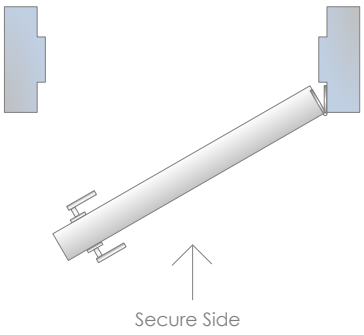
LH



RH

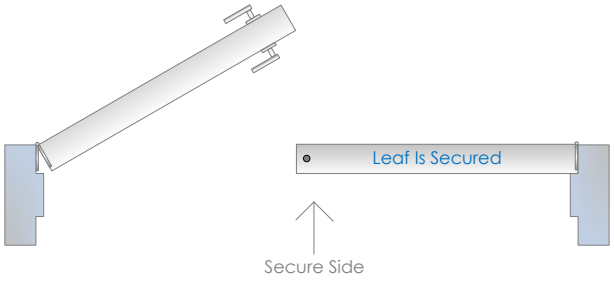


LHR

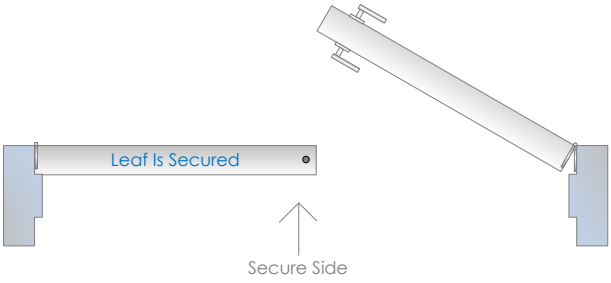


RHR

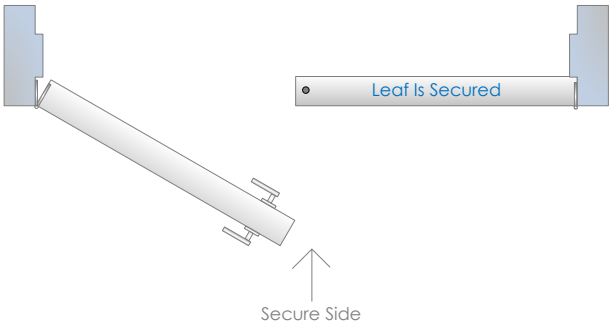
1



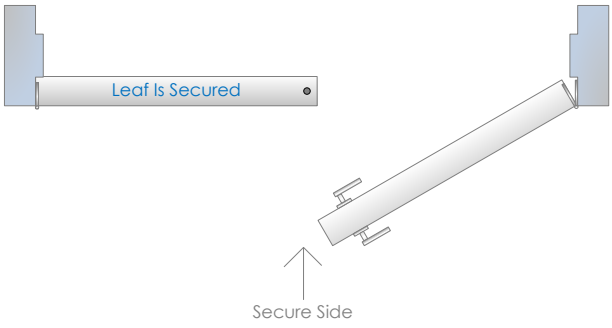
LHA



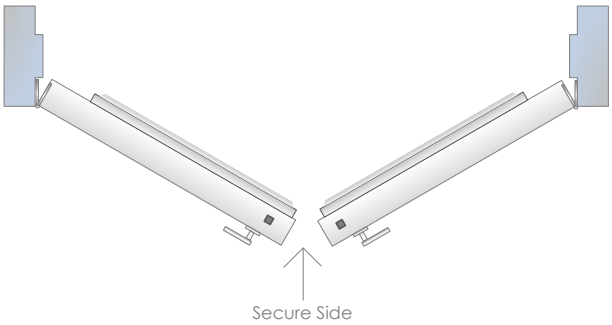
RHA



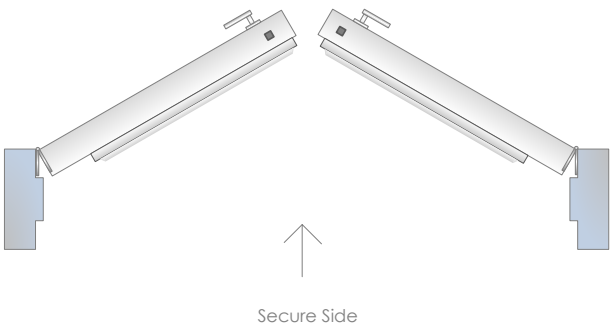
LHRA



RHRA



LHRA / RHRA



LHA / RHA

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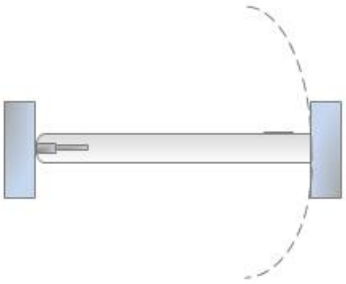
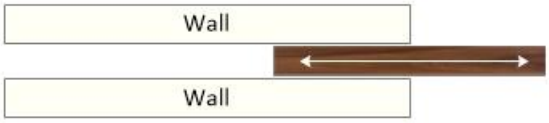


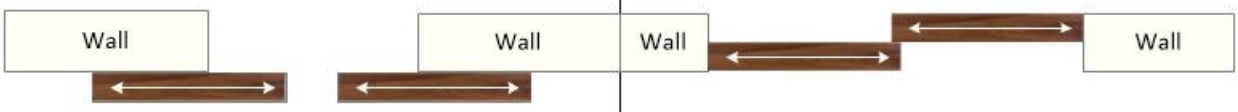
DA-DOUBLE ACTING

DE-DOUBLE EGRESS



PKT – POCKET SLIDER

SS – SINGLE SLIDER or BARN SLIDER



BP – BI-PARTING

BPS – BI-PASSING

3

Manufacturers Used In This Schedule

Click Link for manufacturers web info

SEL= Select
SCH = Schlage
LWR = Lawrence
IVS = Ives
VDP = Von Duprin
DORA = Dormakaba Automatics
LCN = LCN Closers
SEC = Securitron
CBH = Canadian Builders Hardware
KNC = KN Crowder
CAM = Camden Controls
OPT = Optex
GLJ = Glynn Johnson
ANM = Anemostat

Product Options:

Only substitutions listed below will be considered for this project. No Unsolicited substitutions will be considered.

Product Type	Manufacturer	Specified Model	Product Option 1	Product Option 2
Continuous Hinges	Select	SL-11		
Cylindrical Locksets	Schlage	ND Series		
Elec. Mortise Locks	Lawrence	LH-8000 Series		
Closers	LCN	4041XP Series		
Auto Operators	Dormakaba	ED100/250 Series		
Push to Exit Button	Camden	CM-9800-7		
Safety Sensors	Optex	OA-Edge-3		
Relay	Camden	CX-33		
Relay Board	Securitron	RB-4-24		
Power Transfer	Von Duprin	EPT-10		

Door Contacts	Securitron	DPS
Overhead Stops	Glynn Johnson	100 Series
Auto Flush Bolts	Ives	FB31P
Coordinators	Ives	COR Series
Dust Proof Strikes	Ives	DP2
Kickplates /Armour	CBH	CBH 903 Series
Frame Guards	CBH	CBH 460
Edge Guards	Anemostat	FMEA & LEG
Wall Stops	CBH	CBH 140
Smoke Seal	KNC	W-66
Auto Door Bottom	KNC	CT-54

Symbols

- Means the door has a fire rating and all associated hardware must have a fire label to suit.

- Door is automatic and is equipped with an auto operator. Door must meet local barrier free codes

- Door has an electrical requirement and requires power to be brought to the appropriate location above the door or to the latch, for either security or barrier free applications. Refer to security & electrical drawings for further information.

- Door requires security card access. Refer to security / electrical drawings for further information.

Other Abbreviations

HMD – Hollow Metal Door
IHMD – Insulated Hollow Metal Door
HMF – Hollow Metal Frame
ALD – Aluminum Door
ALF – Aluminum Frame
SCWD – Solid Core Wood Door
HCWD – Hollow Core Wood Door
WDF – Wood Frame
FGD – Frameless Glass Door

0 HR – Zero Hour Fire Rating / Smoke Barrier
20 Min – 20 Minute Fire Rating
¾ HR – 45 Minute Fire rating
1 ½ HR – 90 Minute Fire Rating
3 HR – 120 Minute Fire Rating

HARDWARE SCHEDULE

HEADING #1 

Opening Description: 2-915 x 2150 x 45 x HMD (Lead Lined) x HMF (Lead Lined)

1	Pair Doors 285.A	Corridor M2 291A to Hybrid Procedure Room M2 285	RHA/LHA	

By Hardware Supplier

1	Continuous Hinge	SL11-LL x 2108	628	SEL
1	Continuous Hinge	SL11-LL x 2108 x EPT	628	SEL
1	Power Transfer	EPT-10	689	VDP
1	Elec Mortise Lock	LH-8707 x LPM-180-ELRX x L812 x IC Mortise Housing x Lead Lined x 630		LWR
2	Door Contacts	DPS-M-B	BLK	SEC
1	Auto Flush Bolt Set	FB31P	626	IVS
1	Dust Proof Strike	DP2	626	IVS
1	Coordinator	COR52	628	IVS
1	Filler Bar	FL20	628	IVS
2	Overhead Stop	104S	630	GLJ
2	Armour Plate	CBH 903 – 889 x 851 (Push Side)	630	CBH
2	Armour Plate	CBH 903 – 889 x 864 (Pull Side)	630	CBH
4	Frame Guard	CBH 460 x 1220 Height (Width to Suit Jamb Depth)	630	CBH
2	Edge Guard Set	FMEA x 2150 x Lead Lined x Flush Bolt Prep	630	ANM
1	Smoke / Sound Seal	W-66 x 6130	BLK	KNC

By Sunnybrook

1	Permanent Cylinder	BEST Coremax SFIC by Sunnybrook	626	BST

By Automatics Supplier

1	Auto Operator (DBL)	ED-250-SA-NH-H-DBL-PULL-RH-CL-75"-RB-10	628	DORA
4	Safety Sensors	OA-Edge-3	BLK	OPT
1	Push to Exit Button	CM-9800-7	628/Red/White	CAM
1	Logic Relay	CX-33	N/A	CAM
1	Relay Board	RB-4-24	N/A	SEC
1	Power Supply Box	To House Relays	WHT	

By Security Supplier

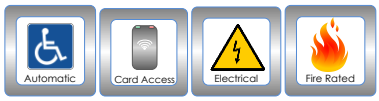
1	Card Reader	To Suit Building System	BLK	

1	Rex Sensor	Included in Lockset, Security to wire
1	Video Intercom	To Suit Building Systems

Order of Operations:
Entry: Entry to room after hours or when doors are closed via the card reader. Alternate entry by using the intercom system and the technician will release the doors. Technician/nurse to push the intercom button located at the desk to open and close the doors.
Exiting: Exiting the room is by either the technician/nurse pushing the button located at the desk or by pressing the push to exit button located on the wall.
When the machine is in operation the light outside will be lit and the automatics/intercom button and the push to exit button will cease to function. Mechanical egress is always possible.

Notes:

- 120VAC is required at the head of the door for all handicap door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations and quantity of wires with auto door operator supplier prior to pulling wires.

HEADING #2 

Opening Description: 1220 x 2150 x 45 x HMD (Lead Lined) x HMF (Lead Lined) x ¾ HR

1	Single Door #285.B	Sterile Core M2 215A to Hybrid Procedure Room M2 285	RH

By Hardware Supplier

1	Continuous Hinge	SL11-LL x 2108 x EPT	628	SEL
1	Power Transfer	EPT-10	689	VDP
1	Elec Mortise Lock	LH-8707 x LPM-180-ELRX x L812 x IC Mortise Housing x Lead Lined x 630		LWR
1	Door Contacts	DPS-M-B	BLK	SEC
1	Overhead Stop	106S	630	GLJ
2	Armour Plate	CBH 903 – 889 x 1156 (Push Side)	630	CBH
2	Armour Plate	CBH 903 – 889 x 1168 (Pull Side)	630	CBH
4	Frame Guard	CBH 460 x 1220 Height (Width to Suit Jamb Depth)	630	CBH
1	Edge Guard	LEG x 2150	630	ANM
1	Smoke / Sound Seal	W-66 x 5520	BLK	KNC
1	Auto Door Bottom	CT-54 x 1220	628	KNC

By Sunnybrook

1	Permanent Cylinder	BEST Coremax SFIC by Sunnybrook	626	BST

By Automatics Supplier

1	Auto Operator	ED-250-SA-NH-H-SGL-PULL-RH-CL-51"-RB-10	628	DORA
2	Safety Sensors	OA-Edge-3	BLK	OPT
1	Push to Exit Button	CM-9800-7	628/Red/White	CAM
1	Logic Relay	CX-33	N/A	CAM
1	Relay Board	RB-4-24	N/A	SEC
1	Power Supply Box	To House Relays	WHT	

By Security Supplier

1	Card Reader	To Suit Building System	BLK
1	Rex Sensor	Included in Lockset, Security to wire	
1	Video Intercom	To Suit Building Systems	

Order of Operations:
Entry: Entry to room after hours or when doors are closed via the card reader. Alternate entry by using the intercom system and the technician will release the doors. Technician/nurse to push the intercom button located at the desk to open and close the doors.
Exiting: Exiting the room is by either the technician/nurse pushing the button located at the desk or by pressing the push to exit button located on the wall.
When the machine is in operation the light outside will be lit and the automatics/intercom button and the push to exit button will cease to function. Mechanical egress is always possible.

Notes:

- 120VAC is required at the head of the door for all handicap door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations and quantity of wires with auto door operator supplier prior to pulling wires.

HEADING #3 

Opening Description: 1070 x 2150 x 45 x HMD x HMF x ¾ HR x STC 52

1	Single Door #283.A	Sterile Corridor M2 215A from Equipment Room M2 283	LHR

By Hardware Supplier

1	Continuous Hinge	SL11-LL x 2108	628	SEL
1	Storeroom Lockset	ND80BDC-SPA	626	SCH
1	Closers	4041XP-RW/PA	689	LCN

1	Overhead Stop	104S	630	GLJ
1	Kickplate	CBH 903 –203 x 1029	630	CBH
1	Sound Seals	BY STC Door Provider	BLK	KNC

By Sunnybrook

1	Permanent Cylinder	BEST Coremax SFIC by Sunnybrook	626	BST

HEADING #4

Opening Description: 915 x 2150 x 45 x HMD x HMF x STC 52

1	Single Door #E11.A	Mechanical Room M3301 from UPS Room M3 E11	LHR

By Hardware Supplier

1	Continuous Hinge	SL11-LL x 2108	628	SEL
1	Storeroom Lockset	ND80BDC-SPA	626	SCH
1	Closers	4041XP-RW/PA	689	LCN
1	Overhead Stop	104S	630	GLJ
1	Kickplate	CBH 903 –203 x 876	630	CBH
1	Sound Seals	BY STC Door Provider	BLK	KNC

By Sunnybrook

1	Permanent Cylinder	BEST Coremax SFIC by Sunnybrook	626	BST

END OF SCHEDULE

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes: Labour, Products, equipment and services necessary to complete the work of this Section for glazing and related accessories.

.1 This Section includes glazing work not specified in other Sections. Refer to other Sections for other glazing.

1.2 DEFINITIONS

.1 Glass: The term “glass” used throughout this specification section refers to the glass and glazing material types specified and scheduled.

1.3 SUBMITTALS

.1 Product Data: Submit manufacturer's product specifications. Include documentation of compliance with specified requirements, referenced tests, and compatibility of all products in contact with glazing.

.1 Provide Installer signed letter listing all products to be used, with signed letters from each glass, sealant, glazing tape, and blocking manufacturer certifying their compatibility.

.2 Provide a sample warranty and instructions for handling, storing, installing, cleaning and protecting each type of glass and glazing material.

.2 Shop drawings: Submit shop drawings indicating manufacturing and installation details.

.3 Samples:

.1 Submit samples for each type of glass and of glazing materials identifying quality and type of glass if required by the Consultant before commencing work.

.2 Ensure samples are clearly labelled with manufacturer's name and glass type.

.4 Operations and Maintenance Manual: Information on cleaning, maintenance and replacement of all types of glass or glazing products shall be included in the Operations and Maintenance Manual.

1.4 QUALITY ASSURANCE

.1 Installer Qualifications: Glazier shall have minimum five (5) years’ experience in the successful installation of glazing products similar to those specified for this Project.

.2 Glazing Installation Standard: Comply with recommendations of the GANA (Glass Association of North America), "Glazing Manual" and "Glazing Sealing Systems Manual" except where more stringent requirements are called for by manufacturers or these specifications. Refer to GANA for definitions of glass and glazing terms not otherwise defined.

.3 Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with OBC, ANSI Z97.1, and requirements of CPSC 16 CFR Part 1201 for category II materials.

.4 Fire rated glass: Each lite shall bear permanent, non-removable label certifying it for use in tested and rated fire protective assemblies, labeled and listed by UL, ULC or other testing and inspecting agency acceptable to authorities having jurisdiction.

.5 Single Source Responsibility: Provide materials obtained from one source for each type of glass and glazing product indicated, and for visually related areas.

.6 Pre-installation Conference: at least two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Consultant of the date and time of the meeting.

.7 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

1.5 **DELIVERY, STORAGE AND HANDLING**

.1 Handle and store materials and products in accordance with manufacturer's recommendations. Deliver and store packaged materials and products in original, undamaged containers with manufacturer's labels and seals intact.

1.6 **WARRANTY**

.1 Special product warranty for tempered glass products:

.1 Provide a written 5 year warranty from date of manufacture for fully tempered glass. Warrant that tempered glass will not break spontaneously as a result of Nickel Sulfide (NiS) inclusions for a period of five years from the date of manufacture. Warranty shall be manufacturer's standard form in which tempered-glass manufacturer agrees to replace tempered-glass units.

.2 Special product warranty for laminated glass products:

.1 Provide written 5 year warranty from date of manufacture for laminated glass. Warranty shall cover deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions. Warranty shall be manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 General: Each unit to bear manufacturer's label indicating quality and thickness.

.1 Thickness of glass: Glass thicknesses indicated or scheduled in the Contract Documents are minimums. Exact thickness of glass to be engineered to account for size of glass and application, to satisfy Building Code requirements and requirements of authorities having jurisdiction.

.2 Fire Protection Rated Glass

.1 GL-FR - Laminated ceramic glazing, non-wired, standard grade, clear glass:

.1 Fire-rated and impact safety-rated, clear laminated ceramic glazing material, and listed for use in doors, sidelites, transoms, and borrowed lites.

.2 Fire-ratings: as indicated or scheduled, from 20 minutes to 90 minutes, 3 hours in doors where applicable, with hose stream test.

.3 Impact Safety Resistance: ANSI Z97.1-2009 and CPSC 16 CFR 1201 (Cat. I and II).

.1 Acceptable Product: Schott 'Pyran Platinum L' or Technical Glass Products 'FireLite Plus'.

.3 Leaded Glass as specified in Section 13 49 00 Radiation Protection.

.4 Laminated Glass: GL-LD / GL-FR

.1 Fabricate laminated glass products free of foreign substances and air or glass pockets, in autoclave with heat plus pressure

.2 Laminate glass with interlayer to comply with interlayer manufacturer's written recommendations. Use materials that have a proven record of no tendency to bubble, discolour, or lose physical and mechanical properties after fabrication and installation

.3 Protect laminated glass interlayer from damage or discolouration resulting from contact with deleterious and incompatible sealants, substances, and materials. Comply with manufacturer's recommended installation instructions.

.4 Interlayer Type: Ionoplast interlayer, thickness 30 mil (0.76 mm), Product Trosifol® Structural Sentry Glass ionoplast, or approved equivalent.

.5 Film: frosted film, where indicated.

2.2 **GLAZING MATERIALS**

.1 General - Glazing materials: Select glazing sealants, tapes, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

.2 Shims, spacers and setting blocks: 45, 70 and 90 Durometer A hardness plus/minus 5 respectively, neoprene rubber, resistant to oxidation and permanent deformation under load.

.3 Glazing gaskets: Extruded neoprene or EPDM of approved profile. Tensile strength of 7300 kPa; Durometer A hardness of 50 plus/minus 5; 25% maximum permanent set; 300 % minimum elongation at break; and resistant to ozone, showing no cracks.

.4 All glazing materials, products, primers and cleaning solvents: Mutually compatible, types recommended by manufacturer of glass and gaskets.

.5 Colours for glazing materials: to match colour selected by Consultant.

.6 Film (FLM): Refer to Section 09 06 00, Finishes Schedule, for complete list of products, designations, and manufacturers.

2.3 **FABRICATION**

.1 Accurately size glass to fit openings allowing clearances recommended by the Flat Glass Marketing Association. Cut glass clean and free of nicks and damaged edges. Grind smooth and polish exposed glass edges. Do not cut or abrade tempered, heat treated, or coated glass.

.1 Take field measurements and levels required to verify and supplement those shown on the Drawings for the proper layout and installation of the work. Co-ordinate dimensional tolerances in adjacent building elements and confirm prior to commencement of work.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Verify dimensions at the site before proceeding with fabrication or glazing units.

.2 Ensure that openings are free from distortion, and that surfaces are free from protrusions that will obstruct face and edge clearances.

.3 Ensure that wood is sealed; ferrous metals are painted or zinc coated; and that surfaces are suitable for adhesion of the glazing materials.

.4 Ensure that movable units to be glazed are adjusted for proper operation.

.5 Ensure that surfaces to receive mirrors are sealed.

.6 Ensure that ambient and surface temperatures are above 5 degree C.

3.2 **PREPARATION**

.1 Inspect hollow metal and other glass framing for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners, existence of minimum required face or edge clearances, and effective sealing of joinery.

.2 Provide written report listing conditions detrimental to performance of glazing work.

.3 Do not perform glazing work prior to correction of unsatisfactory conditions. Commencement of installation indicates Installer's acceptance of substrate.

.4 Ensure rabbets, stops and glass edges are free of dust, dirt, moisture, oil and other foreign matter detrimental to, or, obstructing the glazing material.

.5 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's instructions. Ensure surfaces are free of moisture and frost.

.6 Clean glazing channels and other framing members to receive glass, immediately before glazing.

.1 Remove coatings which are not firmly bonded to substrates.

.2 Promptly complete glazing both sides of a lite once started, to prevent re-entry of dust and dirt in glazing channels.

.7 Clean surfaces thoroughly prior to installation of films. Prepare surfaces using the methods recommended by the film’s manufacturer for achieving the best result for the substrate under the project conditions

3.3 **INSTALLATION - GENERAL**

.1 Handle and install glass in accordance with manufacturer's directions. Prevent nicks, abrasions and other damage likely to develop stress on edges.

.2 Remove and replace glazing stops in original locations, using original fasteners, securely set and undamaged.

.3 Use setting blocks and spacers as required to properly support the glass, centred in place in the glazing space independent of the materials and to uniformly distribute its load.

.4 Use a minimum of 2 setting blocks, located at the quarter points. Locate spacers at jamb edges of glass, uniformly spaced at 600 mm o.c. maximum, and 300 mm maximum from top and bottom.

.5 Assess glass units for colour uniformity and arrange to avoid abrupt variation in appearance.

.6 Set glass properly centred with uniform bite and face and edge clearance, free from twist, warp or other distortion likely to develop stress.

.7 Leave non-permanent labels on glass until it has been set and inspected and approved. Leave glass whole and without cracks, scratches or other defects and with setting in perfect condition at completion, to the approval of the Consultant.

.8 Remove rejected, broken or damaged glass due to defective materials or improper setting and replace with perfect materials. Units producing distorted vision will be rejected and replaced at the reasonable discretion of the Consultant.

3.4 **INSTALLATION - INTERIOR GLAZING**

.1 Unless otherwise specified, all interior glazing shall be dry glazing.

.2 Provide glazing gasket around entire perimeter of glass. Make tight butt joint at corners of lights. Place setting blocks at sill and spacers at both jambs as required to centre the unit in the frame. Place the unit into the frames and apply the stops against the gaskets. Tighten the screws or clips to obtain positive uniform pressure avoiding excessive pressure.

.3 Ensure rattle-free cushioning.

.4 Install fire-rated glazing materials in accord with manufacturer's product data complying with specified fire testing standard. Use specified fire-rated glazing sealant for installation of fire tested glass materials.

.5 Install film by Authorized Dealer/Applicator trained by the manufacturer.

.1 Align and apply film using manufacturer's approved methods and tools to ensure quality installation.

.2 Apply film to glazing where indicated, free of wrinkles, air bubbles and other defects in strict accordance with manufacturer's written instructions.

.3 Refer to drawings for exact locations.

3.5 **POST INSTALLATION PROTECTION AND CLEANING**

.1 Protect glass from contact with contaminating substances resulting from construction operations or cleaning of adjacent materials.

.2 Remove and replace glass which is broken, chipped, cracked, abraded, scratched or damaged in other ways during the construction period, including natural causes, accidents and vandalism.

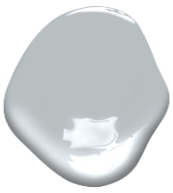
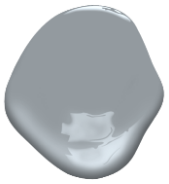
.3 Clean glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of Substantial Performance in each area of project. Clean glass by method recommended by glass manufacturer.

.4 Use necessary means to protect film before, during, and after installation.

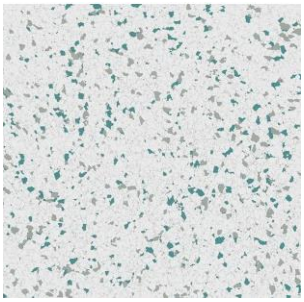
.5 Upon completion of the work, remove all debris, equipment and excess material resulting from the work of this Section from the site.

END OF SECTION

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	LOCATION	SAMPLE IMAGE
DIVISION 06 - WOOD, PLASTICS AND COMPOSITES				
SSF-1	Solid Polymer Surface	Manufacturer: Corian, Or Equivalent Product: Solid Polymer Surface Colour: Antarctica Size: ½" Thick	Control Room work surface	
DIVISION 09 - FINISHES				
PT-1	Paint	Manufacturer: Benjamin Moore, or Equivalent Colour: Chantilly Lace OC-65	Equipment and UPS Room Walls	
PT-2	Paint	Manufacturer: Benjamin Moore, or Equivalent Colour: Thundercloud Gray 2124-40	Doors	
PT-3	Paint	Manufacturer: Benjamin Moore, or Equivalent Colour: Sweatshirt Gray 2126-40	Frames	
PT-4	Epoxy Paint	Manufacturer: Benjamin Moore, or Equivalent Colour to match PT-1	Ceiling	

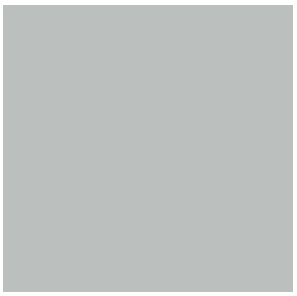
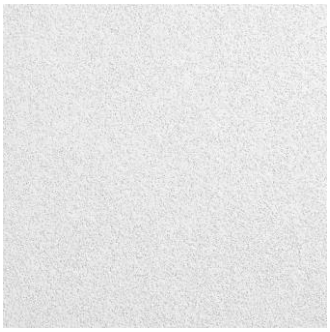
NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	LOCATION	SAMPLE IMAGE
DIVISION 09 - FINISHES				
SDT-1	Static Dissipative Tile	Manufacturer: Amtico Electrotile SDT by American Biltrite (Canada) Ltd Product: **SDT-183 (SDT-83-S11)** Colour: White/Green Size:36 x 36 x 1/8" (915x915x3.17	Equipment and UPS room flooring	
EP-1	Epoxy Flooring	Manufacturer: Sika or approved equivalent Product: Sikafloor 9200 w/Sikafloor Quartzite Trowel Aggregate Colour: To be selected Grout/Top Coat: Sikafloor 2002 Finish Coat: Sikafloor 7500 Top Coat for added abrasion and chemical resistance: 7500 Clear Gloss *Integral Flash Cove base 6"	Operating Room flooring - field, completed with integral cove base	NO IMAGE
EP-2	Epoxy Flooring	Manufacturer: Sika or approved equivalent Product: Sikafloor 9200 w/Sikafloor Quartzite Trowel Aggregate Colour: TBD Grout/Top Coat: Sikafloor 2002 Finish Coat: Sikafloor 7500 Top Coat for added abrasion and chemical resistance: 7500 Clear Gloss	Operating Room – pattern	NO IMAGE

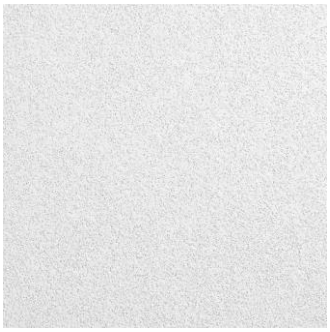
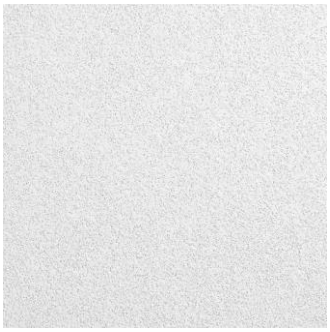
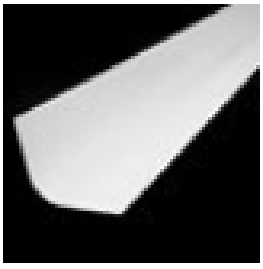
NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	LOCATION	SAMPLE IMAGE
DIVISION 09 - FINISHES				
EP-3	Epoxy Flooring	Manufacturer: Sika or approved equivalent Product: Sikafloor 9200 w/Sikafloor Quartzite Trowel Aggregate Colour: To Match Existing colour in Scrub Alcoves – field verified Grout/Top Coat: Sikafloor 2002 Finish Coat: Sikafloor 7500 Top Coat for added abrasion and chemical resistance: 7500 Clear Gloss	Scrub Alcove Flooring, completed with integral cove base	
		Manufacturer: Easycove Canada or equivalent Product: Cove Base Backing for epoxy flooring application – all locations Colour: N / A Height: 6”	All epoxy flooring locations, Backup for base at OR Corridor	
EP-B	Epoxy Cove Base	Manufacturer: Sika or approved equivalent Product: Sikafloor 9200 w/Sikafloor Quartzite Trowel Aggregate Colour: To match existing colour in Sterile Core – field verified Grout/Top Coat: Sikafloor 2002 Finish Coat: Sikafloor 7500 Top Coat for added abrasion and chemical resistance: 7500 Clear Gloss Heght: 150mm (6”)	Sterile Core	

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	LOCATION	SAMPLE IMAGE
DIVISION 09 - FINISHES				
RB-1	Resilient Base	Manufacturer: Johnsonite or approved equivalent Colour: 21 Platinum CG Style: Wall Finishing System Mandalay 6”H MW-XX-H6 Height: 150mm (6”)	Equipment and UPS Room room base	
RB-2	Resilient Base	Manufacturer: Johnsonite or approved equivalent Colour: to match existing adjacent Style: Laminated on Easycove Height: 150mm (6”)	OR Corridor	
ACT-1	Acoustic Ceiling Tile	Manufacturer: Armstrong, Product: Health Zone Ultima #1938, Mineral Fiber Core Size: 610mm x 1220mm Suspension: Standard 24 mm NRC: 0.70 Durability: Washable, Soil Resistant Surface: Fine Edge: Square Lay-In Colour: White	Replacement of tiles damaged during construction activities in Sterile Core	

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	LOCATION	SAMPLE IMAGE
DIVISION 09 - FINISHES				
ACT-1A	Acoustic Ceiling Tile	Manufacturer: Armstrong, Product: Health Zone Ultima #1938, Mineral Fiber Core Size: 610mm x 610mm Suspension: Standard 24 mm NRC: 0.70 Durability: Washable, Soil Resistant Surface: Fine Edge: Square Lay-In Colour: White	Replacement of tiles damaged during construction activities in green corridor	
ACT-2	Acoustic Ceiling Tile	Mars Clima plus Manufacturer: USG Product: Mars Clima plus Size: 610mm x 1220mm (2'x4') Suspension: Standard 24 mm NRC: 0.70 Durability: Soil Resistant Surface: Fine Edge: Square Lay-In Colour: White	Replacement of tiles damaged during construction activities in office areas M1	
DIVISION 10 - SPECIALTIES				
CG-1	Corner Guard	Manufacturer: Altro or equivalent Product: Altro Whiterock Hygenic Integral Bullnose Corners (thermally formed) Colour: Pearl – AW 41 – FT 2" diameter (90 deg)	Operating Room/ walls	

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	LOCATION	SAMPLE IMAGE
DIVISION 10 - SPECIALTIES				
CG-1A	Corner Guard	Manufacturer: Altro or equivalent Product: Altro Whiterock Hygenic Integral Bullnose Corners (thermally formed) Colour: Pearl – AW 41 – FT 2” diameter (135 deg)	Operating Room/ walls	NO IMAGE
CG-2	Corner Guard	Manufacturer: Construction Specialties Product: Corner Guard CO-8 (90 deg) Material: Type 304 Stainless Steel Finish: No. 4 Satin Finish Installation: Torque Pull Fasteners	OR Corridor, Sterilr Core	
CG-2A	Corner Guard	Manufacturer: Construction Specialties Product: Corner Guard (135 deg) Material: Type 304 Stainless Steel Finish: No. 4 Satin Finish Installation: Torque Pull Fasteners	OR Corridor, Sterilr Core	
PWC-1	Wall Protection	Manufacturer: Altro or equivalent Product: Altro Whiterock Hygenic Wall Cladding Colour: Pearl – AW 41 - FT	Operating Room walls, completed with thermoformed bullnose / rounded corners and hot welded seams	
PWC-2	Wall Protection	Manufacturer: Construction Specialties or equivalent Product: Acrovyn Wall Protection Colour: to match existing corridor wall protection Size: 2.5mm Thick	Corridor walls	

NOTE: The application / location for the materials indicated is not limited to the list below and is to be used in conjunction with and may be supplemented by, the Specifications, Schedules and Drawings. Refer to Specifications, Schedules and Drawings for full extent of material application and additional material types.

CODE	ITEM	DESCRIPTION	LOCATION	SAMPLE IMAGE

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes: Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 RELATED REQUIREMENTS

.1 Read and comply with Conditions of the Contract and Division 01 - General Requirements.

1.3 ACTION SUBMITTALS

.1 Product Data: Submit product data for each type of product.

.1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Fire-rated assembly listings:

.1 Submit fire-rated assembly listings for each required fire resistance rated assembly for work of this section.

.3 Samples: For the following products:

.1 Trim Accessories: Full size sample in 300 mm long length for each trim accessory indicated.

.4 Engineered Shop drawings:

.1 Submit engineered shop drawings and associated design calculations bearing the stamp and signature of the registered professional engineer, licensed to practice in the Province of Ontario, responsible for the design of this Section.

.2 Engineered submittals shall include associated design calculations and load diagrams, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal. Prepare calculations in a clear and comprehensive manner so that they can be properly reviewed.

.3 Submit Engineered Shop drawings including but not limited to the following elements:

.1 Interior metal support systems;

.2 Horizontal framing of ceilings and bulkheads;

.3 Shaftwalls systems;

.4 Walls acting as guards.

.5 Lead-lined Gypsum Board assemblies

.5 Shop Drawings for cove base/solid surface and wall base: Submit the shop drawings indicating the following:

.1 Special conditions affecting installation;

.2 Locations of transitions and intersections between different materials;

.3 Widths, details, and locations of joints in finished surfaces;

.4 Locations and configuration of inserts and edging details.

1.4 **ADMINISTRATIVE REQUIREMENTS**

.1 Pre-installation meeting:

.1 Two (2) weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section.

.2 Establish a procedure to maintain optimum working conditions and to coordinate this work with related and adjacent work.

.3 Review products, conditions, and other performance requirements.

.4 Advise the Consultant of the date and time of the meeting.

1.5 **QUALITY ASSURANCE**

.1 Installer Qualifications: Subcontractor executing the work of this section shall have a minimum of 10 years continuous experience in successful installation of work of type and quality indicated and specified.

.2 Install work level to tolerance of 3 mm in 3000 mm.

.3 Select studs with maximum deflection of L/360 at lateral force of 240 Pa for maximum heights indicated.

.4 Fire test response characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

.5 Sound transmission characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency.

1.6 **ENVIRONMENTAL REQUIREMENTS**

.1 When the outdoor temperature is less than 13°C ensure that heat is introduced in sufficient time, before work commences, to bring surrounding materials up to these temperatures; and maintained until materials installed by this Section have cured.

.2 Do not install paper-faced gypsum panels until installation areas are fully enclosed and conditioned.

.3 Maintain temperature between 10 degree C and 21 degree C both day and night, 24 hours before, during and after entire gypsum board joint finishing and until the permanent heating system is in operation or the building is occupied.

.4 Do not install work in any area unless satisfied that work in place has dried out, and that no further installation of damp materials is contemplated.

.5 Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

.1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

.2 Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.7 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

.2 Store materials on the job site in their original packaging until ready for actual use.

.3 Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

.4 Handle gypsum products with care to avoid damage.

.5 Do not store joint compounds for extended periods, as they are subject to aging.

PART - 2 PRODUCTS

2.1 **PERFORMANCE/DESIGN CRITERIA**

.1 Single source responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

.2 Fire resistance rating: Where gypsum board systems with fire resistance ratings are indicated or required, provide materials and installations that are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.

.3 Follow applicable requirements of ASTM C754 for installation of steel framing.

.4 Design system members to withstand own dead load, super-imposed dead loads, to maximum allowable deflection of L/240, without permanent deformation.

.5 Design framing for lead-lined gypsum board assemblies, for doors over 1220 mm (4') wide, double doors and extra-heavy doors (over 136 kg (300 lb.)) to meet load conditions.

.6 Seismic Bracing: Provide in accordance with OBC requirements for the project location and building Importance Category.

.7 Sheet metal thicknesses indicated herein pertains to the "minimum base steel thickness exclusive of coating".

2.2 **MATERIALS**

.1 Glass scrim interior gypsum board:

.1 Coated inorganic fiberglass mat-faced water-resistant treated gypsum board, conforming to the physical properties of ASTM C1396/C1396M and ASTM C1177/C1177M; rating of 10 "No Mold Growth" as tested for 4 weeks according to ASTM D3273, fire rated where indicated.

.2 Acceptable Products: Georgia-Pacific "DensArmor Plus Fireguard and Fireguard C Interior Panel", or Sheetrock Brand Glass-Mat Panels Mold Tough Regular and Firecode X by CGC.

.2 Shaft wall liner: 25 mm thick Type X gypsum board panel, 600 mm wide, "Shaft Wall Liner" panel by CGC or other acceptable equivalents.

.3 Shaft wall gypsum board: "Sheetrock Firecode C" panels by CGC or other acceptable equivalents.

.4 Shaftwall studs and accessories: 0.455 mm (0.0179"), 0.836 mm (0.0329") where plywood attachment is required, rolled galvanized steel sheet fabricated specially for gypsum coreboard and facing boards.

.1 Provide manufacturer's standard shapes for shaftwall construction; of profile, size and base metal thickness designed to comply with AISI "Specification for Design of Cold Formed Steel Structural Members" for structural performance characteristics indicated. Fabricate from steel sheet complying with ASTM A653/A653M, Grade A or B, for structural performance of base metal, as well as with ASTM A653/A653M, G60, for hot dip galvanized products, and ASTM A463/A463M for aluminized products.

.2 Studs and Runners to comply with ASTM C645, products: "J Runner", "C-H Stud", "E-Stud" or Jamb Strut by CGC or other acceptable equivalents.

.5 Steel studs: ASTM C645, minimum 20 gauge studs (0.792 mm [0.0312 in.] design thickness) base metal, hot-dipped galvanized to ASTM A653/A653M G60 (Z180) zinc coating, roll formed, widths as indicated, with knock-out holes for mechanical and electrical services.

.6 Steel studs at door jambs and where indicated: 1.720 mm (0.0677”) minimum thickness.

.7 Floor and ceiling tracks (runners): ASTM C645, metal thickness to match studs, hot-dipped galvanized to ASTM A653/A653M G60 (Z180) zinc coating, roll formed, width to suit studs.

.1 For openings wider than 914 mm (36"), provide 0.836 mm (0.0329”) minimum thickness for header.

.8 Runner fasteners:

.1 To metal concrete inserts: Use 10 mm (3/8") Type S-12 Pan Head screws.

.2 To suspended ceilings: Use prefinished clips to match ceiling grid, as manufactured by CGC or approved equivalent.

.9 Furring runners and channels: ASTM C645, minimum 0.46 mm base metal thickness, hot-dipped galvanized to ASTM A653/A653M G60 (Z180) zinc coating, roll formed.

.10 Resilient steel furring channels: ASTM C645, 12.7 mm x 65 mm, 0.46 mm base metal thickness, hot-dipped galvanized to ASTM A653/A653M G60 (Z180) zinc coating, roll formed; Hat shaped resilient furring channel for direct wall furring where resilient channels are indicated.

.11 Fasteners for furring members: Type and size recommended by furring manufacturer for substrate and application indicated.

.12 Channel bridging: 1.37 mm bare steel thickness, 38 mm deep with minimum 12.7 mm wide flange.

.13 Backing plate: Galvanized steel sheet for blocking and bracing in length and width indicated, minimum base metal 0.7 mm thick.

.1 Elimination of backer plates or direct attachment of accessories or equipment to studs will not be permitted.

.14 Attachment clips: Sized to suit acoustical ceiling grid members, complete with screws and other fastening system, Revoe Clips by Revoe Manufacturing Ltd.

.15 Hangers, tie wires, inserts, anchors: Manufacturer's standard.

.16 Insulating strip: Rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self-sticking adhesive on one face, lengths as required.

.17 Casing beads, corner beads: 0.48 mm hot dipped galvanized steel, perforated flanges, designed to be concealed with joint compound; one piece length per location.

.18 Reveal trims: Extruded 6063-T5 aluminum, designed to be concealed with joint compound, maximum lengths, reveal width and depth as indicated, Final Forms I 500 Series by Gordon Inc. or other approved equivalents.

.19 Sealants: as specified in Section 07 92 00.

.20 Joint and laminating compounds: to ASTM C475, as recommended by gypsum board and tile backer board manufacturer, high bond, low shrinkage and asbestos-free.

.21 Joint tape: 50 mm wide reinforced tape.

.22 Acoustical insulation (Sound Attenuation Batts): CAN/ULC-S702, mineral (glass and rock wool) fibre, flame spread and smoke developed in conformance with OBC requirements and other authorities having jurisdiction in accordance with CAN/ULC-S102. Non-combustible in accordance with requirements of CAN/ULC-S114. Sufficient thickness to meet required STC rating for sound-rated partitions and of width to suit metal framing spacing and other miscellaneous spacings.

.23 Acoustic putty pads: asbestos free gypsum based synthetic rubber moldable putty pad, 177.8 mm x 177.8 mm x 3 mm, non-conductive, of 1.6 kg/l density, tested to UL 263, in red colour, to match Hilti CP 617L Firestop Putty Pad by Hilti (Canada) Corp., for covering electrical boxes in acoustic partitions.

.24 Acoustical Sealant: Acrylic based sealant providing movement capability in fire rated joint and through-penetration applications, red colour, paintable, smoke, fume and water resistant; to match CP 606 Flexible Firestop Sealant by Hilti Canada.

.25 Access Panels:

.1 Aluminum extrusion with 5/8” drywall in door panel

.2 Door: .080” Aluminum

.3 Door Frame: .080” Aluminum extrusion recessed to provide similar edge to drywall bead to allow for finishing of wall or ceiling surface.

.4 Hinge: Spring loaded hinge pin allows door panel to open to 90 degrees, and also allows for door panel to be removed from frame. Safety chain installed on door and frame for safety.

.5 Finish, grey baked enamel prime coat, sizes as noted on drawings. Recessed access doors designed for flush installation in gypsum ceilings, recessed to receive gypsum board. Flange of door is textured galvanized steel taping bead with prepunched holes. Seal door to frame with continuous neoprene gaskets. Provide finish paint to match the adjacent substrate.

.6 Provide keyed tampered-proof hardware.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Examine areas and substrates including welded hollow-metal frames and framing for compliance with requirements and other conditions affecting performance.

.2 Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged. Remove rejected panels from site and replace with undamaged panels at no additional cost to the Owner.

.3 Do not proceed with installation until the building is completely enclosed and protected from exposure to the elements.

.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **INSTALLATION - GENERAL**

.1 Comply with ASTM C754 and ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.

3.3 **INSTALLATION - PARTITION AND WALL FRAMING**

.1 Align partition top and bottom tracks and secure by screws at 600 mm o.c. maximum.

.2 Place studs vertically at 400 mm oc, unless otherwise noted, and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in top and bottom tracks.

.3 Screw attach end studs to top and bottom tracks. Screw attach intermediate studs to bottom tracks. Secure intermediate studs to top tracks by crimping or by other means of fastening acceptable to Consultant.

.4 Continuously cross brace steel studs at 1500 mm on center to provide rigid installation to manufacturer's instructions.

.5 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.

.6 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using clips or other approved means of fastening placed alongside frame anchor clips.

.7 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

.8 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

.9 Provide stud, furring channel, and backing plates secured between studs for attachment of fixtures, electrical boxes, grab bars, washroom accessories, and other items. Comply with details indicated and with stud and gypsum board manufacturers' written recommendations.

.10 Terminate partitions at ceiling height except where indicated otherwise.

.11 Install continuous insulating strips to isolate studs from exterior window framing.

.12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

.13 Apply two continuous beads of acoustical sealant at junctions of metal framing and structure, including bottom and top tracks, where partitions abut fixed building components. Fill junction completely and continuously from floor to ceiling, or to structure for full height partitions.

.14 Acoustic putty pads: Apply acoustic putty pads to the exterior of electrical boxes in acoustic partitions, completely sealing pads against the stud within the stud cavity and fitting around conduit and cables, in accordance with manufacturer's recommendations.

.15 Frame for gypsum board faced vertical bulkheads within and at termination of ceilings.

.16 Secure light lens support trims to substrate at 300 mm centers. Loose lay light lens on support trims.

.17 Mechanically fasten resilient channels perpendicular to wall framing starting at 50 mm up from floor and end with 150 mm to the underside of structure at no more than 610 mm o.c. Install where indicated.

.18 Install lead-lined partitions as per engineered shop drawings.

3.4 **INSTALLATION – ATTACHMENT CLIPS**

.1 Place attachment clips over acoustic ceiling main/cross tee from top. Line up pre-drilled hole on clip with hole on main/cross tee and screw clip to main/cross tee with 12.7 mm wafer screw.

.2 Screw through pre-drilled holes in attachment clip into top track of stud partition. Do not screw through ceiling grid.

.3 Do not damage ceiling grid system during installation of these clips.

3.5 **INSTALLATION - WALL FURRING**

.1 Space wall furring runners vertically at 600 mm o.c., and secure through alternate flanges of runners. Shim runners as required to present a true, plumb line for application of gypsum board.

.2 Locate furrings not more than 50 mm away from all openings, interior corners, intersections, frames, jambs, control joints and the like.

.3 At windows, doors or similar openings having returns, and around corners, install lengths of mitred and bent pieces of furring horizontally spaced approximately 600 mm o.c. Form mitres by cutting the flanges and bending the web. Do not cut web to form corners.

.4 Mechanically fasten resilient channel perpendicular to wall framing starting at 50 mm up from floor and end within 150 mm to the underside of structure, at no more than 600 mm o.c. Install where indicated.

3.6 **INSTALLATION - SUSPENDED CEILING FRAMING**

.1 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 and in accordance with the engineered shop drawings.

.2 Provide additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of light fixtures and diffusers.

.3 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

3.7 **INSTALLATION - GYPSUM PANELS**

.1 Do not apply gypsum panels until bucks, anchors, blocking, electrical and mechanical work are approved.

.2 Apply gypsum panels to furring or framing using screw fasteners, at 300 mm oc., and at closer spacings as required for fire resistance rated assemblies. Space fasteners in tile baker boards a maximum of 200 mm o.c.

.3 Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

.4 Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1.6 mm of open space between panels. Do not force into place.

.5 Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

.6 Attach gypsum panels to framing provided at openings and cutouts.

.7 Control Joints

.1 Prior to installation review exact locations of control joints with the Consultant. Install purpose made control joint metal trim at following locations:

.1 Where partition, wall, or ceiling traverses a construction joint (expansion, seismic, or building control element) in the base building structure.

.2 Furring or partition abuts a structural element or dissimilar wall or ceiling.

.3 Ceiling abuts a structural element, column or dissimilar wall, partition, or other vertical penetration.

.4 Construction changes within a partition or ceiling.

.5 Partition or furring runs exceeding 9100 mm and total area between control joints exceeding 84 m^2

.6 Partition and ceiling runs on column lines or at joints in ceiling runs.

.7 In interior ceilings without perimeter relief exceeding 9100 mm in either direction and total area between control joints exceeding 84 m^2

.8 In interior ceilings with perimeter relief exceeding 15000 mm and total area between control joints exceeding 230 m^2

.9 In exterior ceilings or soffits exceeding 9100 mm in either direction and total area between control joints exceeding 84 m^2

.2 Install control joints full height floor to ceiling or door header to ceiling in partitions and furring runs.

.3 Install control joints from wall to wall in ceiling areas.

.8 Cover both faces of steel stud partition framing with gypsum panels in concealed spaces.

.1 Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 0.7 sq.m. in area.

.2 Fit gypsum panels around ducts, pipes, and conduits.

.3 Where partitions intersect open joists and other structural members projecting below underside of slabs and decks, cut gypsum panels to fit profile formed by joists and other structural members; allow 6 mm to 10 mm wide joints to install sealant.

.9 Gypsum board single layer application:

.1 On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

.2 On partitions and walls, apply gypsum panels parallel to framing, unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints.

.3 Stagger abutting end joints not less than one framing member in alternate courses of board.

.10 Gypsum board multilayer application - ceilings: Apply gypsum board indicated for base layers before applying base layers on partitions and walls; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face layer joints one framing member, 400 mm minimum, from parallel base layer joints, unless otherwise indicated or required by fire resistance rated assembly.

.11 Gypsum board multilayer application – partitions and walls: Apply gypsum board indicated for base layers and face layers parallel to framing with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

.1 Furring members: Apply base layer parallel to framing and face layer either vertically parallel or perpendicular to framing with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

.12 Single layer fastening method: Fasten gypsum panels to supports with steel drill screws.

.13 Multilayer fastening method: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners, unless otherwise indicated or required by fire resistance rated assembly.

.14 Laminating to substrate: Where gypsum panels are indicated as directly adhered to a substrate, comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.8 **INSTALLATION - ACOUSTICAL INSULATION**

.1 Install acoustical insulation to partitions indicated. Provide continuous coverage between studs and run continuously from floor to ceiling, or to structure for full height partitions, over door frames and openings and around corners.

.2 Install acoustical insulation within induction units where partitions meet window mullions.

.3 Pack acoustical insulation around cut openings in gypsum board, behind outlet boxes around plumbing, heating or structural items passing through the system and at abutting walls.

.4 Secure acoustical insulation to one interior face of gypsum board with adhesive or mechanical fasteners or by other approved means.

.5 For partitions receiving acoustical insulation, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919, Standard Practice for Use of Sealants in Acoustical Applications, and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings

3.9 **INSTALLATION - FIRE RATED ASSEMBLIES**

.1 Construct fire rated assemblies where indicated, to requirements of authorities having jurisdiction.

3.10 **INSTALLATION - ACCESSORIES**

.1 Erect casing beads, corner beads straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured by screw fasteners. Fit corners accurately, free from rough edges.

.2 Provide corner beads at external corners of gypsum board partitions and where indicated.

.3 Provide casing beads at gypsum board terminations, at gypsum board wall/ceiling junctions, where gypsum board butts against surfaces having no trim concealing junction and where indicated.

.4 Construct control joints of two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint. Provide continuous polyethylene dust barrier behind and across control joints.

3.11 **INSTALLATION - ACCESS PANELS**

.1 Install access doors. Rigidly secure frames to furring or framing systems.

3.12 **INSTALLATION - TAPING AND FILLING**

.1 Fill joints, casing beads, corner beads, screwholes and depressions on gypsum board surfaces exposed to view to provide smooth seamless surfaces and square neat corners.

.2 Apply joint compounds and reinforcing tapes in accordance with manufacturer's specifications.

.3 Fill joints and apply joint compounds by three-coat method. Apply cover coat 175 mm wide, level coat 250 mm wide, and skim coat 300 mm wide.

.4 Embed reinforcing tape in a cover coat of joint compound. Apply level coat of joint compound when cover coat has dried. Apply skim coat of compound when level coat has dried.

.5 Feather edges of compounds into surfaces of gypsum boards. After skim coat has dried for at least 24 hours sand to leave smooth for decoration. Do not sand paper face of gypsum board.

.6 At internal corners: First fill gaps between boards with joint compound. Imbed creased reinforcing tape into a thin coat of joint compound applied 50 mm wide at each side of corner. Apply cover coat. Apply skim coat to one side of joint, and when dry apply skim coat to other side.

.7 At external corners: Fill to nose of corner bead with joint compound and sand smooth.

.8 At screwheads and nailheads: Fill holes and depressions with a two coat application of joint compound and sand smooth.

.9 Finish gypsum board joints above finished ceiling with tape and first coat of joint compound.

3.13 **EXISTING BASE BUILDING GYPSUM WALL PARTITIONS**

.1 All existing Base Building gypsum wall partitions mast be repaired, patched, taped, filled and sanded prior to receive new finishes.

.2 Patching and Repair:

.1 Gypsum panel product patch must be mechanically secured; attachment with joint compound material only is not acceptable. The patching material should be cut from gypsum panel product of a type and thickness equal to the original materials so that the patching material is in the same geometric shape as, but slightly larger than, the damaged area. The damaged area is then further enlarged to match exactly the size of the patching material. Restore thermal insulation, if present.

.2 Metal runner track is secured to the inside edges of the damaged area. The patching material is screw attached to the exposed face of the runner track with fasteners a maximum of 8 in. (200 mm) apart. The patch should be treated with tape and joint compound to restore appearance to Level 5 gypsum board finish, fire resistance qualities, and acoustical performance.

.1 Apply skim coat of topping or all-purpose drying-type compound over the entire wall where patching and repair was performed.

3.14 **FINISHING**

.1 Provide levels of gypsum board finish for locations as follows, in accordance with GA-214.

.1 Level 1: Ceiling plenum areas and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.

.2 Level 2: Gypsum board substrate at applied hard surfaces, except remove tool marks and ridges.

.3 Level 4: Exposed gypsum board surfaces where flat paints, light textures, or wallcoverings are to be applied.

.4 Level 5: Exposed gypsum board surfaces where paint Gloss Level 3 or higher is specified, indicated, scheduled, or required, for all glass scrim (fiberglass mat) interior gypsum boards, and for areas where critical lighting exists, including wall and ceiling areas abutting glazed assemblies, long hallways, and areas with large surface areas flooded with artificial or natural lighting.

3.15 **INSTALLATION TOLERANCES**

.1 Provide and install studs, framing, shimming, and furring to provide proper support for gypsum board to achieve the following installation tolerances:

.1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane.

.2 Do not exceed 10 mm (3/8") from drawings locations.

.3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.

.4 Install each framing member so fastening surfaces vary not more than 3.2 mm (1/8") from the plane formed by faces of adjacent framing.

.2 Suspended and furred ceilings:

.1 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft).

.3 Installation tolerances gypsum board panels:

.1 Do not exceed 3 mm (1/8") in 3 m (10') variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.

.2 Do not exceed 10 mm (3/8") from indicated location.

.3 Do not exceed 1.5 mm (1/16") variation between planes of abutting edges or ends.

.4 Surface flatness shall not exceed 1.5 mm (1/16") within 305 mm (12") straight edge. For non-tapered-edge end joints between boards, measure flatness tolerance with end of straight end at centreline of joint.

.4 Installation tolerances accessories:

.1 Alignment with board panels shall not exceed tolerances specified above.

.2 End joints shall be flush aligned to maximum offset of 0.5 mm (0.020").

3.16 **PROTECTION**

.1 Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

.2 Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

.3 Remove and replace panels that are wet, moisture damaged, and mold damaged at no additional cost to the Owner.

.1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

.2 Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

.2 Related Requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.2 Finish ceiling system: Square with adjoining walls and level within 1:1000, in true plane, free from distorted, warped, soiled or damaged panels or grid.

.3 Comply with ASTM C635/C635M Intermediate Duty and C636/C636M except as otherwise specified herein.

.4 Maximum deflection of completed ceiling system: 1/360 of span.

.5 Design suspended ceiling system for adequate support of electrical fixtures as required by Electrical Safety Authority.

.6 Maintenance seminars: Provide, to the Owner, training seminars and recommendations on Product maintenance procedures.

.7 Pre-installation meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Consultant of the date and time of the meeting.

.8 Manufacturer’s site inspection: Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

1.3 SAMPLE INSTALLATION

.1 Construct on site a 10 m x 10 m minimum sample installation of each type acoustical ceiling. Accepted sample installation may become part of finished work.

1.4 SUBMITTALS

.1 Product Data:

.1 For each type of product, certifying compliance with the specified or named product or material.

.2 Prior to ordering products or materials, submit manufacturer's printed product datasheets for each type of product. Include product characteristics, performance criteria, physical size, finish and limitations for products listed in selected designs.

.2 Samples: Duplicate full size samples of each type acoustical units and 300 mm long grid members.

.3 Provide shop drawings, load diagrams, and design calculations signed and stamped by a professional engineer licensed in the Province of Ontario. Ensure that the proposed ceiling and suspension system comply with the requirements of the Ontario building Code, and with the seismic requirements for the project location and Building Importance Factor.

.1 Shop drawings: Indicate typical plans, reflected ceiling plans, and sections of the suspended ceiling system as well as details on connections to the building, suspension system layout, spacing, locations, member sizes and thicknesses, fasteners, hangers, and all relevant accessories. Indicate materials and finishes.

.2 Load diagrams: Indicate dead and live loads to be carried by the building structure, and method in which vertical building deflections are handled.

1.5 **ENVIRONMENTAL CONDITIONS**

.1 Permit wet work to dry before commencement of installation.

.2 Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before and during installation.

.3 Store materials in work area 48 hours prior to installation.

1.6 **EXTRA STOCK**

.1 Provide two percent of each pattern and type of acoustical units. Store where directed. Extra stock to be same production run as installed materials.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Basis of Design – Acoustic Tile Products: Refer to Section 09 06 00, Finishes Scheduel for complete list of acoustic tile products, designations, manufacturers, sizes and colours .

.2 Exposed main tee: Hot dipped galvanized steel to ASTM A653/A653M minimum Z90 coating designation, 24 mm exposed face and 38 mm high bulb tee design with double web and separate exposed cap piece, maximum length, with reversible and integral splice. Prefinish tee in baked enamel, standard colour.

.3 Exposed cross tee: Hot dipped galvanized steel to ASTM A653/A653M minimum Z90 coating designation, exposed face to match main tees, 38 mm high bulb tee design of same fabrication as main tee, with override stepped ends to allow cross tee flange to sit on main tee flange providing flush exposed faces, and with positive interlock to main tee, grid module to suit acoustical panels. Finish to match main tees.

.4 Main tee splices: Designed to lock lengths of main tees together so that joined lengths of tee function structurally as a single unit with tee faces at joint perfectly aligned and presenting a tight seam.

.5 Hangers and wires: Galvanized hangers and 2.6 mm minimum galvanized steel wire.

.6 Hold-down clips: Spring steel clips by the grid system manufacturer.

.7 Wall moulding: Prefinished galvanized steel, nominal 25 mm x 25 mm with nominal 25 mm exposed face, hemmed edges. Finish to match main tees.

.8 Shadow wall moulding: Prefinished galvanized steel, 19 mm x 19 mm reveal with nominal 25 mm exposed face, hemmed edges. Finish to match main tees.

.9 Adhesive: Recommended by acoustic unit manufacturer.

PART - 3 EXECUTION

3.1 INSTALLATION – GENERAL

.1 Do not commence installation until work above ceiling has been inspected by Consultant.

.2 Install work in accordance with ASTM C636/C636M and to manufacturer's instructions except where specified otherwise.

.3 Do not commence installation until work above ceiling has been inspected by Consultant.

.4 Lay out system in accordance with reflected ceiling plans.

.5 Ensure work is co-ordinated with location of related components, and with mechanical and electrical fixtures.

3.2 INSTALLATION - GRID SYSTEM

.1 Centre acoustical ceiling suspension systems on room axis; install equal border pieces, unless otherwise indicated.

.2 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.

.3 Install supplemental suspension system where ducts or other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support suspension system members. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

.4 Install hanger wires plumb and securely anchored to the building structural framing, independent of walls, pipes, ducts, and metal deck; install additional framing and hangers to bridge interference items.

.5 Do not bend or twist hangers as a means of levelling. Form double loops tightly and lock to prevent vertical movement or rotation within the loop.

.6 Install wall moulding at intersection of ceiling and vertical surfaces to provide correct ceiling height.

.7 Provide additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of light fixtures and diffusers.

.8 Use longest practical lengths of tees, furring and running channels to minimize joints. Make joints square, tight, flush and reinforced with concealed splines. Assemble framework to form a rigid and interlocking system.

.9 Run main tees at right angles to length of light fixtures.

.10 Interlock cross tees to main tees to provide rigid assembly.

.11 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.

3.3 INSTALLATION - ACOUSTICAL PANELS

.1 Neatly cut acoustic units for mechanical and electrical and other services.

.2 Carefully fit acoustic units in place; no broken edges permitted.

.3 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

.4 Provide hold-down clips at acoustical system to hold units tight to grid system throughout entire system.

.5 Install adhesive bonded acoustic units to clean, dry and firm substrate.

3.4 **ADJUSTING AND CLEANING**

.1 Clean exposed surfaces of trim, edge mouldings, and suspension members.

.2 Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

.3 Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum 5 years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type.

.2 Maintenance seminars: Provide, to the Owner, training seminars and recommendations on Product maintenance procedures.

.3 Pre-installation meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Consultant of the date and time of the meeting.

.4 Manufacturer’s site inspection: Have the manufacturer’s technical representative inspect the work at suitable intervals during application and at conclusion of the work of this Section, to ensure the work is correctly installed. When requested, submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

.5 Products: Provide like products from same production run. Install products in sequence from sequentially numbered dye lots.

.6 Testing of concrete floors: Test floors that have been cured for minimum 28 days, and after preparation for Product installation is complete and patching or levelling compound is fully cured. Conduct testing simultaneously on floors free of sealer, curing compounds, oil, grease and other agents detrimental to the test and the Product performance, and in strict conformance with test kit manufacturer’s written instructions. Locate test sites to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.

.1 Moisture vapour emission: Maximum 5.0 lbs of moisture per 1000 sq.ft. per 24 hour for vinyl sheet flooring. Test floors to ASTM F1869 using anhydrous calcium chloride method. Provide 3 test sites for floor area up to 1000 sq.ft., add one test site for each additional 1000 sq.ft. or fraction thereof.

.2 Alkalinity: Acceptable range of 5 to 9 on the pH scale. Test floors using distilled water and pH paper. Provide 2 tests for every moisture vapour emission test.

1.3 SUBMITTALS

.1 Samples: Duplicate 300 mm x 300 mm samples of each type of floor tile, 300 mm long grounding strip, and resilient base.

.2 Maintenance data: Incorporate into project record manual; give specific warning of any maintenance practice or materials which may disfigure or damage the flooring.

1.4 ENVIRONMENTAL CONDITIONS

.1 Maintain floor and material temperature at 21 degree C 48 hours prior to, during and 48 hours after installation.

.2 Protect grounding strips from damage by work of other Sections.

1.5 **EXTRA STOCK**

.1 Provide two percent of each colour, pattern and type flooring material required for this project for maintenance use. Store where directed. Extra stock to be same production run as installed materials. Include cost of extra stock in the Contract Price.

1.6 **ELECTRICAL RESISTANCE TESTING**

.1 Test Report: Upon completion of work, manufacturer's representative shall visit site to review installation and conduct electrical resistance of the completed installation. Tile manufacturer shall submit test report and letter stating installation is in accordance with specifications and manufacturer's recommendations.

.2 Measure tile surface resistance using two 5 lb electrodes placed 900 mm apart and 900 mm away from any grounded objects and walls. Similarly measure resistance to ground between one electrode placed 36” from the ground and the walls.

.3 Connect electrodes to a megohmeter with 100 volts open circuit voltage. Apply 100 volts and record reading 15 seconds after application of 100 volts.

.4 Make five tile surface resistance and five resistance to ground measurements at different locations for every 1000 sq.ft.

.5 The average surface resistance and resistance to ground must be less than 106 ohms and no single reading shall be greater than 5 x 106 ohms.

1.7 **EXTENDED WARRANTY**

.1 Submit a 5 year product and labour warranty, issued in the name of the Owner by the conductive floor tile manufacturer and commencing from date of Substantial Performance. Warranty shall cover the electrostatic performance and wearability of the conductive floor tile installation.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Basis of Design – Tile and Sheet Flooring Products: Refer to Section 09 06 00, Finishes Schedule, for complete list of products, designations, manufacturers, sizes, finishes and colours.

.2 Static dissipative floor tile: CSA A126 and SS-T-312B, Class 1 flame spread and smoke contribution to ASTM E84, electrical resistance 1 Mohms to 1,000 Mohms to ESD S7.1.

.3 Grounding strip: 12 mm wide self-adhering copper tape, acceptable to tile manufacturer.

.4 Resilient base: Rubber wall base, manufacturer, model, height and colour as indicated, including premoulded end stops and external corners for coved base, laminated to backing material.

.5 Backing Material: cove backing by EasyCove Canada or equivalent.

.6 Primers and adhesives: Nontoxic, waterproof type, solvent free polyurethane, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade. Provide compatible primer.

.7 Metal edge strip: Extruded aluminum, smooth mill finish, polished, with lip to extend under floor tile, tapered edge.

.8 Transition adapter: Rubber, by Johnsonite or equivalent, colour to be sxelected by the Consultant.

.9 Substrate filler: as specified in section 03 54 16 Self Levelling Floor Underlayment.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Examine floor surfaces to ensure that they are clean, level and free from cracks, ridges, dusting, scaling and carbonation.

.2 Examine the floors from time to time in advance of the application of flooring to ensure that floors are protected against entry of water and moisture.

.3 Prior to the installation of the flooring, test concrete for excessive moisture content by a method acceptable to the flooring manufacturer.

.4 Cooperate with recommendations of flooring manufacturer.

3.2 PREPARATION

.1 Prepare floor substrates in accordance with manufacturer's recommendations including but not limited to vacuuming, grinding, sanding, cleaning, etc.

.2 Remove paint, coating, rust, and other materials that will prevent the grounding effect of the conductive floor tile installation.

.3 Fill cavities, cracks, joints and other surface imperfections in substrate with latex type fill in order to produce a smooth, flat, hard surface for receipt of the flooring.

3.3 INSTALLATION – GROUNDING STRIPS

.1 Apply grounding strips to floor and building grounds such as walls and columns. Provide minimum 600 mm long strips on floor and minimum 75 mm on walls or columns. Mechanically fasten strips to building grounds using fasteners approved by the tile manufacturer.

.2 Provide one grounding strips per 93 sq.m. of floor and a minimum of two strips per room, or as directed by floor manufacturer.

3.4 INSTALLATION – FLOOR TILES

.1 Apply adhesive uniformly on subfloor and grounding strips using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.

.2 Lay flooring with joints aligned and parallel to building lines to produce symmetrical tile pattern. Start tile pattern at centre of room. Border tiles minimum half tile width.

.3 Continue flooring through areas to receive demountable type partitions without interrupting floor pattern.

.4 As installation progresses roll flooring in perpendicular directions with 150 lb minimum roller to ensure full adhesion.

.5 Cut tile and fit neatly around walls, columns and fixed objects.

.6 Terminate flooring at centerline of door in openings where adjacent floor finish is dissimilar.

.7 Install metal edge strips at unprotected or exposed edges where flooring terminates.

.8 Provide transition adapter at interface of dissimilar floor finishes, straight and true. Where interface occurs at doorway, locate adapter underneath door in its closed position.

3.5 INSTALLATION - BASE

.1 Install base to walls and fitments.

.2 Fill cracks or irregularities with filler approved by the manufacturer.

.3 Provide solid backing material over the entire area behind the base.

.4 Set base in adhesive tightly by using hand roller, against wall and floor surfaces.

.5 Lay out base to keep number of joints at minimum, with no two joints closer than 18” apart. Make joints vertical and tight.

.6 Scribe and fit to door frames and other obstructions.

.7 Mitre internal corners. Use premoulded corner units for right angle external corners. Miter base for external corners of other angles.

3.6 **CLEANING**

.1 Remove any adhesive and releasing agent from flooring and base as the work progresses.

.2 Protect the newly laid flooring from construction traffic for a period of 48 hours. At the end of this period thoroughly clean all surfaces with a manufacturer approved cleaner.

.3 Do not wax floor tiles.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section required to install complete epoxy flooring systems specified in this Section including surface preparation.

1.2 ABBREVIATIONS AND ACRONYMS

.1 w.f.t.: Wet film thickness.

.2 d.f.t.: Dry film thickness.

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C307-03 (2012) Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing's.

.2 ASTM C413-01(2012), Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

.3 ASTM C579-01 (2012), Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.

.4 ASTM C580-02 (2012), Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing's, and Polymer Concretes.

.5 ASTM C884/C884M-98(2010) Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay.

.6 ASTM D635-10, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

.7 ASTM D696-08e1 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30degC and 30degC with a Vitreous Silica Dilatometer.

.8 ASTM D2369-10e1, Standard Test Method for Volatile Content of Coatings.

.9 ASTM D2794-93(2010) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

.10 ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

.11 ASTM D4060-10, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

.12 ASTM F2170-11 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

.13 ASTM F2659-10, Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter.

.14 ASTM G21-13, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 Canadian Standards Association (CSA):

.1 CSA A23.1-14/A23.2-14 Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.

.3 International Concrete Repair Institute (IRCI):

.1 ICRI Guideline No. 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays.

.4 United States Department Defence

.1 MIL-PRF-24613A (SH) 11-2007, Performance Specification: Deck Covering Materials, Interior, Cosmetic Polymeric.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-application Meeting:

.1 Convene a pre-application meeting two (2) weeks before commencing the Work of this Section. Require attendance of parties directly affecting Work of this Section, including Owner, Contractor, Consultant, Applicator, Manufacturer's technical representative and other Subcontractors affected by the Work of this Section to review the following:

.1 Surface preparation.

.2 Priming.

.3 Application.

.4 Curing and protection.

.5 Coordination with other Work.

1.5 SUBMITTALS

.1 Product Data: Submit manufacturer's Product data, including physical properties and appearance options including: standard colours, variable surface textures and surface sheen.

.2 MSDS: Submit Manufacturer’s Safety Data Sheet for each Product being used.

.3 Samples for Initial Selection: Submit manufacturer's colour charts showing the full range of colours available for each type of finish coat material indicated for Consultant’s initial selection.

.4 Samples for Verification: Submit samples of each colour and material being applied, with texture to simulate actual conditions, on representative samples of the actual substrate and as follows for Consultant’s verification:

.1 Use representative colours when preparing samples for review; resubmit until required sheen, colour, and texture are achieved.

.2 List of material and application for each coat of each sample; label each sample for location and application.

.3 Submit samples on the following substrates for Consultant's review of colour and texture:

.1 Hardboard: Provide two (2) 100 mm square samples for each colour and finish.

.4 Obtain written acceptance of Samples in writing from the Consultant before commencing Work of this Section.

1.6 **CLOSEOUT SUBMITTALS**

.1 Operations and Maintenance Data: Submit manufacturer's printed maintenance instructions for repair, cleaning and maintenance procedures; include name of original installer and contact information.

1.7 **QUALITY ASSURANCE**

.1 Applicator Qualifications:

.1 Applicators: Use experienced applicators having a record of successful in-service resinous flooring system applications similar in material and extent to those specified in this Section and as follows:

.1 Applicators must have completed flooring manufacturer’s training program for Products specified.

.2 Applicators must be licensed, certified or approved in writing by the flooring manufacturer for the Products specified.

.2 Applicator Experience: Minimum 5 years’ experience in the application of the type of system specified. Applicator shall submit a list of five (5) projects of similar size, scope and complexity.

.3 Mock-Up:

.1 Construct one 10 sq.m. (100 sq.ft.) mock-up of each type and colour of resinous flooring in location acceptable to Consultant to demonstrate quality of finished system, complying with manufacturer's installation instructions and requirements of this section.

.2 Arrange for Consultant’s review and acceptance, obtain written acceptance before proceeding with Work.

.3 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the Work of this Section. Mock-up shall be left in place for the duration of the Work.

.2 Testing of concrete floors: Test floors that have been cured for minimum 28 days, and after preparation for Product installation is complete and patching or levelling compound is fully cured. Conduct testing simultaneously on floors free of sealer, curing compounds, oil, grease and other agents detrimental to the test and Product performance. Locate test sites to cover representative installation areas. Do not proceed with work when the test results do not conform to the allowable limits prescribed by the flooring system manufacturer.

.3 Level and Flatness of the finish flooring:

.1 The floor surface upon which Specialty Equipment is to be placed shall be flat and level to within 1/16” (2 mm) over a length of 39” (1 mm).

1.8 **DELIVERY, STORAGE AND HANDLING**

.1 Delivery:

.1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number and date of manufacture.

.2 Material should be delivered to job site and checked for completeness and shipping damage prior to job start.

.2 Storage:

.1 Store materials in accordance with manufacturer's written instructions.

.2 Keep containers sealed until ready for use. Material should be stored in a dry, enclosed, protected area from the elements.

.3 Do not subject material to excessive heat or freezing.

.4 Shelf life: Established based on manufacturer's written recommendation for each material being used.

.3 Handling:

.1 Protect materials during handling and application to prevent damage or contamination.

.2 Condition materials for use accordingly to manufacturer's written instructions prior to application.

.3 Record material lot numbers and quantities delivered to jobsite/storage.

1.9 **SITE CONDITIONS**

.1 Do not install the Work of this Section outside of the following environmental ranges without Manufacturers' written acceptance:

.1 Material Temperature: Precondition material for at least 24 hours between 18°C and 30°C (65°F and 86°F).

.2 Ambient and Substrate Temperature: Minimum/Maximum 10˚/30˚C (50˚/86˚F).

.3 Substrate temperature must be at least 3˚C (5˚F) above measured Dew Point.

.4 Mixing and Application attempted at Material, Ambient and/or Substrate Temperature conditions less than 18˚C (65˚F) will result in a decrease in Product workability and slower cure rates.

.5 Relative Ambient Humidity: maximum ambient humidity 85% (during application and curing).

.6 Measure and confirm acceptable test results for Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.

.2 Substrate Moisture:

.1 Moisture content of concrete substrate must be ≤ 4% by mass as measured with a Tramex CME/CMExpert type concrete moisture meter.

.2 Additionally, internal concrete relative humidity tests may be conducted as per ASTM F2170 and values must be ≤ 85%.

.3 If moisture content of concrete substrate is higher than 4% by mass and / or if relative humidity test results exceed readings of 85% RH, Consultant will instruct on addition of moisture mitigation systems or moisture tolerant primers.

.3 Supply temporary utilities, including power, water, temporary ventilation and lighting for use by applicator.

.4 Maintain constant ambient room temperature for 48 hours before, during and after installation or until cured. Minimum temperature of 10°C (50°F) and maximum temperature of 30°C (85°F). Do not apply Product while ambient and substrate temperatures are rising.

.5 Erect suitable barriers and post legible signs at points of entry to prevent traffic and trades from entering the work area during application and curing period of the floor.

.6 Ensure adequate ventilation and air flow.

1.10 WARRANTY

.1 Provide 5 years materials and workmanship of the epoxy system, provided by the installer and backed-up by the manufacturer.

PART - 2 PRODUCTS

2.1 SYSTEM

.1 Basis-of-Design: low VOC epoxy floor coating system by Sika Canada Inc. The total system breakdown is as follows:

.1 Prime: Sikafloor 156

.2 Body: product Sikafloor 9200 with Sikafloor Quartzite Trowel Aggregate

.3 Grout/Top Coat: Sikafloor 2002

.4 Finish coat: Sikagard 7500

.5 Integral Flash Cove base: 6” high

2.2 ACCESSORIES

.1 Provide all cleaning agents, cleaning cloths, sanding materials, and clean-up materials required per manufacturer’s specifications.

.2 Divider strips: L shape to required floor thickness, white alloy zinc.

.3 Cove strips: As recommended by flooring manufacturer.

.4 Joint backing: Preformed, compressible strips of closed cell polyethylene or urethane foam, rubber tubing or non-migrating plasticized vinyl with shore 'A' hardness of 20 and tensile strength between 140 kPa and 200 kPa. Sizes and shapes to suit various conditions, diameter 25% greater than joint width. Compatible with sealant, primer, epoxy flooring and substrate.

.5 Joint sealant: multicomponent modified urethane base, chemical curing; material compatible with floor finish and as recommended by flooring manufacturer.

2.3 COLOURS

.1 For colours refer to Interior Finishes Schedule, Section 09 06 00.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Examine surfaces to receive flooring system. Submit Notice in Writing to Consultant, Contractor, and Owner if surfaces are not acceptable. Do not begin surface preparation or

application until unacceptable conditions have been corrected. Do not apply flooring system to substrate treatments for moisture, repair, or levelling not of the same manufacturer.

.2 Surface must be clean, sound and dry.

.3 Pre-Installation Testing:

.1 Substrate moisture:

.1 Measure and confirm acceptable conditions for Substrate Moisture Content, Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.

.2 Confirm and record above values at least once every 3 hours during installation or more frequently whenever conditions change (e.g. Ambient Temperature rise/fall, Relative Humidity increase/decrease, etc.).

.2 Concrete substrate to have a minimum compressive strength of 25 MPa (3,625 psi) at 28 days and a minimum of 1.5 MPa (218 psi) in tension at time of application.

.4 Ensure concrete substrate conforms to the minimum requirements of the flooring manufacturer.

.5 Verify that required environmental conditions are maintained before commencing work. Be familiar with manufacturer's product literature and Material Safety Data Sheets and comply with precautions, handling procedures and equipment requirements.

3.2 SURFACE PREPARATION

.1 Prepare surface to receive flooring systems in accordance with manufacturer's written instructions.

.2 Remove dirt, oil, grease, wax, laitance, curing and sealing compounds, water-soluble concrete hardeners, and other surface contaminants.

.3 Remove sealers, finishes, and paints.

.4 All projections, rough spots, etc. should be removed and patched to achieve a level surface prior to the application.

.5 Remove unsound concrete by appropriate mechanical means.

.6 Concrete: Clean and prepare to achieve laitance-free and contaminant-free, open textured surface by shot blasting or equivalent mechanical means. Provide CSP level in accordance with ICRI Guideline No. 310-2R and manufacturer’s written recommendation.

.7 Chemical Surface Preparation: Chemical surface preparation (acid etching) is unacceptable and will void manufacturer’s warranty.

.8 Control Joints and Cracks: Repair and treat control joints and surface cracks utilizing manufacturer’s standard materials and installation details.

.9 Protect adjacent surfaces, fixtures and equipment with drop cloths or masking as necessary to prevent damage from splatter or spillage.

3.3 APPLICATION

.1 Prepare, mix materials and apply each component of flooring system in strict accordance with manufacturer's printed directions to produce uniform monolithic wearing surface of

thickness indicated for each system, with integral cove bases where indicated, uninterrupted except at divider strips, sawn joints or other types of joints required

.2 Mix and apply material in accordance with manufacturer's written installation instructions and procedures. Apply to manufacturer's recommended coverage rates unless thicker coverage is specified in this Section.

.3 Do not apply while ambient and substrate temperatures are rising.

.4 Apply resinous flooring with care to ensure that no laps, voids, or other marks or irregularities are visible. Apply to achieve appearance of uniform colour, sheen and texture; all within limitations of materials and areas concerned.

.5 Broadcast Aggregates into the wet Broadcast Coat resin.

.6 Match colours and textures of Consultant accepted samples.

.7 Where required, install cove base 100 mm (4")] high with 25 mm (1") radius in accordance with manufacturer's written instructions. Install cove base with a minimum 3 mm (1/8") thickness.

.8 Install L type white alloy or zinc base bead top strips at specified heights straight and level.

.9 Thresholds

.1 Where flooring terminates at doorways, and difference in height occurs between seamless flooring and other finishes, install tapered aluminum thresholds not less than 100 mm W X 12 mm H.

.2 Where flooring terminates at doorways, and floor finishes are of same thickness, provide metal divider strips flush with surfaces.

.10 Floor drains: Slope flooring to drains minimum of 1:100 from furthest surface point. Grind concrete around perimeter to provide 6 mm thickness of flooring material which is flush with top of drain and slopes as indicated on Drawings.

.11 Follow manufacturer's written recommendations on terminations and connections to walls, drains, columns and floor-to-floor transitions.

.12 Chasing: Provide chase where flooring does not abut against vertical surface by chiselling out 38 mm wide chase to straight saw-cut 12 mm depth.

.13 Control joints: Where substrate is interrupted by isolation, control or expansion joints, provide saw-cut joint in flooring after floor installation, install backer rod and fill with manufacturer's recommended epoxy or urethane sealant.

3.4 **CLEAN UP**

.1 Dispose of all waste from resinous flooring system installation in accordance with environmental legislation applicable to the Place of the Work and requirements of all authorities having jurisdiction.

.2 Dispose of empty containers at an approved waste handling facility for recycling or disposal.

3.5 **PROTECTION**

.1 Protect finished floor from damage by subsequent trades.

.2 Protect freshly applied Products from dampness, condensation and water for at least seventy-two (72) hours.

.3 Monitor air flow and changes in air flow. Protect against introduction of dust, debris, and particles, etc. that may result in surface imperfections and other defects.

.4 Follow manufacturer's written recommendations with respect to cure, wait time and return to service.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 QUALITY ASSURANCE

.1 Applicator experience: Having minimum of five years proven satisfactory experience. When requested, provide a list of the last three comparable projects including, name and location, consultant, start and completion dates, and value of the painting work.

.2 Applicator qualification: Qualified journeypersons, painters, as defined by local jurisdiction shall be engaged in painting and decorating work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson in accordance with trade regulations.

.3 Materials, preparation and quality of work: In conformance with requirements of the latest edition of the Architectural Painting Specification Manual by the Master Painters Institute, referred to as the MPI Painting Manual in this Section.

.4 Manufacturers and products: Listed under the Approved Product List section of the MPI Painting Manual.

.5 Pre-installation meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Consultant of the date and time of the meeting.

.6 Manufacturer’s site inspection: Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

1.3 SAMPLES AND MOCK-UPS

.1 Samples:

.1 Submit samples of each colour from the manufacturer’s full range for colour selection.

.2 Provide duplicate minimum 300 mm square samples of surfaces or acceptable facsimiles requested painted with selected paint or coating in colours, gloss, sheen and textures required to MPI Painting Manual standards for review.

.3 When approved, samples become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

1.4 SUBMITTALS

.1 List of painting materials: Submit duplicate copy of list of painting materials for review prior to ordering materials. If requested, provide an invoice list of all paint materials ordered for project work indicating manufacturer, types and quantities for verification and compliance with specification and design requirements.

.2 Material Safety Data Sheets (MSDS): Submit duplicate copies prior to commencement of work for review and for posting at job site as required.

.3 Project Data Manual: At project completion provide an itemized list complete with manufacturers' application instructions, paint type and colour coding for all colours used for Owner's later use in maintenance.

1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Deliver all painting materials in sealed, original labelled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.

.2 Store all paint materials in original labeled containers in a lockable, dry, heated and well ventilated single designated area meeting the minimum requirements of both paint manufacturer and authorities having jurisdiction and at a minimum ambient temperature of 7 degree C. Only material used on this project to be stored on site.

.3 Where toxic, volatile, explosive, flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings such as no smoking signs as required.

.4 Take necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills. Store materials that constitute a fire hazard in suitable closed and rated containers and removed from the site on a daily basis.

.5 Comply with requirements of authorities having jurisdiction, in regard to the use, handling, storage and disposal of hazardous materials.

1.6 **SCHEDULING**

.1 Schedule painting operations to prevent disruption of and by other Sections.

.2 Schedule painting operations in occupied facilities to prevent disruption of occupants in and about the building. Perform painting in accordance with Owner's operating requirements. Schedule work such that painted surfaces will have dried before occupants are affected. Obtain written authorization from Consultant for changes in work schedule.

1.7 **PROJECT CONDITIONS**

.1 Do not perform interior work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above minimum requirements for 24 hours before, during and 48 hours after work is complete, unless required otherwise by manufacturer's instructions. Provide supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.2 Do not perform work when the relative humidity is above 85% or when the substrate temperature is less than 3 degree C above the measured dew point.

.3 Do not perform work when the maximum moisture content of the substrate exceeds:

.1 12% for concrete and masonry.

.2 12% for plaster and gypsum board.

.4 Conduct all moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple cover patch test.

.5 Test concrete, masonry and plaster surfaces for alkalinity as required.

.6 Apply work only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

.7 Do not perform work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted or decorated.

1.8 **EXTRA STOCK**

.1 At project completion provide 4 liters of each type and colour of paint from same production run used in unopened cans full unopened cans of surplus paint, properly labeled and identified for Owner's later use in maintenance. Store where directed.

1.9 **WASTE MANAGEMENT AND DISPOSAL**

.1 Paint, stain finishes and related materials such as thinners, solvents are regarded as hazardous products and are subject to regulations for disposal. Obtain information on these controls from applicable authorities having jurisdiction.

.2 Separate and recycle waste materials. Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility. Materials that cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.3 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.4 Strictly adhere to the following procedures to reduce the amount of contaminants entering waterways, sanitary and storm drain systems or into the ground:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case shall equipment be cleaned using free draining water.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return soaked rags used during painting operations for contaminant recovery, proper disposal.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.6 Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

.5 Set aside and protect surplus and uncontaminated finish materials not required by the Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Provide material from a single manufacturer for each system used.

.2 Use materials listed in the latest edition of the MPI Approved Product List (APL).

.1 Other materials not listed in the APL shall be the highest quality product of an MPI listed manufacturer and shall be compatible with paint materials being used as required.

.3 All materials used shall be lead and mercury free.

.4 Use only materials having zero (0) VOC.

.5 Where indoor air quality is an issue, use only MPI listed materials having a minimum E2 or E3 rating.

.6 Provide materials having good flowing and brushing properties and capable to dry or cure free of blemishes, sags, air entrapment.

.7 Where required, paints and coatings shall meet flame spread and smoke developed ratings to code requirements and authorities having jurisdiction.

.8 Slip Resistant Aggregate: Rubber, clean/washed silica sand or ground walnut chips, as required to provide slip resistance. Where aggregate is site mixed into paint, mix constantly to keep additive in suspension.

2.2 **EQUIPMENT**

.1 Painting and Decorating Equipment: to best trade standards for type of product and application.

.2 Spray Painting Equipment: of ample capacity, suited to the type and consistency of paint or coating being applied and kept clean and in good working order at all times.

2.3 **MIXING AND TINTING**

.1 Unless otherwise specified or pre-approved, provide materials ready-mixed and pre-tinted. Re-mix materials in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

.2 Mix paste, powder or catalyzed materials in strict accordance with manufacturer's written instructions.

.3 Do not exceed amount of thinner beyond manufacturer's recommendations. Do not use kerosene or organic solvents to thin water-based materials.

.4 If required, thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.

2.4 **FINISH AND COLOURS**

.1 The Consultant will select colours from a manufacturer’s full range of colours. Final selection to be confirmed by Consultant.

.2 Where required by authorities having jurisdiction, finish exit and vestibule doors in contrasting colour to walls and a different colour than any other door in the same area.

.3 Access doors, prime coated butts and other prime painted hardware, registers, radiators and covers, exposed piping and electrical panels: To match adjacent surfaces, unless otherwise noted or where pre-finished.

2.5 **GLOSS AND SHEEN RATINGS**

.1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values:

Gloss Level	Description	Units@ 60 degrees	Units@ 85 degrees
G1	Matte or Flat finish	Max. 5	Max. 10
G2	Velvet finish	Max. 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	Min. 35
G5	Semi-Gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	More than 85	

PART - 3 EXECUTION

3.1 CONDITION OF SURFACES

.1 Prior to commencement of work thoroughly examine and test as required conditions and surfaces scheduled to be painted. Do not commence work until adverse conditions and defects have been corrected.

3.2 SURFACE PREPARATION

.1 Prepare all surfaces in accordance with MPI requirements.

.2 Sand, clean, dry, etch, neutralize and test surfaces under adequate illumination, ventilation and temperature requirements.

.3 Remove and securely store miscellaneous hardware, surface fittings and fastenings such as electrical plates, mechanical louvers, door and window hardware, hinges, knobs, locks, trim, frame stops, removable rating/hazard/instruction labels, washroom accessories, light fixture trim, from wall and ceiling surfaces, doors and frames, prior to commencement of work. Carefully clean and replace items upon completion of work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes. Remove doors to finish bottom and top edges and re-hang doors when work is complete.

.4 Protect all adjacent interior surfaces and areas, including rating/hazard/instruction labels on doors, frames, equipment, piping, from painting operations and damage using drop cloths, shields, masking, templates, or other suitable protective means and make good damages caused by failure to provide such protection.

.5 Make good substrate defects and sand ready for finishing particularly after the first coat is applied. Start of finishing on defective surfaces indicates acceptance of substrate and any costs of making good defects shall be borne by this Section including re-painting of entire defective surface.

.6 Confirm preparation and primer used with fabricator of steel items.

3.3 APPLICATION

.1 Do not perform work unless substrates are acceptable and until heating, ventilation, lighting and completion of work of other Sections are acceptable for applications of products.

.2 Apply materials in accordance with MPI Painting Manual Premium Grade finish and manufacturers' requirements.

.3 Work specified is intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.

.4 Tint each coat of finish progressively lighter to enable confirmation of number of coats.

.5 Unless otherwise approved by the Consultant, apply a minimum of four coats of paint where deep or bright colours are used to achieve satisfactory results.

.6 Sand between each coat to provide an anchor for next coat and to remove defects visible from a distance up to 1000 mm.

.7 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.

.8 Paint finish shall continue through behind all wall-mounted items.

.9 Unless noted otherwise, field-apply finish paint to all structural steel work, which will remain exposed and subject to normal view by occupants on the completed interior of the building.

3.4 **INTERIOR FINISHING SYSTEMS**

.1 Finish interior surfaces in accordance with MPI Painting Manual requirements:

.2 Structural Steel and Metal Fabrications:

.1 INT 5.1A: Quick dry enamel semi-gloss finish, Gloss Level 5 (Semi-Gloss)

.3 Galvanized Metal: (Doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etc).

.1 INT 5.3M: High performance architectural latex; semi-gloss.

.4 Plaster and Gypsum Board:

.1 INT 9.2B, High performance architectural latex.

.5 Epoxy Paint for Ceilings and walls:

.1 Primer: type and thickness as recommended by the manufacturer for the substrate intended;

.2 Top coat: Two-component water based catalyzed polyamine epoxy, Pro Industrial (B70 Series) by Sherwin Williams, semi-gloss; two (2) coats, at 2.0-4.0 mils DFT per coat.

3.5 **MECHANICAL, ELECTRICAL EQUIPMENT AND RELATED SURFACES**

.1 Unless otherwise specified or noted, finish all unfinished conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and texture to match adjacent surfaces, in the following areas:

.1 Where exposed-to-view.

.2 In interior high humidity interior areas.

.3 In mechanical and electrical rooms.

.2 Touch up scratches and marks on factory finished equipment with products compatible with factory finish.

.3 Do not paint over nameplates.

.4 Paint the inside of all ductwork where visible behind louvers, grilles and diffusers for a minimum of 450 mm or beyond sight line, whichever is greater, with primer and one coat of flat black paint.

3.6 **FIELD QUALITY CONTROL AND STANDARD OF ACCEPTANCE**

.1 Painted surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent to the Consultant:

.1 Brush and roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.

.2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.

.3 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.4 Damage due to application on moist surfaces or caused by inadequate protection from the weather.

.5 Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

.2 Painted surfaces will be considered unacceptable if any of the following are evident under final lighting source (including daylight) for interior surfaces:

.1 Visible defects are evident on vertical and horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm.

.2 Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.

.3 When the final coat on any surface exhibits a lack of uniformity of colour, sheen, texture, and hiding across full surface area.

.3 Make good painted surfaces rejected by the inspector to approval of Consultant and at the no extra cost to the Owner. Touch up small affected areas. Repaint large affected areas or areas without sufficient material dry film thickness. Remove runs, sags of damaged paint by scraper or by sanding prior to application of paint.

3.7 **PROTECTION**

.1 Protect interior surfaces and areas, equipment and any labels and signage from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.

.2 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.

3.8 **CLEAN-UP**

.1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

.2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

.3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.

.4 Clean equipment and dispose of wash water / solvents as well as all other cleaning and protective materials (e.g. rags, drop cloths, masking papers, etc.), paints, thinners, paint removers / strippers in accordance with the safety requirements of authorities having jurisdiction.

3.9 **EXISTING SURFACES**

.1 Finish or refinish existing surfaces of items or rooms where noted, including new work which has been incorporated into the existing work, such as concrete blocks, concrete, gypsum and other surfaces, and existing work which has been damaged, altered or otherwise disturbed during renovation operations.

.2 Refinish surfaces or rooms adjacent to rooms where alterations or renovations have been carried out and which have been damaged or otherwise disturbed by the alterations or renovations. Where such damages occur, refinish completely.

.3 Remove from existing surfaces rust, scale, oil grease, mildew, chemicals and other foreign matters.

.4 If coatings on existing surfaces have failed so as to affect the proper performance or appearance of materials to be applied, or if such coatings can be easily removed, remove them and prepare the substrates properly. Dull hard or glossy surfaces by sanding, sandblasting or by other abrasive methods prior to finishing.

.5 Refinish surfaces entirely between changes of planes which have been incorporated into the existing work and existing work which has been damaged, altered or otherwise disturbed during renovation operations.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section, including but not limited to:

.1 Wall coverings;

.2 Corner guards

1.2 QUALITY ASSURANCE

.1 Installer: Trained and approved by the manufacturer and having a minimum three years experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.2 Maintenance seminars: Provide, to the Owner, training seminars and recommendations on Product maintenance procedures.

.3 Pre-installation meeting: Two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Consultant of the date and time of the meeting.

.4 Source limitations: Obtain each type of product from a single manufacturer.

.5 Products: Provide like Products from same production run. Install Products in sequence from sequentially numbered dye lots.

1.3 SUBMITTALS

.1 Samples: Three 300 mm x 300 mm samples of each wall covering material and 300 mm long samples of corner guards.

.2 Maintenance data: Printed manufacturer's maintenance instructions giving specific warnings of maintenance practices of substances, which may stain or otherwise damage the wall coverings or handrails.

1.4 SAMPLE INSTALLATION

.1 Apply each type of covering to a sample area on the project and obtain the approval of the Consultant of such applications before proceeding. Locations of sample areas shall be as directed by the Consultant.

.2 Sample areas of wall covering shall be full height, as indicated on Drawings, and include one outside corner and one covering material joint.

.3 Sample areas of rail shall be full length, and include one outside corner, and one end cap.

.4 Promptly revise or replace coverings on sample areas at no additional cost to the Owner until approval of the Consultant is obtained. The approved sample area installations shall be the standard for acceptance of the remaining work.

1.5 **STORAGE**

.1 Store materials with manufacturer's seals and labels intact. Store materials flat in clean, dry storage area at temperatures over 10 deg C and normal humidity.

1.6 **PROJECT CONDITIONS**

.1 Environmental Limitations: Do not commence work until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

.2 Lighting: Do not commence work until a lighting level of not less than 160 lux is provided on the surfaces to receive wall covering.

.3 Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall covering manufacturer for full drying or curing.

1.7 **EXTRA STOCK**

.1 Provide minimum 5% of each type and colour of wall covering and handrail material in unopened packages, and accessories installed. Store the extra materials at locations as directed by the Owner. Extra stock shall be of same production run as installed materials.

PART - 2 PRODUCTS

2.1 **MANUFACTUERER**

.1 Supply products indicated in this Section from a single source manufacturer to ensure like products.

2.2 **MATERIALS**

.1 Basis of Design: Refer to Section 09 06 00, Finishes Schedule, for complete list of corner guards and protective wall covering products, designations, manufacturers, sizes, finishes and colours.

.2 Aluminum Retainers: Extruded aluminum retainers 6063-T6 alloy, nominal 0.62” thick. Minimum strength and durability properties as per ASTM B221. Supplied by manufacturer.

.3 Fasteners: non corrosive and compatible with aluminium retainers supplied by manufacturer.

.4 Adhesive: Mildew resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall covering manufacturer.

.5 Primer/Sealer: Mildew resistant primer/sealer, and recommended in writing by wall covering manufacturer for intended substrate.

.6 Sealant: antimicrobial, 100% silicone sealant.

2.3 **ACCESSORIES**

.1 Wall covering manufacture to supply a packaged system, containing all materials needed for a complete and proper installation.

.2 Supply all primers and adhesive required to install wall coverings, as per manufacturer's recommendations.

PART - 3 EXECUTION

3.1 **INSPECTION**

.1 Examine areas, which are to receive the work of this Section and proceed only if conditions are satisfactory. Verify adequacy of support at substrate. Report unsuitable substrates. Commencement of work shall imply acceptance of conditions.

.2 Substrates shall be smooth, dry, free of dust and dirt.

3.2 **PREPARATION**

.1 Remove materials from packaging and acclimatize materials in the installation areas not less than 24 hours before installation.

.2 Test surfaces for moisture and alkali content prior to application of materials. Moisture content shall be less than 4%. Neutralize and seal surfaces in accordance with manufacturer's directions.

.3 Where substrate has been painted, apply a thin coat of adhesive over substrate and allow drying for one hour.

.4 Comply with manufacturer's written instructions for surface preparation.

.5 Clean substrates of substances that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, dirt, and dust.

.6 Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

.7 Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

3.3 **INSTALLATION – WALL COVERINGS**

.1 Apply materials in strict accordance with manufacturer's instructions and as specified; report discrepancies immediately to Consultant.

.2 Install materials free from tears, ripples or air pockets. Horizontal joints in wall covering are not permitted except upon specific, written approval of the Consultant.

.3 Take special care to prevent plaster particles, grit, dirt, or other extraneous matter from being imbedded beneath the wall covering.

.4 Spread adhesive in a uniform coat to back of material and apply material to wall within time recommended by adhesive manufacturer. Thoroughly wash excessive adhesive off material and adjacent surfaces as application progresses.

.5 On gypsum board construction, avoid scoring gypsum board face by using a metal strip cutting base.

.6 Neatly and carefully trim around fixtures, door frames and the like, as indicated on Drawings.

.7 Match adjacent panels for colour, pattern, texture and direction of nap where applicable. All panels shall be uniform in colour and texture. Remove material, which fails to match when applied, and replace with matching material.

.8 Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

3.4 **INSTALLATION – CORNER GUARDS**

.1 Install work in accordance with manufacturer's written installation instructions and as shown on drawings.

3.5 **PATCHING**

.1 Perform cutting, fitting and patching of wall covering material as required to accommodate fixtures, railing brackets and other appurtenances occurring in surfaces to receive coverings. Maintain covering pattern regardless of position of appurtenances.

3.6 **CLEANING**

.1 Immediately upon completion of installation, clean wall covering and accessories in accordance with manufacturers recommended cleaning method.

.2 Remove surplus materials, and debris upon completion or work.

END OF SECTION

PART - 1 GENERAL

1.1 SECTION INCLUDES

.1 Lead lined gypsum board.

.2 Lead lined fire-rated plywood.

.3 Lead lined steel door frames.

.4 Lead lined steel doors.

.5 Leaded glass.

.6 Lead labels.

1.2 SUBMITTALS

.1 Product data sheets:

.1 Submit manufacturer's Product data sheets for Products proposed for use in the work of this section.

.2 Shop drawings:

.1 Submit engineered shop drawings.

.2 Indicate dimensions, materials, layout, attachment methods, trims and locations of openings, and related work.

.3 Indicate layout of radiation-protected areas.

.4 Indicate lead thickness or lead equivalencies of components.

.5 Indicate anchorage, wall support and framing systems.

.3 Certifications:

.1 Submit written certification of source of supply (including purchase orders and chain of supply/custody), as well as physical properties of materials (from a third party testing laboratory) for confirmation and review of authorities having jurisdiction and Hospital Radiation Protection Officer.

.4 Photographic record:

.1 Submit complete photographic record of each type of lead material installation.

.2 Photographic record shall be done prior to installation of finish materials or covering of the work of this section.

.3 Submit 3 copies of photographic record of finished installation in each location.

1.3 CLOSEOUT SUBMITTALS

.1 Maintenance Instructions:

.1 Submit maintenance instructions for incorporation in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

.1 Retain a Professional Engineer registered in the Site to design the work of this section; to prepare, seal and sign shop drawings; and to perform field review. Shop drawings shall show both design and installation requirements.

.2 Execute the work of this section only by a Subcontractor who has adequate plant, roll forming machinery, equipment, and skilled workers to perform it expeditiously, and is

known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past 5 years.

.3 Mock-ups:

.1 Construct mock-ups in locations as indicated by Consultant, provide typical installation of each type, complete with lead shielding, including door/window frame and partition junction, and electrical box and pipe intrusions. Modify mock-ups as directed and as required to obtain approval of the Consultant.

.2 Do not proceed with remainder of installation until mock-up installation has been reviewed and accepted by Consultant.

.3 Accepted mock-up may become a part of the final Work.

PART - 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers: Unless otherwise indicated.

.1 MarShield - Division of Mars Metal Company.

.2 Mayco Industries, Inc.

.3 Nelco.

.4 Pitts Little Corporation.

.5 Ray-Bar Engineering Corporation.

2.2 DESIGN REQUIREMENTS

.1 Radiation shielding shall meet the requirements of the Contract Documents, of authorities having jurisdiction, and of Hospital Radiation Protection Officer.

.2 Supports and support framing for lead Products shall be designed to withstand loads, without deflection that might impair the continuity of radiation protection.

.1 Supports and support framing shall maintain lead Products in place without any vertical slip movement or displacement of the lead Products due to the weight of the lead.

.3 Design radiation shielding to provide equivalent thickness in any straight line with no gaps in system.

.4 Seismic restraint: Design and install radiation protection systems, including support framing, and fastening and anchoring systems, to withstand the effects of earthquake motions in accordance with building code.

2.3 GENERAL

.1 Provide reinforcing, fastenings, and anchorage required for building-in of Products.

.2 Specified materials are minimum acceptable quality. Manufacturer’s standards exceeding specified quality shall be accepted.

2.4 LEAD MATERIALS

.1 Rolled lead sheet: 99.9% pure unpierced virgin lead, free from dross, oxide inclusions, scale, laminations, blisters, and cracks, to ASTM B749.

.1 Thickness: as required to meet applicable codes and standards.

.2 Variation in thickness: Not to exceed 3%.

.2 Lead plate: 99.9% pure virgin lead, free from dross, oxide inclusions, scale, laminations, blisters and cracks, to ASTM B749.

.1 Thickness: as required to meet applicable codes and standards.

.2 Variation in thickness: Not to exceed 3%.

2.5 **RADIATION-SHIELDED DOORS, FRAMES AND SCREENS**

.1 Lead lined steel doors:

.1 Steel doors in accordance with Section 08 11 13.

.2 Heavy duty doors; steel stiffened:

.1 Face sheets fabricated from: 14 gauge steel.

.2 Steel stiffened core.

.3 Securely install lead sheet lining to inside of scheduled door faces.

.4 Longitudinal edges continuously welded the full height of the door, filled and ground smooth with no visible seams.

.2 Lead lined steel door frames:

.1 Steel door frames in accordance with Section 08 11 13.

.2 Fabricated from:

.1 16 gauge steel.

.3 For frames with lead thickness of 3 mm (1/8”) or greater:

.1 Provide steel angle reinforcing, spot welded at 152 mm (6”) on centre, with anchor bolts to secure frame.

.4 Design lead lined door frames to accommodate lead lining up to 13 mm (1/2”) thick.

.5 Door frame supports: minimum 57 mm (2-1/4”) steel angle.

.6 Securely install lead lining to inside of frame profile from jamb return to jamb stop on the door side of frame only where indicated on drawings or as required to meet applicable codes and standards.

2.6 **LEADED GLASS**

.1 X-ray protective glass or leaded glass:

.1 Thickness: various, refer to drawings for locations.

.2 Acceptable Product:

.1 ‘Type LX-57B’ as manufactured by Nippon Electric Glass Company Ltd. and as distributed by Technical Glass Products.

.2 Subject to compliance with the Contract Documents, acceptable equivalent Products of the following manufacturers may be used upon approval:

.1 A&L Shielding.

.2 Ameray Corp.

2.7 **LEAD LAMINATED GYPSUM BOARD**

.1 Lead laminated gypsum board; fire-rated:

.1 Single unpierced layer of sheet lead laminated to back of gypsum board with a specially formulated core for use in fire-resistive Type X or Type C designs, to ASTM C1396/C1396M.

2.8 **LEAD LINED FIRE-RATED PLYWOOD**

.1 Lead lined fire-rated plywood:

.1 Construction: 12 mm (1/2") thick lead lining on 19 mm (3/4") thick fire-retardant-treated plywood.

.2 Provide required lead battens and lead corner battens as required to suit layout in accordance with the Contract Documents.

.3 Fasteners: Screw with lead disc covers as recommended by lead lined plywood manufacturer.

.4 Acceptable Product:

.1 Nelco 'Lead Lined Plywood'.

2.9 **ACCESSORIES; LEAD LINED GYPSUM BOARD AND LEAD LINED PLYWOOD**

.1 Screw fasteners: Type S bugle head, length as required.

.2 Lead strips: 51 mm (2") wide, unless indicated otherwise, by same thickness as sheet lead laminated on gypsum board and plywood.

.3 Lead angles: Leak-proof, lead angle system providing complete coverage of gamma rays used in lieu of lead strips and lead discs where sheet lead thickness is greater than 3 mm (1/8") thick.

.4 Lead discs: 9.5 mm (3/8") diameter lead discs for use with screw heads.

.5 Adhesive: Acceptable to radiation protection Product manufacturer and capable of adhering lead sheets where required.

2.10 **LEAD LABELS**

.1 Lead labels:

.1 Type 1: Lead label 15.9 mm x 50 mm x 0.635 mm (5/8" x 2" x 24 gauge) stainless steel plate with edges ground smooth. Stamp lead thickness on plate with minimum 3.2 mm (1/8") high lettering. Secure plates with stainless steel screws to lead lined building components in locations as directed by Consultant.

.2 Type 2: Lead label 50 mm x 100 mm x 0.635 mm (2" x 4" x 24 gauge) stainless steel plate with edges ground smooth. Stamp lead thickness on plate with minimum 9.5 mm (3/8") high lettering. Secure plates with stainless steel screws to wall containing lead in locations as directed by Consultant.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Verification of conditions:

.1 Examine areas and conditions under which work of this section is to be performed and identify conditions detrimental to proper or timely completion.

.2 Do not proceed until unsatisfactory conditions have been corrected.

3.2 **COORDINATION**

.1 Refer to mechanical, electrical and plumbing drawings for utility penetrations and shielding.

.2 Items furnished by other sections for installation into this section shall be installed in accordance with the requirements of such other sections, providing such requirements do not violate the shield.

.3 Items furnished by this section for installation into the work of other sections shall be furnished sufficiently early to the proper section for timely installation.

.4 Perform work of this section in proper sequence with the work of other sections and trades and in strict conformance with the reviewed shop drawings.

.5 Coordinate as required with other trades to assure proper and adequate provision in the work of those trades that interface with the work of this section.

3.3 **INSTALLATION**

.1 Shielding shall be continuous within its limits, with soldered seams, where other work, materials or accessories penetrate the shielding, all penetrations must be approved by shielding Subcontractor.

.2 Installation shall be by the manufacturer's field installation technicians.

.3 Supplier shall provide information and templates required for installation of the work of this section, and assist or supervise, of both, the setting of anchorage devices, and construction of other work incorporated with products specified in this section in order that they function as intended.

.4 Install work to meet manufacturer's recommended specifications, true, tightly fitted, and level or flush to adjacent surfaces, as suitable for installation.

.5 Provide lead sheet envelope to enclose back and sides of all items and equipment recessed in solid masonry walls, and in locations so noted. Form lead so as not to reduce the effective thickness at any location. Lead shall not be pierced for fastenings unless essential and pierced areas shall be covered with sheet lead lapped to ensure continuity of protection.

.6 Cabinets, pipes, conduits or any other materials built-in to, or projecting through, lead lining shall be shielded with 1.6 mm (1/16") thick sheet lead. Overlap sheets a minimum of 50 mm (2").

.7 Complete room installation shall provide a continuous uninterrupted membrane protection to heights and areas indicated and be free of holes, cracks or areas of penetration by radiation.

3.4 **INSTALLATION – DOOR, FRAME AND SCREEN**

.1 Lead lined frames:

.1 Install lead lined steel door and screen frames in accordance with Section 08 11 13.

.1 For lead lining less than 3 mm (1/8") thick:

.1 Secure door frames with steel stud anchors.

.2 For lead lining 3 mm (1/8") thick or greater:

.1 Provide door frame supports:

.1 Run steel angle supports full height on each door frame jamb to structure above.

.2 Secure supports to structure.

.3 Spot-weld supports at 152 mm (6”) along jambs and at corners of jambs and head frame.

.4 Anchor frame to substrate with fasteners appropriate for substrate.

.5 Apply coating of asphalt mastic or paint to lead lining in door frames where lead will come in contact with masonry or grout.

.2 Provide minimum 3 anchors per jamb, located adjacent to hinge on hinge jamb, and at corresponding heights on strike jamb.

.3 In metal stud construction, use wall anchors attached to studs with screws.

.4 Lap lead lining of frames over lining in walls at least 25 mm (1”).

.5 Lead lining of frames:

.1 Line inside of frames with lead of thickness not less than that required in doors and walls in which frames are used. Form lead to match frame contour, continuous in each jamb and across head, lapping stops. Form lead shields around areas prepared to receive hardware. Lap lead lining over lining in walls by minimum 25 mm (1”).

.2 Lead lined doors:

.1 Install lead lined steel doors in accordance with Section 08 11 13.

.2 Install doors in frames level and plumb, aligned with frames and with uniform clearance at edges.

.3 Hardware:

.1 Install finish hardware in accordance with Section 08 71 00.

.2 Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors.

.3 Coordinate with requirements of Section 08 71 00 for other installations requirements.

.4 Hinge reinforcements for lead-lined doors shall be 3.51 mm (0.138") 10 gauge minimum with each cut-out provided with 114.3 mm (4.5”) heavy weight 4.6 mm (0.180”) high frequency type reinforcing.

3.5 **INSTALLATION – PENETRATION ITEMS**

.1 Provide lead shields to maintain continuity of protection at penetrations of lead linings.

.2 Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.

.3 Cut wall penetration covers from lead sheet of equal or greater thickness than backing on adjacent wall panels. Cut wall penetration covers to size required to cover wall penetrations with laps 25 mm (1”) minimum wide.

.4 Adhesive-apply lead sheet penetration covers on penetrating boxes and raceways and return penetration covers to backside of lead-backed wall panels with 25 mm (1”) minimum laps.

.5 Do not use penetrating fasteners unless indicated otherwise.

.6 Outlet boxes and conduit: Install between studs using steel telescoping mounting brackets. Cover or line with lead sheet lapped over adjacent lead lining at least 25 mm (1”). Wrap conduit with lead sheet for a distance of 250 mm (10”) from box.

3.6 **INSTALLATION – WALL PENETRATION COVERS**

.1 Duct penetrations; with 8 psf or less of lead sheet:

.1 Wrap ducts with wall penetration covers, lapping lead joints 25 mm (1”) minimum.

.2 Secure lead sheet in place with 25 mm (1”) minimum width steel bands spaced not more than 305 mm (12”) on centre.

.3 Do not cut into lead sheet with tightening steel bands.

.2 Duct penetrations; with greater than 8 psf of lead sheet and where duct shielding exceeds 610 mm (24”) in width:

.1 Laminate wall penetration covers to plywood or other similar structural panels conforming to shape of duct, lapping lead joints 25 mm (1”) minimum.

.2 Secure lead laminated panels to ducts with mechanical fasteners located at duct seams and corners.

.3 Where necessary to prevent lead laminated panels from overloading duct supports, independently suspend panels from hangers secured to overhead building structure.

.4 Cover fastener heads with lead sheet matching thickness of adjacent lead.

.3 Piping: Unless indicated otherwise, wrap piping with lead sheet for 250 mm (10”) from point of penetration.

3.7 **INSTALLATION - LEAD-LAMINATED GYPSUM BOARD**

.1 Installation to comply with gypsum board manufacturer's written recommendations and with Section 09 29 00.

.2 Adhere lead strips on face of studs at joints in lead-laminated gypsum board, including inside and outside corners. Use 50 mm (2”) wide strips by same thickness as sheet lead laminated on gypsum board.

.3 Shim studs and other framing members as necessary to provide flat, flush finished surfaces.

.4 Install lead-laminated gypsum board on framing with screws spaced not more than 203 mm (8”) on centre along edges of board and 305 mm (12”) on centre in field of board.

.5 Adhere lead discs to fastener heads. In each case, use method that provides continuous radiation shielding.

.6 Where lead-laminated gypsum board is final substrate, apply joint treatment on fasteners and joints in accordance with Section 09 21 16.

.7 Where second layer of gypsum board occurs over lead-laminated gypsum board, comply with Section 09 21 16 for application of second layer gypsum board.

3.8 **INSTALLATION – LEAD LAMINATED PLYWOOD**

.1 Install lead lined plywood on metal framing system in strips extending across face of framing flanges and wrapped around flange and secured with screws to framing, in accordance with lead lined plywood manufacturer’s written installation instructions.

.2 Install lead batten at joints and corner locations as required to ensure continuity of radiation protection.

.3 Secure lead lined plywood with screw, complete with lead disc, fasteners at spacing as recommended by lead lined plywood manufacturer's recommendations.

3.9 **INSTALLATION - FLOOR LEAD**

.1 At concrete floor slabs:

.1 Thoroughly cleaned and smooth, and free of defects that might cause damage to lead.

.2 Floor slab shall be cured a minimum of 90 days.

.3 Before installation of lead, coat concrete surfaces with 2 coats of asphalt-base emulsion conforming to ASTM D1187.

.4 Lap sheets of floor lead not less than 38 mm (1-1/2").

3.10 **CLEANING AND ADJUSTMENT**

.1 Immediately remove all spots, smears, stains, residues, adhesives, etc., from work of this section and/or upon adjacent areas or surfaces which result from the work of this section.

.2 Upon completion of the work of this section, dispose of all debris, trash, containers, residue, remnants and scraps which result from the work of this section.

.3 Check and readjust operating hardware items, leaving doors and frames undamaged and in proper operating condition.

.4 Leave exposed surfaces ready for site finishing.

3.11 **PROTECTION**

.1 Protect work of this section against damage, should damage occur prior to Substantial Performance of the Work, it shall be removed and replaced at no additional expense to the Owner.

.2 Lock radiation-protected rooms once doors hardware is installed. Limit access to only those persons performing Work in radiation-protected rooms or as directed by the Owner.

.3 Tape temporary paper signs on radiation-resistant walls with the following text:

.1 "Radiation Shielded Assembly - Do not make penetrations or mount equipment on this wall without prior approval of the Owner".

3.12 **FIELD QUALITY CONTROL**

.1 Coordinate field reviews of installations for review by Consultant and the Hospital Radiation Protection Officer before building-in finishes, enclosing, or covering the work of this section.

.2 The Owner will initiate radiation leakage testing by Ministry of Health, Radiation Inspection Service, Institutional Services Branch.

.3 If tests reveal radiation leakage, Contractor shall make remedial repairs to ensure a leak-free installation at no additional cost to the Owner.

.4 Manufacturer and Independent inspection and testing company shall attend the pre-installation meeting.

END OF SECTION

HHAngus

Sunnybrook
HEALTH SCIENCES CENTRE

Mechanical Specification

FOR

SUNNYBROOK HEALTH SCIENCES CENTRE

M-Wing Level 2
Hybrid Operating Room
2075 Bayview Ave.
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MECHANICAL TABLE OF CONTENTS

Division 25

MECHANICAL GENERAL REQUIREMENTS
20 01 01

1 GENERAL

1.1 General Contract Documents

.1 Comply with General Conditions of Contract, Supplementary Conditions and Division 1 - General Requirements.

1.2 Work Included

.1 Work to be done under Divisions 20, 21, 22, 23 and 25 to include furnishing of labour, materials and equipment required for installation, testing and putting into proper operation complete mechanical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

1.3 Document Organization

.1 Applicable Divisions for Mechanical Work:

.1 Division 20 - Common Work for Mechanical

.2 Division 21 - Fire Protection

.3 Division 22 - Plumbing and Drainage

.4 Division 23 - Heating, Ventilation and Air Conditioning (HVAC)

.5 Division 25 - Building Automation System

.2 For clarity, any reference in the Contract Documents to Division 20 includes Divisions 21, 22, 23 and 25.

.3 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.

.4 Contractor is responsible for completion of work whether or not portions are sublet.

1.4 Division 20, as it applies to Divisions 21, 22, 23 and 25

.1 Articles that are of a general nature, applicable to each Section of these Divisions.

.2 Articles specifying materials, equipment, installation techniques and workmanship that are applicable to more than one Section of these Divisions.

.3 Articles that are to be read in context with and form part of relevant Sections of these Divisions.

1.5 Definitions

.1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in this Specification, mean that material or item referred to is "indicated", "shown", "listed" or "noted" on Drawings or in Specification.

.2 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases used in this Specification, mean that material or item referred to is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by", Consultant.

.3 Instructions using any form of word "provide" involves Contractor in furnishing labour, materials and services to supply and install referenced item.

1.6 Language

.1 The specification is written as a series of instructions addressed to the Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where list follows a semi-colon (;) the punctuation is for clarity. Where a list follows a colon (:) the punctuation is to be read as a short-hand form of the verb “to be” or “to have” as context requires.

.2 It is not intended to debate with the Contractor the reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

1.7 Examination

.1 Examine any existing buildings, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of the work.

.2 No allowance will be made for any expense incurred through failure to make these examinations of the site and the documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender.

.3 Examine work of other Divisions before commencing this work, and report any defect or interference.

1.8 Design Services

.1 Provide design services for elements of the Work where specified in other sections of Division 20, sealed by a professional engineer licensed in the applicable jurisdiction.

1.9 Standard of Material and Equipment

.1 Provide materials and equipment in accordance with this Division.

.2 Materials and equipment:

.1 new and of uniform pattern throughout work,

.2 of Canadian manufacture where obtainable,

.3 standard products of approved manufacture.

.4 labeled or listed as required by Code and/or Inspection Authorities,

.5 registered in accordance with the requirements of TSSA Boilers and Pressure Vessels Safety Division Guidelines for the Registration of Non-nuclear Fittings in the Province of Ontario,

.6 in compliance with Standards and Regulations with respect to;

(a) chemical and physical properties of materials,
(b) design,
(c) performance characteristics, and
(d) methods of construction and installation.

.7 identical units of equipment to be of same manufacture.

.8 identical component parts of same manufacture in similar units of equipment, but various component parts of each unit need not be from one manufacturer.

.3 Materials and equipment are described to establish standards of construction and workmanship.

.1 Where manufacturers or manufacturers' products are identified in lists with the phrase "Standard of Acceptance", these are manufacturers and/or products which meet required standards with regard to performance, quality of material and workmanship.

.2 Manufacturers and or products used are to be chosen from these lists.

.3 Alternatively, the Contractor has the option to propose an alternative according to the Substitution process outlined in Specification Section 01 25 00

.4 Similarly the term "or approved equal" refers to a manufacturer, supplier or manufacturers' product that has been accepted as part of the Substitution Process outlined in Specification Section 01 25 00

.4 Select materials and equipment in accordance with manufacturer's recommendations and install in accordance with manufacturer's instructions.

.5 Materials and equipment not satisfying these selection criteria will be condemned.

.6 Remove condemned materials from job site and provide properly selected and approved materials.

1.10 Basis of Design

.1 Specifications, floor plans, schematics and schedules have been created using a "Basis of Design"

.1 The "Basis of Design" component is as indicated on the schedules, drawings and/or in the specifications under Standard of Acceptance.

.2 The contractor is to select equipment, as specified, under "Standard of Acceptance" and make any changes to work as necessary to install selected equipment.

.1 Costs for re-design, preparation of drawings and details, and changes to scope (for all trades) by the implicit use of equipment under the "Standard of Acceptance", will be the burden of the contractor.

1.11 Substitutions

.1 The use of a substitute article or material which the manufacturer represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions:

.1 a substitution will not be considered for reasons of meeting the construction schedule unless the contractor can demonstrate to the satisfaction of the [Consultant][Engineer] they made all reasonable efforts to procure the specified product or material in a timely fashion,

.2 the manufacturer must advise the Consultant of this intention to use an alternative article or material before doing so,

.3 the burden of proof as to the quality and suitability of alternatives to be upon the manufacturer and they shall supply all information necessary as required by the [Consultant][Engineer] at no additional costs to the contract,

.4 the Consultant to be the sole judge as to the quality and suitability of alternative materials and their decision to be final,

.5 where use of an alternative material involves redesign or changes to other parts of the work, the costs and the time required to effect such redesign or changes will be considered in evaluating the suitability of the alternative materials,

.6 no test or action relating to the approval of substitute materials to be made until the request for substitution has been made in writing by the manufacturer and has been accompanied by complete data as to the quality of the materials proposed. Such request to be made in ample time to permit appropriate review without delaying the work, taking into consideration that such a

substitution request may be rejected and require providing the product or material as originally specified,

.7 Whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials to be accompanied by reports from the equivalent body indicating compliance with the requirements of the specifications,

.8 The costs of all testing required to prove equality of the material proposed to be borne by the manufacturer.

1.12 Owner's Special Requirements for existing sites

.1 Provide a written list of names for employees and sub-trades entering the building, advising which areas they need access to at least 48 hours prior to expected time of arrival. This lead time is required to prearrange security passes.

.2 Security Passes must be visibly worn at all times by all employees.

.3 All trades people must strictly adhere to Building Security regulations or entrance into the building will be denied.

.4 All trades people are to enter the entrance identified by the Owner. Vehicles are to be parked in proper designated areas. Driveways are not to be blocked.

.5 Freight elevator must be used at all times to transport tools and material. Freight elevator door must be shut immediately after exiting the cab.

.6 Under no circumstances are any electrical or mechanical systems to be disabled or activated without prior knowledge and approval by the Owner's Project Manager. Prior to disabling or activation of any electrical or mechanical systems, Building Operations and Building Security must also provide approval.

.7 Prior notification must be forwarded to Building Security Staff before any construction activity can start which will result in heat, smoke, dust or fumes, such as sawcutting, soldering, spray painting, which can affect the sensitive fire protection equipment.

.8 Schedule work and meet the sub-trades daily on site, showing all trades people the work areas and work to be done.

.9 Trades-people are to supply and use their own tools. No tools, ladders or equipment, etc. will be loaned by the Owner.

.10 Contractor is responsible for all associated environmental cleaning to the job site, daily during construction and upon completion. This includes both under raised floor and above ceiling. No materials or garbage will be permitted to be stored on the loading dock.

.11 Special care and attention must be adhered to at all times when transporting equipment and materials to prevent accidental damage to the fire protection equipment and all furnishings and fixtures.

.12 "No Smoking" - smoke free building. Violators will be denied entry. Smoking is not allowed on the roof.

.13 If Building Operations deems that work on a particular system requires security escort, allow 48 hours to make appropriate arrangements.

.14 For any fire system isolation requests, allow for 24 hours notification to Building Operations.

.15 For any open flame work, a fire extinguisher and security fire watch is required, and will be provided and paid for by Owner. Provide 24 hour notice prior to work to allow Owner to make necessary arrangements.

.16 Storage of materials on site must be cleared through the Building Manager.

.17 Contractors must perform a daily cleanup prior to leaving the site.

.18 Oxygen and acetylene cylinders are to be secured at all times and capped nightly.

.19 Work performed on operating and redundant systems must be restored to their normal condition at the end of each work day unless otherwise approved by the Owner.

.20 At the conclusion of each work day, the Contractor's superintendent is to advise the Building Manager on the day's activities and plans for the next day's work. A security escort will be required for any work being done in secured areas, e.g. raised floor, computer room and mechanical/electrical rooms.]

2 SUBMITTALS

2.1 Shop Drawings and Product Data Sheets

.1 Submit shop drawings, manufacturers and product data and samples in accordance with this Section.

.1 Submit shop drawings in the same unit of measure as are used on the drawings. Both metric and imperial measures may be included.

.2 Submitted shop drawings by email to: shopdrawings@hhangus.com

.2 Include a H.H. Angus shop drawing cover sheet form prepared for this project, for each shop drawing, or, include the same information on the general or trade contractor's submittal cover sheet:

.1 Information required on each submission:

(a) Client/Architect name
(b) Project Name
(c) H.H. Angus project number
(d) Date
(e) Contractor name
(f) Contractor reference no.
(g) Manufacturer name
(h) Product type
(i) Specification section number
(j) Contractor trade: mechanical, electrical, elevators, or general trades
(k) If a re-submission, the previous submission H.H. Angus reference number.

.3 Submit shop drawings in PDF format;

.1 If submitted in hardcopy format, submit in 8.5 x 11 or 11 x 17 size, black and white originals of graphic quality suitable for photocopying. Allow one additional week for processing of shop drawings submitted in hardcopy format.

.2 for each item of equipment[.][in following list;

(a) plumbing fixtures,
(b) pumps,
(c) air moving units,
(d) heating units,

(e) coils,
(f) motor controls centers
(g) motor starters, and
(h) special systems.

.4 Manufacturer's letter sized printed data sheets, as black and white originals of graphic quality suitable for photocopying, are acceptable in place of shop drawings for standard production items.

.5 Submit with manufacturers data sheets, typed schedules listing manufacturer's and supplier's name and catalogue model number for;

(a) valves,
(b) traps,
(c) expansion joints,
(d) pipe hangers

.6 For[plumbing fixtures and lighting fixtures][plumbing fixtures][lighting fixtures], submit fixture cuts with catalogue numbers for fixtures to be used on job. Identify and arrange fixture cuts in same sequence as specification fixture list.

.7 Shop drawings and product data to show;

(a) dimensioned outlines of equipment
(b) dimensioned details showing service connection points.
(c) elevations illustrating locations of visible equipment such as gauges, pilot lights, breakers and their trip settings, windows, meters, access doors.
(d) description of operation.
(e) single line diagrams.
(f) general routing of bus ducts and connecting services.
(g) mounting and fixing arrangements.
(h) operating and maintenance clearances, and
(i) access door swing spaces.

.8 Shop drawings and product data to be accompanied by;

(a) detailed drawings of bases, supports and anchor bolts,
(b) sound power data, where applicable, and
(c) performance curve for each piece of equipment marked with point of operation.

.9 Shop drawing and data sheet submission is taken as certification;

.1 that units are from Manufacturer's current production and

.2 in compliance with applicable Codes, Standards, and Regulations.

.10 Do not submit drawings showing internal construction details, component assemblies or interior piping and wiring diagrams. These may be necessary to understand correct functioning of equipment and should be submitted with operating and maintenance data.

.11 Check and stamp each shop drawing as being correct before submission. Shop drawings without such stamps will be rejected and returned.

.12 Keep one copy of each reviewed shop drawing and product data sheet on site available for reference purposes.

.13 Where equipment is delivered without reviewed shop drawing available on site, equipment will be condemned and is to be removed from site and replaced with new equipment after shop drawing has been submitted and reviewed.

2.2 Field, Fabrication, or Installation Drawings

.1 Contractor field, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal only will be returned identifying the submitted drawings have not been reviewed.

.2 Maintain a copy on site of such drawings for reference by the Consultant.

.3 Provide a copy of such drawings to the Consultant for general information purpose only, upon request.

3 BILLING BREAKDOWN

.1 Immediately after award of contract, submit detailed mechanical billing breakdown of values. Breakdown to be sufficiently detailed into equipment and labour components for all mechanical systems. Breakdown will form the basis of monthly progress draws. Revise breakdown to reflect requirements of Inspector and resubmit. No billing will be approved without having an approved contract breakdown.

.2 Regardless of actual value, Contractor to allow a line item in submitted breakdown for "**coordination, fabrication and installation design drawings"** with a value equal to a minimum of 5% of the mechanical contract.

.3 Regardless of actual value, Contractor to allow a line item in submitted breakdown **"as-built and manuals"** with a value equal to a minimum of 2% of the mechanical contract price.

.4 Payment for the amounts noted above will be withheld until the submittals are received and approved. Failure to submit drawings and manuals meeting the requirements laid out in the contract documents will result in a change order being issued to delete the specified amount from the contract value.

4 PRICING OF CHANGE NOTICES

.1 The value of a proposed change in the work shall be determined in one or more of the following methods:

.1 by time and material;

.2 by unit prices set out in the Contract or subsequently agreed upon:

.3 by labour and material costs submitted in a detailed quotation.

.2 In the case of changes in the Work to be paid for under the time and material or the unit price methods, the form of presentation of costs and methods of measurement shall be agreed to by the Consultant and Contractor before proceeding with the change. The Contractor shall keep accurate records, as agreed upon, of quantities or costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices where applicable.

.3 In the case of changes in the Work to be paid for under the time and material or the labour and material method, the material costs are to be less trade discounts. The discount to be provided from list price for items included in AllPriser guideline is 20%.

.4 The detailed quotation referenced under the labour and material method is to include a summary of charges made up of three components: labour charges, material costs and fees.

.1 Labour Charges

(a) The labour hour estimates are to be based on the current MCA manual for labour.
(b) Labour costs are to include burden on wages such as taxes, worker compensation charges, CPP, EI, project insurance, safety meetings, estimating, as-built drawings, supervision, small tools, site facilities, parking, labour warranty and clean up.
(c) The all inclusive hourly labour rate applicable for quotations submitted for changes to the work is 1.90 times the BASE RATE of the current Collective Agreement (ie if current rate for a Journeyman is $31.70 x 1.9 = $60.23 per hour per hour. The hourly labour rate for specialists not governed by union agreements (technicians or engineers) is 2.25 times the base rate for Mechanics.
(d) The all inclusive hourly labour rate indicated above is to include:
- Collective Agreement relevant to the place of work (vacation pay, RRSP, Health & Welfare, RST of Health & Welfare, Pension, Union admin fund, ECA fund (or others), Secretariat.)
- Legislation as relevant to the place of work (Emp. Health Tax, E.I., CPP, WSIB, taxes)
- Project insurance, safety meetings, estimating, lay outs, site facilities, warranties, storage,
- clean up, office supervision and miscellaneous charges.

(e) Foreman Mechanical, General Foreman, Superintendent rates shall be as for the calculated Journeyman rate above plus 15% of the base rate. A maximum of 10% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the Foreman rate.
(f) A maximum combined amount of 3% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the General Foreman / Supervisor rate.
(g) No other overhead supervision hours will be permitted.

.2 Material Charges

(a) Material costs are to be less trade discounts. The discount for items included in the AllPriser manual is 20%.

.3 Fees

(a) The overhead and profit fee is to include for the Contractor's head office and site office expenses, project manager, assistants, site office and storage facilities, utility charges, site security, telephone and facsimile transmission costs, As Builts, expendable small tools, financing costs, coffee breaks, site facilities, general clean up and disposal, security, storekeeper, and all other non-productive labour.
(b) Contractor is allowed a combined overhead and profit fee of 15% for work to be performed by his own forces.
(c) Contractor is allowed an overhead and profit fee of 5% for work performed by a Sub-Contractor
(d) Sub-Contractor is allowed an overhead and profit fee of 5% for work performed by a Sub-Subcontractor.

5 REFERENCE CODES STANDARDS AND REGULATIONS

5.1 Codes, Standards and Regulations

.1 Latest current versions in force at time of Tender.

.2 Where relevant documents applicable to this work exist, follow these criterion, recommendations, and requirements as minimum standards.

.3 In event of conflict between codes, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring application of most demanding requirements.

5.2 Confined Spaces

.1 Unless otherwise proscribed by the Constructor's / Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as "confined spaces", including but not limited to:

.1 horizontal and vertical service spaces, shafts, and tunnels,

.2 inside of equipment which permits entry of the head and/or whole body, and

.3 ceiling spaces which are identified as containing a hazardous substance.

5.3 Permits, Tests and Certificates

.1 Arrange and pay for permits, tests, and Certificates of Inspection required by Authorities having jurisdiction.

.2 Submit applications requiring Owner's signature before commencing work.

.3 Obtain and submit Inspection Certificates for

(a) Electrical Inspection.
(b) Plumbing Inspection.
(c) Pressure Vessel Inspection.
(d) Piping and Boiler Inspection.
(e) Fuel safety Inspection.

.4 Certificates to be renewed as to remain in force for guarantee period.

.5 Co-ordinate and perform testing required by Authorities having jurisdiction in accordance with Clause **TESTING** in this Section

6 EQUIPMENT

6.1 Manufacturers Nameplates

.1 Metal nameplate with raised or recessed lettering, mounted on each piece of equipment.

.2 On insulated equipment, mechanically fasten plates on metal stand-off bracket arranged to clear insulation and mount Underwriters Laboratories and/or CSA registration plates on same stand-off brackets.

.3 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating of motors, and approval listings.

6.2 Factory Applied Finish Painting

.1 Apply prime and final paint coats to equipment and materials where specifically detailed in Sections of these Divisions.

.2 Apply prime and final paint coats factory to pumps, air moving units, un-insulated pressure vessels and bare metal equipment items in boiler, mechanical and fan rooms.

.3 Use heat resistant paint where conditions require.

.4 Protect factory finished equipment during construction, and clean at completion of work.

6.3 Factory Applied Prime Painting

.1 Have prime paint factory applied to other equipment fabricated from iron or steel including access doors, registers, grilles, diffusers, dampers, metal radiation enclosures and fire hose cabinets.

6.4 Field Painting

.1 After equipment has been installed and piping and insulation is completed, clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted.

.2 In "occupied" areas of building touch up any damage to prime coat resulting from shipping or installation and leave ready for final painting under Finishes, Division 9.

.3 In "un-occupied" areas of the building such as mechanical equipment rooms, boiler rooms, fan rooms, crawl spaces, pipe tunnels and penthouses:

.1 paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% Alkyd base enamel in an approved colour; and

.2 paint exposed iron or steel work with one coat of chrome oxide phenolic base primer and one coat of 100% Alkyd base enamel in an approved colour.

6.5 Provision for Future

.1 Where space is indicated as reserved for future equipment or for future extension to building, leave such space clear and install piping, raceways and equipment so that connections can be made to future apparatus or building.

.2 Identify provisions and service terminations for future on Record Drawings.

6.6 Maintenance of Bearings

.1 "Turn over" rotating equipment at least once a month from delivery to site until start-up.

.2 "Run-in" sleeve type bearings in accordance with manufacturer's written recommendation. After "run-in", drain, flush out and refill with new charge of oil or grease.

.3 Protect bearings, shafts and sheaves against damage, corrosion and dust accumulation during building construction.

6.7 Pre-purchased Equipment Damage and Ownership

.1 At time of receipt of pre-purchased or pre-tendered equipment at job site by the installing mechanical contractor, the manufacturer/Distributor/supplier technical representative to be present to inspect the equipment prior to unloading and report any damage to the [Consultant][Engineer]. The technical representative to also witness the unloading and advise the contractor on the appropriate method for handling the equipment in order to avoid damage during the unloading, moving and setting in place phase of the equipment.

.2 In the event the equipment has been found to be damaged before unloading it is to be returned immediately to the factory for repairs and/or replacement by the manufacturer/supplier.

.3 In the event of damage occurring at any time during unloading and until the equipment is accepted by the Owner, the installing contractor is responsible for repairs and/or replacement to the satisfaction of the Owner.

7 OFFICE, STORAGE AND TOOLS

7.1 Office and Storage

.1 Provide temporary office and lunchroom facilities, workshop, and tools and material storage space. Facilities may be site trailers or as otherwise approved by the General Contractor/Construction Manager.

.2 Assume responsibility for security of these facilities and provide heat, light and telephone and Internet service

.3 Owners cafeteria is off limits.

7.2 Appliances and Tools

.1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, required to carry out work.

8 COORDINATION

8.1 General

.1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductwork, piping, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as “double line”, they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

.2 Lay out and coordinate Work to avoid conflict with work under other Divisions.

.3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.

.4 When equipment provided under other Sections connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

.5 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.

.6 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.

.7 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.8 Location of floor drains, hub drains, combination drains, plumbing fixtures, convectors, unit heaters, diffuser, registers grilles and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.

.9 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the work as an operating installation.

8.2 Field, Fabrication, and Installation Drawings

.1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades.

.1 Drawing scale: minimum 1:50 (1/4"=1'-0")

.2 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.

.3 Layout equipment and services to provide access for repair and maintenance.

.4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;

.1 “This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants’ review”.

8.3 Cutting and Remedial Work

.1 For details of cutting and patching and Division of Work refer to Division 1.

.2 Assume responsibility for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing trades and similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade whose work is involved to do such cutting and patching. Pay for any resulting costs. Layout such work for approval by the Structural Engineer before undertaking same.

.3 Neatly cut or frill holes required in existing construction to accommodate cable, raceways, bus duct or cabletray.

.4 Division 20 contractor to be responsible for arranging and paying for all cutting and patching as required for own work. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Consultant’s approval of location and methods in writing. Employ original installer or expert in the finishing of material required to perform cutting or patching for weather exposed or moisture resistant elements or sight exposed surfaces.

.1 Layout cutting of structural elements, such as floors slabs, walls, columns or beams and obtain approval before starting work. Conduct an electromagnetic scan of reinforcing rods, such as Hilti PS200 Ferroscan, and review with Structural Engineer. Based on these results, arrange and pay for supplemental x-ray examination to locate concrete reinforcement and embedments where required. Submit x-rays and obtain approval before starting work Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Reroute any circuits damaged by core drilling.

8.4 Anchors and Inserts

.1 Supply anchor bolts and locating templates for installation in advance of concrete pouring.

9 PROTECTION OF WORK AND PROPERTY

9.1 General

.1 Protect this work and work of other trades from damage.

.2 Cover floors with tarpaulins and provide plywood and other temporary protection.

.3 Assume responsibility for repairing damage to floor and wall surfaces resulting from failure to provide adequate protection.

.4 Protect equipment, pipe and duct openings from dirt, dust and other foreign materials.

10 WORK IN EXISTING BUILDING

10.1 General

.1 During the tender period, the Contractor shall perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of As Built conditions to determine scope of renovation or demolition work required prior to submitting tender.

.2 Work includes changes to existing building and changes at junction of old and new construction. Route pipes, ducts, conduits and other services to avoid interference with existing installation.

.3 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services required for proper installation of new work, including as required for temporary removal and re-installation to suit new installation work.

.4 Remove existing plumbing fixtures, lighting fixtures, piping, ductwork, wiring, and equipment to suit new construction. Cut back and cap drain, vent and water outlets, conduits and electrical outlets, not being used.

.5 Plumbing fixtures, piping, ductwork, conduit and wiring shown to be removed and not shown relocated, to become property of Contractor and to be taken from site.

.6 On completion of relocations, confirm relocated equipment are in proper working order.

.7 Where Owner wishes to take over renovated areas ahead of project completion date and these areas are to be fed from new distribution systems, make temporary connections to existing services in these areas. Reconnect to permanent services, at later date, when new distribution systems are available.

10.2 Continuity of Services

.1 Make connections to existing systems at approved times. Obtain written approval recording times when connections can be made. Arrange work so that physical access to existing buildings is not unduly interrupted.

.2 Be responsible for and make good any damages caused to existing systems when making connections.

.3 Keep existing buildings in operation with minimum length of shutdown periods. Include overtime work to tie-in piping or wiring at night or on weekends.

11 MOVING AND SETTING IN PLACE OF OWNER'S EQUIPMENT

11.1 S.B.O. (Supplied by Owner)

.1 Items marked SBO on drawings will be;

.1 purchased by Owner.

.2 received, checked, and stored and

.3 subsequently unpacked, uncrated, assembled and located by Contractor under Division 1

.2 Connect mechanical and electrical services to this equipment.

11.2 E.R. or Ex. Rel. (Existing Relocated) or otherwise so identified

.1 Items so marked on drawings will be;

.1 moved from their present location and reinstalled by Contractor under Division 1.

.2 Disconnect and reconnect mechanical and electrical services to accommodate this equipment relocation.

12 TEMPORARY HEATING

12.1 During Construction

.1 Temporary heating required while building is under construction will be provided under Division 1.

.2 Permanent heating system may be used for temporary heating, when this equipment is installed in its permanent location and building is closed in and Contractor under Division 1 provides staff for operation and maintenance whenever permanent heating system is being used for temporary heating..

.3 Hot water boilers may not be used unless heating units, radiation, pumps and piping are complete and approved chemical water treatment is in operation.

.4 Permanent heating equipment used for temporary heating to be thoroughly cleaned and put in first class approved operating condition and appearance at completion of job.

13 FINAL CLEANING AND ADJUSTMENTS

13.1 General

.1 Conduct final cleaning in accordance with Section 01 74 23 and as specified herein.

.2 Thoroughly clean exterior surface of exposed piping, and vacuum external surfaces of exposed ducts and interior surfaces of air handling units. Clean strainers in piping systems and install clean filters in air handling systems.

.3 Remove tools and waste materials on completion of work and leave work in clean and perfect condition.

.4 Calibrate components and controls and check function and sequencing of systems under operating conditions.

.5 Supply lubricating oils and packing for proper operation of equipment and systems until work has been accepted.

14 RECORD DRAWINGS

14.1 Record drawings

.1 Provide record drawings in accordance with this Section and Div 01 requirements.

.2 A set of design drawings will be provided by the Consultant. Make sets of white prints for each phase of Work, and as Work progresses and changes occur mark white prints in coloured inks to show revisions. Dimension locations of drains, pipes, ductwork, conduit, manholes, foundations and similar buried items within the building, with respect to building column centres. Mark level with respect to an elevation which will be provided.

.3 Survey information from excavation and backfill of site services to be held on site, after approval, and to be similarly transferred to white prints.

.4 Retain these drawings and make available to Consultant for periodic review.

.5 At 50%, 75% and 90% project completion, scan marked-up drawings to Adobe .pdf format and submit copy to the Consultant, or to the project on-line document service if one is used.

14.2 As-built drawings

.1 Prior to testing, balancing and adjusting, transfer site record drawing information to AutoCad (CAD) files, to record final as-built condition. Obtain a current set of CAD files from the Consultant.

.1 Drawings are to remain set to and follow Consultants AutoCad Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.

.2 The Consultant's CAD files may not reflect all or any construction changes.

.2 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the CAD files to record these changes. “Bubble” these revisions, and place these annotations on a separate and easily identified drawing layer.

.3 Show on mechanical as-built drawings final location of piping, ductwork, switches, starters, Motor Control Centres, thermostats, and equipment.

.4 Show on site services as-built drawings survey information provided by Ontario Land Surveyor (OLS) monitoring services installation.

.5 Identify each drawing in lower right hand corner in letters at least 12 mm (½ in) high as follows "AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed" (Signature of Contractor) (Date). The site services drawings are to include signature and stamp of OLS surveyor attached to note.

.6 Submit one (1) set of white prints of the draft as-built Cad files for Consultant’s review.

.7 Once “AS BUILT DRAWINGS” white prints are reviewed, transfer Consultant's comments to the CAD files. Return AutoCad drawings modified to “As Built” condition to Consultants on CD or DVD Rom.

.8 Submit three (3) sets of white prints and three (3) copies of CAD files with Operating and Maintenance Manuals.

15 OPERATING AND MAINTENANCE INSTRUCTIONS

15.1 Operating and Maintenance Manuals

.1 Provide operation and maintenance data bound in 210 mm x 300 mm x 50mm thick (8½ in x 11 in x 2 in thick) size, vinyl covered, hard back, three-ring covers.

.1 Organize material in volumes generally grouped by Trade Section; Site services, Plumbing, Fire Protection, Heating and Cooling Plant and Distribution, Air Handling, and Controls and Instrumentation.

.2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear Project Name, Project Number, Date, Trade Section, and List of Contents.

.2 In addition, provide Adobe PDF files for each document, produced from original direct-to-digital file creations.

.1 Organize documents into separate PDF files for each Trade Section identified above, and apply Adobe Bookmarks to create Table of Contents.

.3 Operating data to include;

.1 control schematics for each system,

.2 description of each system and associated control elements,

.3 control operating sequences at various load conditions, reset schedules and anticipated seasonal variances,

.4 operating instructions for each system and each component,

.5 description of actions to be taken in event of equipment failure,

.6 valves schedule and flow diagram,

.7 service piping identification charts.

.4 Maintenance data to include;

.1 manufacturer's literature covering, servicing, maintenance, operating and trouble-shooting instructions for each item of equipment,

.2 fault locating guide,

.3 manufacturer's parts list,

.4 reviewed shop drawings,

.5 equipment manufacturer's performance sheets,

.6 equipment performance verification test results,

.7 voltage and ampere rating for each item of electrical equipment,

.8 spare parts list and an itemized cost,

.9 name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.

.5 Approval procedure

.1 Submit one set of first draft of Operating and Maintenance Manuals for approval.

.2 Make corrections and resubmit as directed.

.3 Review contents of Operating and Maintenance Manuals with Owner's operating staff or representative to ensure thorough understanding of each item of equipment and its operation.

.4 Hand-over two copies of Operating and Maintenance Manuals to Owner's operating staff and obtain written confirmation of delivery.

15.2 Operating and Maintenance Instructions

.1 Provide instructions to Owners operations staff to thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections in these Divisions. Include classroom instruction and hands-on instruction, delivered by competent instructors.

.2 Submit an outline of the training program for review, adjustment and approval by the Owner.

.3 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each equipment, utilizing the services of the manufacturers' representative as required.

.4 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for two (2) training sessions for each training session, separated by approximately one week each. Develop the proposed training plan and obtain approval from the Owner before commencing training.

.5 Complete the training as close to Substantial Performance as possible, so that the operations staff are prepared to operate the systems after Substantial Performance is certified.

.6 Organize each training sessions as follows:

.1 Fire Protection - Division 21

.2 Plumbing – Division 22

.3 HVAC – Division 23

.4 Building Management System – Division 25

.7 Keep record of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.

.8 For each training session, include the following topics:

.1 General purpose of system (design intent),

.2 Use of O&M manuals,

.3 Review of control drawings and schematics,

.4 Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control set-up and programming troubleshooting, and alarms,

.5 Interaction with other systems,

.6 Adjustments and optimizing methods for energy conservation,

.7 Health and safety issues,

.8 Special maintenance and replacement sources,

.9 Occupancy interaction issues, and

.10 System response to different operating conditions.

.9 Develop and provide training material, including printed documents and electronic presentation aids (e.g. MS PowerPoint) for each session. Submit three (3) copies of materials in both hardcopy and electronic format, in accordance with article on Operating and Maintenance Manuals.

.10 Sessions may be videotaped by the Owner as an aid to ongoing training of Owners staff.

16 START-UP AND TESTING

16.1 Care, Operation and Start-up

.1 Arrange and pay for services of manufacturer's factory service technician to supervise start-up of installation, check, adjust, balance and calibrate components.

.2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with every aspect of the operation, care and maintenance thereof.

16.2 TESTING - General

.1 Methods to comply with following references:

(a) The Ontario Building Code
(b) Ontario Installation Code for Oil-burning Equipment
(c) CSA B149.1 Natural Gas and Propane Installation Code

.2 Conduct tests, during progress of Work and at its completion to show equipment and systems meet contract. Submit details of test methods in writing and obtain approval before commencing work.

.3 Supply test equipment, apparatus, gauges, meters and data recorders, together with skilled personnel to perform tests and log results.

.4 Submit written notice 24 hours in advance of each test series, setting out the time, place and nature of the tests, the Inspection Authority and personnel witnessing tests.

.5 Conduct tests before application of external insulation and before any portion of pipes, ducts or equipment is concealed.

.6 Do not subject expansion joints, flexible pipe connections, meters, control valves, convertors, and fixtures, to test pressures, greater than stated working pressure of equipment. Isolate or remove equipment or devices during tests when prescribed test pressure is greater than working pressure of any piece of equipment or device.

.7 Should section of pipe or duct fail under test, replace faulty fittings or duct with new fittings, pipe or duct, repair and retest. Do not repair screwed joints by caulking nor welded joints by peening. Repeat tests until results are satisfactory.

.8 Where it is necessary to test portions of duct or piping system before system is complete, overlap successive tests so that no joint or section of duct or pipe is missed in testing.

.9 Upon completion of work and testing of same, submit logs to demonstrate that tests have been carried out satisfactorily. Repeat any tests if requested.

16.3 Testing - Potable Water Piping

.1 Test potable water systems with water or air as required by The Ontario Building Code, Part 7.

.2 For water service pipes 100 mm (4") and larger, disinfect the pipe with chlorine from the street valve to the first shut-off valve inside the building. Provide testing laboratory certificate confirming water contaminates are below the threshold values in O.Reg. 248/06.

16.4 Testing - Other Piping

.1 Hydraulically test other water piping systems at 1½ times system design pressure (relief valve setting) or 1000 kPa (150 psi), whichever is greater, for 24 hours. Pressure must remain essentially constant throughout test period without pumping. Make allowance for correction of pressure readings for variations in ambient temperature between start and finish of test. Hammer test welded joints during hydrostatic test.

.2 Test natural gas system to CSA B149.1

.3 Test fuel oil systems to CSA B139

.4 Test drainage, waste and vent piping for tightness and grade as required by The Ontario Building Code, Part 7.

.5 Test special service piping as detailed.

.6 Test high pressure steam piping and compressed air piping in accordance with requirements of local and Provincial Authorities.

16.5 Testing - Ventilation

.1 Test ductwork in accordance with procedures detailed

16.6 Testing - Electrical

.1 Make tests of equipment and wiring.

.2 Tests to include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load and examination of each piece of equipment for correct operation.

.3 Test electrical work to standards and function of Specification and applicable Codes.

.4 Replace defective equipment and wiring with new material.

.5 Connect single phase loads to minimize unbalance of supply phases.

16.7 Commissioning

.1 Participate in commissioning of equipment and systems in accordance with Section 20 08 15.

17 TEMPORARY AND TRIAL USAGE

17.1 General

.1 Temporary and trial usage by Owner of any mechanical or electrical device, machinery, apparatus, equipment or any other work or materials before final completion and written acceptance is not to be construed as evidence of acceptance by Owner.

.2 Owner to have privilege of such temporary and trial usage, as soon as that said work is claimed to be completed and in accordance with Contract Documents, for such reasonable length of time as is sufficient for making complete and thorough test of same.

.3 No claims will be considered for damage to or failure of any parts of such work so used which may be discovered during temporary and trial usage, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

.4 Defects in workmanship and materials identified during temporary and trial usage are to be rectified under guarantee.

18 SPECIAL TOOLS AND SPARE PARTS

18.1 General

.1 Furnish spare parts as follows

.1 One set of packing for each pump gland.

.2 One casing joint gasket for each size pump.

.3 One head gasket for each heat exchanger.

.4 One glass for each gauge glass.

.5 One set of V-belts for each drive.

.6 One filter cartridge or set of filter media for each filter or filter bank installed.

19 CONSULTANT REVIEWS

19.1 General

.1 Consultant's attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and the local authority have jurisdiction.

19.2 Site Reviews

.1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances before the work is completed, deficiencies may be recorded where the item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date. Any such reported items, or lack thereof, shall not be relied on in any way as part of the Contractors quality assurance program nor relieve the Contractor in the performance of the Work.

.2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless otherwise shown.

19.3 Milestone Reviews

.1 Specific milestone reviews may be conducted at key stages by the Consultant, including;

.1 before backfilling of buried drainage,

.2 before closing of shafts,

.3 before closing of ceilings,

.4 before closing of walls,

.5 equipment demonstration,

.6 Substantial Performance deficiency review,

.7 Total Performance deficiency review.

.2 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements in the construction schedule.

.3 Notify the Consultant in writing seven (7) calendar days in advance of work to be concealed to arrange a site review prior to the Work being concealed where required by the Consultant. Any noted deficiencies are to be corrected before being concealed. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

19.4 Substantial Performance Review

.1 At the time of applying for project Substantial Performance, submit to Consultant a comprehensive list of items to be completed or corrected.

19.5 Final Review

.1 At project completion submit written request for final review of mechanical and electrical systems.

.1 Refer to section 20 08 19 Project Close-Out.

.2 Include with the request a written certification that:

.1 reported deficiencies have been completed,

.2 systems have been balanced and tested and are ready for operation,

.3 completed maintenance and operating data have been submitted and approved,

.4 tags are in place and equipment identification is completed,

.5 cleaning is finished in every respect,

.6 all mechanical equipment surfaces have been touched up with matching paint, or re-finished as required,

.7 spare parts and replacement parts specified have been provided and receipt acknowledged,

.8 As-built and Record drawings are completed and approved,

.9 Owner's operating personnel have been instructed in operation and maintenance of systems,

.10 fire protection verification is 100% completed and Verification Certificates have been submitted and accepted.

20 CONTRACTOR DUTIES DURING REVIEW OF THE WORK BY CONSULTANTS

.1 Review from the Consultant's team will be provided in accordance with regulation 941/90 of the Professional Engineers Act. Inspections will be performed on a periodic basis to ensure general compliance only. Unscheduled random inspections and scheduled pre-occupancy inspections will be conducted to ensure installation generally meets specified quality standards and intent of the design according to the Ontario Building Code. Not all work will be inspected as walls and ceilings are closed in and buried services covered to meet schedule deadlines. It is the **Contractor's responsibility** to ensure that work is complete and constructed to specified standards.

.2 The Mechanical Contractor shall assign one person responsible for ensuring that work from all mechanical trades is complete prior to closing in wall, ceilings or burying services, and prior to Pre-occupancy Inspections. In conjunction with the Mechanical and Electrical Co-ordinator, the Contractor shall walk the site and thoroughly review that the work is complete, in good workmanship and installed according to the drawings and specifications. The Contractor shall then submit a "Statement of Completion" report. In the case of pre-occupancy inspections, the Statement of Completion report will be submitted 24 hours prior to the scheduled Inspection.

.3 Services to be covered (behind drywall or buried) shall be photographed and assembled in a journal to form a comprehensive documentation of the completed services. The photos will be turned over to the Inspector for review prior to pre-occupancy inspection and will again be turned over to the Owner for his use at the end of the Project.

.4 In preparation for the pre-occupancy inspection of the area or phase being turned over to the Owner, the Mechanical Contractor shall perform a comprehensive inspection of their own to ensure that their contractual obligations are met before requesting the pre-occupancy inspection. The written report or Statement of Completion shall consist of the following items:

.1 date and time of the inspection, signed by the person who conducted the inspection

.2 confirmation that previously noted deficiencies have been completed

.3 confirmation that the work is 100% complete, tested, balanced and deficiency free or

.4 include a list of outstanding work with

(a) with a reason why work has not been completed (ie another trade has to complete their work)
(b) plan of action to complete work
(c) estimate of completion time.

.5 The format of the Statement of Completion will be agreed upon with the Consultant. The Consultant's Inspector shall sign off the Statement of Completion Report and return a copy to the Contractor. The Contractor will retain on site a log of all signed off Statement of Completion reports.

.6 If Statement of Completion is not received, the Consultant reserves the right to withhold pre-occupancy inspection.

.7 If the Statement of Completion is received and the Inspector enters an area that is obviously not ready for inspection (ie the report was falsified), the Inspector shall immediately leave the site without completing the inspection. The Mechanical Contractor shall request another inspection 72 hours in advance and shall resubmit the Statement of Completion 24 hours prior to the inspection.

21 CORRECTION AFTER COMPLETION

21.1 General

.1 At completion, submit written guarantee undertaking to remedy defects in work for a period of one year from date of substantial completion. This guarantee is not to supplant other guarantees of longer period called for on certain equipment or materials.

.2 Guarantee to encompass replacement of defective parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation work.

.3 Submit similar guarantee for one year from date of acceptance for any part of work accepted by Owner, before completion of whole work.

22 ATTACHMENTS

22.1 Shop Drawing Submittal Form

.1 Attached sample of shop drawings submittal form.

HHAngus

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hhangus.com

SHOP DRAWING SUBMITTAL

Include this cover page with each shop drawing submission.
Submissions without this form will be returned without review.
Submit one submittal form per shop drawing; do not group under one submittal sheet

Client/Architect: **[Client/Architect name]**

Project Name: **[Project name]**

HHA Project No: **[HHA Project No]**

Contract: **General**

Contractor to complete the following for each submission.

Date: _____

Contractor Name: _____ Ref No:_____

Manufacturer Name: _____

Product Type: _____

Specification Section No: _____

Contractor Trade:

☐ Mechanical ☐ Electrical ☐ Elevators ☐ General Trades

If this is a resubmission, check here: ☐

Previous submission HHA reference no.: _____

HHA distribution - for internal use only:	
Mechanical review:	[Mechanical designer name]
Electrical review:	[Electrical designer name]
Elevators review:	[Elevator designer name]

Document1

END OF SECTION

QUALIFICATIONS AND AUTHORITIES - ONTARIO
20 01 02

1 GENERAL

1.1 Scope

.1 The specification section:

.1 describes the qualification requirements for tradesmen in the province of Ontario;

.2 defines the applicable authorities having jurisdiction related to construction in Ontario; and

.3 describes the responsibilities of the contractor and/or Owner for registration and inspection of systems and application for construction or installation permits.

1.2 Definitions

.1 ***TSSA***: Technical Standards and Safety Authority

.2 ***ESA***: Electrical Safety Authority

2 QUALIFICATIONS

2.1 Trades Qualification and Apprenticeship

.1 Tradesmen to hold a certificate of competency for the following applicable trades:

.1 Construction Millwright, O.Reg. 1048

.2 Electrician, O.Reg. 1051

.3 Plumber, O.Reg. 1073

.4 Refrigeration and air-conditioning mechanic, O.Reg. 75/05

.5 Sheet metal worker, O.Reg. 1077

.6 Sprinkler and fire protection installer, O.Reg. 1078

.7 Steamfitter, O.Reg. 1079

2.2 Work-Specific Qualification Licenses

.1 Fabricators and installers of pressure piping and equipment which are subject to O.Reg. 220/01 *Boilers and Pressure Vessels* regulation shall hold the required license for performing such work, unless otherwise exempt by the regulation.

.2 Contractors performing work on liquid or gaseous fuel piping systems and related equipment shall hold certificates of authorization made under O.Reg. 215/01 *Fuel Industry Certificates* to perform work within the scope of the following regulations:;

.1 Gaseous Fuels, O.Reg. 212/01

.2 Propane Storage and Handling, O.Reg. 211/01

.3 Fuel Oil, O.Reg. 213/01

.4 Compressed Natural Gas, O.Reg. 214/01

3 AUTHOURITIES

3.1 Authorities having Jurisdiction

.1 When referenced in specification sections in Division 20 to 25, the authority-having-jurisdiction ("AHJ") over regulated portions of the work are identified in the following table.

Work Element	Authority	AHJ Abbreviation
Fire Protection	Municipal Building Department or Fire Department	None
Plumbing	Municipal Building Department	None
HVAC	Municipal Building Department	None
Flammable and Combustible Liquids	Fire Department	None
Liquid fuels (for vehicle refueling)	TSSA	TSSA (FS)
Heating Oil and Diesel Fuel	TSSA	TSSA (FS)
Propane	TSSA	TSSA (FS)
Pressure Piping	TSSA	TSSA (BPV)
Refrigeration	TSSA	TSSA (BPV)
Licensed Plant Operators	TSSA	TSSA (OE)
Electrical	ESA	ESA

4 PERMITS, REGISTRATION AND INSPECTION

4.1 Building Code Permits

.1 Application for Building Permit including plumbing and HVAC has been made by the Owner. Arrange and coordinate for municipal inspections as required under the Ontario Building Code.

4.2 Other Work Permits, Registration and Inspection

.1 Arrange, provide documentation, and pay for registration and inspection of the following work elements:

.1 Boilers, pressure vessel and pressure piping,

.2 Buried liquid fuel tanks and underground piping,

.3 Electrical work performed under Division 20 to 25, and

.4 Where described elsewhere in Division 20 to 25.

.2 Arrange, provide documentation, and pay for variance approvals and field inspections where specified elsewhere in Division 20 to 25.

END OF SECTION

MECHANICAL COORDINATION AND INSTALLATION DESIGN SERVICES
20 01 03

1 GENERAL

1.1 Scope

.1 Provide detailed coordination, fabrication, and installation design drawings for the services provided under Division 20. Integrate the coordination drawings provided under Division 26 into the design drawings provided under Division 20.

.2 Provide the services of an experienced mechanical and electrical coordination supervisor to manage these contractors' design services. The supervisor is responsible for leading a multi-trade coordination effort including but not limited to: detailed inspection of existing conditions, layout and finalize routing of services, setting sleeves for structural openings and sequencing of service installation.

1.2 Document Ownership

.1 Ownership and copyright of Contractors coordination, fabrication, and installation design drawings remains with the Contractor producing these documents, subject to the requirements of the project agreement. In the absence of any requirements in the project agreement, the Contractor will provide the Owner with a royalty-free, transferrable, and irrevocable license to copy and use the materials for the purpose of operating and maintaining the building and building systems.

1.3 Consultant Drawings

.1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductwork, piping, bus duct, etc, and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

1.4 Design Commentary

.1 The following design commentary is provided to assist the contractor in developing an appreciation for the potential complexities and level of risk which may impact the preparation of a bid price for the Work. This commentary does not limit the scope of work nor does it address all potential risk factors associated with the Work.

.1 restricted access to ceiling spaces for coordination with existing services

.2 hidden conduit in slabs and walls

1.5 Requests for Information

.1 Requests for Information (RFI's or similar type of document) concerning coordination are to be submitted with sketch drawings indicating proposed solution for review by the Consultant. RFI's submitted without such proposals will be returned for re-submission.

1.6 Itemized Price

.1 Include costs associated with this Section as an Itemized Price in the Bid documents.

2 INTERFERENCE CO-ORDINATION DRAWINGS

2.1 General

.1 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.

.2 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.

.3 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.

.4 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.5 Location of floor drains, hub drains, combination drains, plumbing fixtures, convectors, unit heaters, diffuser, registers grilles and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.

.6 Include incidental material and equipment not specifically shown but which is needed to complete the work as an operating installation.

2.2 Interference Coordination Drawings

.1 Prepare interference coordination drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades. Drawings shall be prepared by a specialist firm experienced in CAD mechanical and electrical interference drawing production. Interference drawings are to include coordination with all mechanical and electrical services.

.2 Mechanical contractor is to consult and co-operate with electrical contractor to identify electrical services which are to be incorporated into interference drawings. Contractor shall perform site survey work to document all existing mechanical and electrical services that are to remain and are to be included in the interference drawings.

.3 Conduct weekly meetings to discuss and resolve interference issues discovered during interference drawing production.

.4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;

.1 “This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants’ general review”

.5 Drawing scale to be minimum 1:50 (1/4"=1'-0").

.6 Produce coordination drawings, preferably in 3D AutoCad MEP or Revit MEP format, and keep a set of drawings on site for Consultant’s general review.

.7 Obtain architectural and consultant's drawing files for background information, pending completion and return of any electronic file waiver forms.

2.3 Coordination with Other Trades

.1 Lay out and coordinate Work to avoid conflict with work under other sections of this Division and other Divisions.

.2 When equipment provided under other Sections or Divisions connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

2.4 Interconnecting Control and Power Wiring

.1 Provide wiring block diagrams and detailed termination drawings for controls wiring connections to equipment and instrumentation, for both Building Automation System control and hard-wired interlock wiring. Provide wiring terminal numbers specific for each equipment connection.

2.5 Fire Alarm and Building Automation System

.1 Provide a wiring coordination interface drawing for termination of fire alarm annunciation circuits to Building Automation System I/O equipment and/or motor starters, adjustable frequency drives, dampers, and motorized fire dampers.

.2 Drawings to include wiring terminal numbers and description label for FAS annunciation zone.

2.6 Owners Equipment and Relocated Equipment

.1 The service provisions shown for Owner's supplied equipment and/or relocated equipment is based on the best available information at the time of design. Examine the actual service requirements for this equipment and make adjustments as necessary to connection sizes of service drops to suit. A change (increase or decrease) in one trade size for piping, tubing, electrical conductors and conduit, and a change of up to 25% in duct cross-sectional area will be provided at no change to the construction cost.

.2 Where actual service requirements (except as described above for size) are different between the Consultant's drawings and Owner's equipment requirements, submit proposal for new or deleted services or capacities to the Consultant for review.

3 FABRICATION AND INSTALLATION DRAWINGS

.1 On an as-needed basis, prepare fabrication, spooling, and/or installation drawings based on the completed interference coordination drawings. CAD drawing system is in accordance with Contractor's company standards.

.2 Drawing scale: same as the interference coordination drawings or at larger scale as needed.

.3 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.

.4 Layout equipment and services to provide access for repair and maintenance.

END OF SECTION

DEFINITIONS AND ABBREVIATIONS - MECHANICAL
20 01 13

1 GENERAL

1.1 Scope

.1 This specification provides definitions and abbreviations of terms which may apply to one or more specification sections under Division 20, 21, 22, 23 and 25.

.2 Additional definitions and/or abbreviations may also be included in other specification sections where they apply only to one specification section.

1.2 Definitions

Authourity having Jurisdiction ("AHJ"): the designated government body or regulatory agency responsible for enforcement of applicable statute.

Bronze: a copper alloy with a minimum copper content of 84%.

Class XXX: a numerical pressure-temperature designation "XXX" in accordance with ANSI/ASME B16 series of standards.

Canadian Registration Number ("CRN"): as defined in accordance with CSA B51.

Certificate of competency: a license, certificate or other document which attests to the qualifications of a construction tradesperson and which is recognized and/or required under prevailing provincial, territorial or federal statutes in the location of the project as an authorization to perform such work.

Cold Working Pressure ("CWP"): the maximum non-shock cold working pressure at temperatures as stated in a MSS valve standard.

Design Criteria: criteria that states the requiree performance of equipment or a system, and is also the minimum design basis for equipment, systems and contractor's design responsibilities.

Design Pressure: (in reference to a pressure piping system) - the maximum allowable internal pressure in a piping system at the indicated coincident Design Temperature that the piping system may be subjected under normal operating conditions and is the basis for determining the piping system hydrostatic or pneumatic test pressure requirements.

Design Temperature: (in reference to a pressure piping system) – the maximum allowable in-service temperature of the piping system.

Double Regulating Valve ("DRV"): a calibrated manual flow balancing valves with pressure test ports (also referred to as circuit balancing valve),

Dezincification Resistant ("DZR"): a brass copper alloy which by means of its alloy and method of manufacture is certified as being resistant to the process of dezincification.

Flow Limiting Regulating Valve ("FLRV"): an automatic calibrated flow control device which limits the maximum flow to a branch piping network.

Minimum Component Pressure Rating ("MCPR"): the minimum pressure at the indicated coincident temperature at which the component must be capable of withstanding, remain functional and not exceed its maximum allowable stress in accordance with its referenced standard.

National Pipe Taper ("NPT"): a pipe thread in accordance with ANSI/ASME B1.21.1

Operating Pressure: the estimated maximum expected internal operating pressure of a fluid in a pipe or equipment for the purpose of establishing a piping system Design Pressure; actual in-service gauge pressures may be lower. The operating pressure may be specified as a single value, or it may vary by location in the system. "Working pressure" has the same meaning.

Operating Temperature: the estimated maximum normal temperature of the fluid in a piping system

Potable water: has the same meaning as defined in the applicable plumbing code or building code in the jurisdiction of the project. "Domestic water" has the same meaning.

Steam Working Pressure ("SWP"): the maximum steam pressure at the indicated maximum steam temperature or it is the saturated steam pressure if a coincident temperature is not specified.

Service rooms: means a room provided in a building to contain equipment associated with building services, and which includes but is not limited to: boiler rooms; furnace rooms; incinerator rooms; garbage handling rooms; rooms to accommodate HVAC appliances, pumps, compressors and other related equipment; rooms containing electrical distribution equipment; and rooms containing telecommunications and data equipment.

Service space: means space provided in a building to facilitate or conceal the installation of building service facilities such as chutes, ducts, pipes, shafts or wires.

1.3 Abbreviations

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineers
ASTM	ASTM International (formerly American Society for Testing and Materials)
CSA	Canadian Standards Association
FM	Factory Mutual Approvals
MSS	Manufacturers Standardization Society
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	NSF International (formerly National Sanitary Foundation)

SMACNA	Sheetmetal and Air Conditioning Contractors' National Association
UL	Underwriters Laboratory (USA)
ULC	Underwriters Laboratory Canada

End of Section

BASIC MATERIALS AND METHODS
20 05 01

1 GENERAL

1.1 Scope

.1 Articles that are of a general nature, applicable to each Section of Division 20.

2 ACCESSIBILITY FOR CONTROL DEVICES

.1 Mount control devices, intended to be adjusted or to otherwise be used by the occupant for the operation of building services or safety devices, as follows:

.1 room environmental controls, including thermostats/adjustable room temperature sensors: at 1200 (47 in) above the finished floor,

.2 all other controls: between 900 and 1100 mm (36 in. and 43 in.) above the finished floor.

.3 be positioned to have a clear space in front of and centered on the control device, of 810 x 375 mm (32 x 15 in).

.4 be operable using a closed fist and with a force not exceeding 22.2 N (5 lbsf).

.2 The above requirements do not apply to control devices that are solely located and used by the building operations staff.

3 ACCESS DOORS

.1 Provide access doors to be installed at locations where equipment requiring inspection, service, maintenance or adjustment is "built-in" to work of other trades.

.2 Access is required at;

.1 expansion joints,

.2 dampers,

.3 fire dampers,

.4 air valves,

.5 air terminal units,

.6 isolation and control valves ,

.7 pressure reducing valves,

.8 heating or cooling coils,

.9 control wiring junction boxes.

.3 Submit shop drawings showing access door size, type and location.

.4 Construction:

.1 constructed of steel, prime coated,.

.2 flush mounted with 180° opening door, round safety corners, concealed hinges, plaster lock and anchor straps

.3 600 mm x 600 mm (24 in x 24 in) for personnel entry,

.4 300 mm x 450 mm (12 in x 18 in) for hand entry, and

.5 constructed of stainless steel in areas finished with tile or marble surfaces

.6 constructed of stainless steel with neoprene gasketed door in damp and high humidity areas

.7 generally fitted with screwdriver operated latches, except in areas subject to security risks (Public Corridors, Psychiatric Patient Areas, Public Washrooms). In these areas doors to be fitted with keyed cylinder locks with similar keys.

Standard of Acceptance
- Baird - ABCO
- Acudor Acorn
- Mifab

.5 Installation:

.1 Supply access doors and make arrangements and pay for installation by Division in whose work they occur.

.2 Size and locate access doors in applied tile, block or in glazed or unglazed structural tile to suit joint patterns.

.3 Access doors in ceilings, where acoustic tile is applied to plaster or gypsum board, to be dish type designed to receive tile insert.

.4 Access doors are not required in removable ceilings. Provide coloured marking devices after completion of ceilings, at four corners of each panel below point requiring access. Colour code markers to show service or device above.

.5 At time of instruction of owners operating staff, hand-over and obtain signed receipt for 4 sets of each type of key used to lock access doors in secure areas.

4 DIELECTRIC COUPLINGS

.1 Provide dielectric isolation between pipes of dissimilar metals with suitable couplings, insulating dielectric unions, insulating flanges, or insulating gaskets between flanges.

.1 Place dielectric isolation between steel piping and bronze or brass valves.

.2 Do not use bronze or brass valves as dielectric fittings.

.2 Insulating unions for pipe sizes NPS 2 and under

Standard of Acceptance
- Epco - Dielectric
- Watts

.3 Insulating flanges for pipe or tube from NPS 2 to NPS 4

Standard of Acceptance
- Watts No. 3100 or 3200

.4 Insulating gaskets for flanges NPS 5 and over:

.1 compatible with pressure and temperature service,

.2 flange bolts run in insulating sleeves with insulating washers under nuts.

5 DRAIN VALVES

.1 Provide drain points for piping systems with drain valves at low points and at section isolating valves.

.2 Drain valves: minimum NPS 2 straight pattern bronze with hose end male thread, cap and chain.

6 V-BELT DRIVES

.1 Provide V-belt drive for each motor driven device which is not direct connected. Keep overhung loads on prime mover shafts within manufacturer's design guidelines.

.2 Sheaves for motors to 7.5 kW (10 hp) with not more than two belts:

.1 cast iron or steel secured to shafts with removable keys.

.2 adjustable pitch on motor, fixed pitch on driven device, giving plus or minus 10% speed range,

.3 selected to meet specified operating condition at mid position in pitch adjustment.

.3 Sheaves for motors over 7.5 kW (10 hp) or drives with three or more belts

.1 cast iron or steel with split tapered bushing and keyway.

.2 fixed pitch.

.4 Belts:

.1 matched sets of 'b' section, selected for service factor of 2.0 based on installed motor horsepower.

.2 capable of carrying load with one belt broken.

.5 Motor slide rails:

.1 adjustment plates for centre line alignment

.2 belt tension adjusting screws.

.6 Installation

.1 Tension belts to manufacturer's recommendations before start-up and after first 100 hr of operation using calibrated belt tensioning gauge.

.2 Provide replacement pulleys and belts during start-up and balancing to suit field operating conditions.

7 DRIVE AND COUPLING GUARDS

.1 Provide guards to protect belt drives, flywheels, rotating couplings on equipment and fan inlet and outlets.

.2 Guards:

.1 removable for servicing,

.2 arranged to permit lubrication with guards in place.

.3 Guards for belt drives:

.1 expanded metal screen welded to steel bar stock or angle frame,

.2 minimum 1.2 mm (18 ga) thick galvanized sheet metal tops and bottoms,

.3 40 mm (1½") diameter holes at both shaft centres for insertion of tachometer.

.4 Flexible coupling and flywheel guards:

.1 Removable "U" shaped, minimum 1.6 mm (16 ga) thick galvanized mild steel or expanded metal mesh on substantial welded angle iron or round barstock frame.

.5 Guards on unprotected fan inlets and outlets:

.1 Minimum 20 mm (¾ in) galvanized wire mesh or expanded metal screen with net free area of guard not less than 80% of fan opening.

.6 Installation

.1 Belt guards to accommodate movement of motors for belt tension adjustment.

.2 Where equipment is installed on resiliently mounted base frame or pad, attach belt guard to this base

.3 Belt guards and fan inlet guards may be omitted where fan and motor is installed in plenum less than 1.4 m (4 ft) high and disconnect for fan motor is mounted adjacent to and outside access door to plenum.

.4 Fan inlet guards may be omitted where fan is fitted with inlet guide vanes.

8 SLEEVES

8.1 General

.1 Sleeve pipes, ducts and conduits passing through masonry walls, concrete floors, and fire rated gypsum board ceilings and partitions.

.2 Maintain fire rating integrity where pipes and ducts pass through fire rated walls, floors and partitions.

8.2 Floor and Wall Sleeves

.1 Sleeves in fire separations:

.1 sized to suit fire stopping methods employed for bare pipes, conduits, insulated pipes, and bare and insulated ducts without fire dampers, and

.2 sized to suit conditions of approval given in manufacturers installation instructions for fire and smoke dampers.

.2 Sleeves in other construction:

.1 sized to clear insulated pipes and ducts by 13 mm (½ in) all round, and

.2 sized to clear conduits, bare pipes, and bare ducts by 6 mm (¼ in) all round.

.3 Sleeves for pipes, conduits and ducts smaller than 0.4 m^2 (4 sq ft) through solid walls and floors:

.1 Schedule 40 steel pipe or 1 mm (20 ga) (minimum) sheet metal, lapped and spot welded.

.2 Sleeves for pipes, conduits and ducts smaller than 0.4 m^2 (4 sq ft) through gypsum board partitions:

(a) 1 mm (20 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one and.

.4 Sleeves for ducts 0.4 m^2 (4 sq ft) and larger through walls and floors:

.1 1.6 mm (16 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one end.

8.3 Waterproof sleeves

.1 Applications:

.1 where pipes and ducts pass through floors in areas subject to water, in mechanical rooms, in kitchens, in washing areas and in slabs over electric and telephone rooms.

.2 Waterproof sleeves for pipes and conduits:

.1 Schedule 40 pipe, with 75 mm (3 in) wide annular fin continuously welded at midpoint, hot dip galvanized after fabrication.

.3 Waterproof sleeves for ducts less than 0.4 m^2 (4 sq ft):

.1 1 mm (20 ga) galvanized steel, with 40 mm (1½ in) flange at midpoint.

.4 Waterproof sleeves for ducts 0.4 m^2 (4 sq ft) and larger and openings with multiple ducts:

.1 1.6 mm (16 ga) galvanized steel, with 40 mm (1½ in) flange at midpoint, or,

.2 form opening with wood (removed after concrete is set) and trim opening with welded steel angle frame 75 mm (3 in) high , bolted to slab and caulked, or,

.3 trim opening with 75 mm x 75 mm (3 in x 3 in) continuous concrete curb doweled to slab.

.5 Modifications for existing construction:

.1 annular fins and flanges attached to sleeve at point equivalent to surrounding floor level or curb.

8.4 Installation

.1 Place and secure sleeves in concrete form work.

.2 Supply sleeves to be set in concrete and masonry walls with installation detail drawings.

.3 Regular sleeves;

.1 terminate flush with surfaces of concrete and masonry walls.

.4 Waterproof sleeves in new construction;

.1 extend 75 mm (3 in) above finished floor.

.2 with flange embedded within concrete floor.

.5 Sleeves in existing concrete and masonry walls and floors;

.1 installed in neatly cut or drilled holes in existing construction,

.2 cutting and drilling of structural elements, such as floors, slabs, walls, columns, or beams to be carried out in accordance with procedure set out in Article "Cutting and Patching" below.

.3 terminate sleeves flush with surfaces of concrete and masonry walls,

.4 extend waterproof sleeves 75 mm (3 in) above finished floor with flange, countersunk, and bolted down flush into floor surface,

.5 fill opening between sleeve and wall or floor with 2 hour fire rated fire-stopping sealant with water barrier.

.6 Fill future-use sleeves with weak concrete, gypsum plaster or similar material.

.7 Coat exposed exterior surfaces of un-galvanized ferrous sleeves with heavy application of zinc rich paint

.8 At fire separations and smoke separations, pack and seal void between sleeve and pipe, duct without fire damper, conduit, or insulation in accordance with Article "Fire Stopping and Smoke Seals" in this Section.

.9 At other locations, pack void between sleeve and pipe, conduit, duct or insulation for full depth of sleeve, with mineral wool and seal with silicone-free caulking compound.

.10 Install fire dampers in accordance with conditions of approval given in manufacturer's instructions.

9 FIRE STOPPING AND SMOKE SEALS

.1 Refer to 20 05 04

10 WALL AND FLOOR PLATES

.1 Fit pipes passing through walls, floors and ceilings in finished areas with escutcheon, wall or floor plates.

.2 Plates:

.1 at floor; chrome plated two piece split type with hinge.

.2 at walls and ceilings; similar to floor plate but with set screw to fasten plate to pipe.

10.2 Installation

.1 Plates:

.1 sized to cover sleeves

.2 secured tight against finished surfaces, and

.3 fitted to cover sleeve extensions where sleeves extend above finished floor.

11 LINK SEALS

.1 Fit each pipe passing through floor slab in contact with ground or basement walls below grade with link seal between sleeve and bare pipe.

.2 Submit manufacturer’s literature and schedule showing location, service, inside diameter of wall opening, sleeve length and pipe outside diameter.

.3 Link seal:

.1 Manufactured from modular synthetic rubber links with stainless steel hardware.

.2 Loosely assembled with bolts to form continuous rubber belt around pipe, with pressure plate under each bolt head and nut.

.3 Constructed to provide electrical insulation between pipe and sleeve.

Standard of Acceptance

- Power Plant Supply - "Thunderline Linkseal"
- Advance Products & Systems – "Innerlynx"

.4 Installation

.1 Determine inside diameter of each wall opening or sleeve before ordering seal.

.2 Position seal in sleeve around pipe and tighten bolts to expand rubber links until watertight seal is obtained.

END OF SECTION

MECHANICAL WORK IN EXISTING HOSPITALS
20 05 02

1 GENERAL

1.1 Scope

.1 Contractor is responsible to review all documents for all divisions to co-ordinate phasing and services required at end of each phase.

.2 Portion of the New Work and all of the work in existing areas will be heavily phased. Rework of services will impact on the existing hospital.

.3 Contractor shall submit and identify any shut-down requests in the General Contractor's six week look ahead schedule. The six week look ahead schedule shall be reviewed at the bi-weekly construction meetings with the Owner. Any required changes made to the contractor's schedule shall be given to the hospital not less than two weeks in advance of the shutdown request date for Owner approval. The shutdown request shall identify:

.1 What services will be impacted

.2 The length of shutdown

.3 The contingency plan, should the shutdown need to be cancelled last minute or during the shutdown

.4 Emergency contact information for any emergencies during the shutdown.

.4 Notify the Owner and the Architect, in writing, at least one week in advance of the work where work requires shut-down or isolation of existing services.

.5 Except as identified, shut downs of existing services will be restricted from 11PM to 5AM and on Sundays.

.6 All work outside area of renovation and/or outside of IPAC hoarding to be done after hours and/or on weekends. Work to be done in accordance with Hospital's IPAC procedures.

1.2 Ventilation

.1 The main AHU serving the area of renovation is in the basement and serves other O.R.s. Coordinate tie-in and shutdown with Owner, after hours and/or weekends. Provide temporary connections, as required, to keep surrounding spaces in operation.

.2 All new and existing ductwork serving the area of renovation is to be professionally cleaned at end of project.

1.3 Chilled Water and Heating Water

.1 Provide connections to existing chilled water system by live tapping as the system is always active, or

.2 Co-ordinate with Owner freezing of lines to make required connections. Cost of freezing to be Contractor's cost and does not include the additional freezing carried in 1.7 below.

1.4 Domestic Hot and Cold Water

.1 The systems are always active and serve other occupied areas. Connect to the existing water main by live tapping where line sizes are large enough or by freezing of lines to make required connections.

.2 Co-ordinate with Owner.

1.5 Medical Gas Connections

.1 Make connections to the existing medical gas systems, on a gas by gas basis, within a night time shut-down. Provide additional valves where new connections are to be made to limit shutdown to one night.

.2 Complete, inspect and certify the medical gas installation, by hospital's designated inspection agency prior to connection to the existing hospital.

.3 Arrange for the inspection to the connections to the existing hospital to be made immediately at the completion of the work.

1.6 Core Drilling and Scanning

.1 Unless stated otherwise all core drilling and scanning for mechanical services is to be done afterhours.

.2 Include in contract for additional scanning, cores, outer sleeves and firestopping as follows:

.1 2@4"cores

1.7 Additional Freezing and Valving of Live Water Services

.1 Include in contract an additional allowance for replacing shut off valves and freezing lines where existing valves do not hold or do not exist. Include valves and freezing for the following:

.1 Freezing of four (4) three inch sprinkler lines

.2 Freezing of six (6) one inch water lines

.3 Freezing of six (6) two inch water lines

.4 Freezing of six (6) four inch water lines

.5 Freezing of four (4) 8 inch water lines

1.8 Spare Components

.1 Provide the following valves including installation on existing or new piping, modifications to insulation as required:

.1 Domestic Water service – 4@1/2", 4 @ 1", 2@1 ½", 2 @ 3", 2@4".

.2 Heating and Cooling service -– 4 @3/4", 4 @ 1", 2@1 ½", 2 @2", 2 @ 3", 2@4".

.3 Steam Service – 4@2", 2@4"

.4 Medical Gas service -– 4@1/2", 4 @3/4", 4 @ 1", 2 @2", 2 @ 3",

.2 Provide 2 – 4" floor drains complete with 30 feet of insulated 4" line and 30 feet of vent piping.

.3 Provide the following spare fire dampers c/w installation in new or existing ductwork

.1 2 @ 8" x 12"

.2 2 @ 12" x 20"

.3 2 @ 18" x 24"

.4 2@ 24" x 36"

1.9 Phasing

.1 Carefully examine the phasing plan form the Architectural drawings and develop a mechanical construction plan in conjunction with the General Contractor to ensure that areas can be constructed mechanically for each phase/stage with all active services. All services will be complete and available for occupancy of the phased spaces, unless noted otherwise.

.2 The drawings show service configuration for final construction layout and do not include scope required for each individual phase of construction. Prior to construction, the mechanical contractor shall review each phase, review existing services and formulate a plan on how to construct the area with all services without interruption to other occupied areas.

.3 The mechanical work necessary to maintain services will not be restricted to the architectural phased areas of work. This division will have to work in the existing occupied building during off hours; obtaining and modifying services for new phased areas.

.4 The contractor shall maintain existing systems until the new services are ready for use. New equipment, ductwork, piping is to be installed prior to demolition of existing services, where possible to minimize shut down period.

.5 Provide balance and reports at each phase of construction.

1.10 Air and Water Balancing

.1 Provide air/water balancing at the end of ***each*** phase.

.2 Ductwork being cleaned must be done prior to balancing as damper locations often get moved during the cleaning process. If duct cleaning is done after, include for re-balancing of the system to verify original air quantities.

1.11 Work in Occupied Areas

.1 Work in Owner occupied areas outside of the construction site to be schedule with the Hospital.

.2 Projects having multiple phases in and around occupied spaces will require work outside of the current phased area. This work shall be scheduled with the Owner at nights or on weekends. Contractor for this division to coordinate associated general trades work required to complete the work outside of the immediate construction area with appropriate infection control measures and pay for general trades work if not shown on the architectural drawings.

.3 Access to these areas will be after hours as noted above at the discretion of the Hospital

1.12 Phased Occupancy and Substantial Performance

.1 Although there may be several phases to this project, it is one project and substantial performance will be granted at the end of the project. There will be no phased substantial performance or phased release of holdback.

1.13 Equipment Maintenance and Operation during Construction

.1 The Mechanical Contractor to ensure equipment, systems and all related services are operational for each phase of construction.

.2 The mechanical contractor will be responsible to maintain and operate the new equipment (and systems) supplied under this project until the project is formally handed over to the Owner. Maintenance shall include all manufacturer recommended maintenance, filter changes, bearing lubrication, fan belt adjustment, chemical treatment, cleaning of coils. Maintenance and system downtime to be minimized and scheduled to suit the Hospital.

.3 The mechanical contractor shall operate the systems to the Owners benefit to ensure that the occupied phases are fully serviced to the Owners schedule and needs and to maintain occuppiable environmental conditions. The mechanical contractor to provide a list of emergency contacts so they can respond 24/7 to issues with their system. Service calls and repairs to be made quickly to minimize disruption to the Hospital and at the contractor's expense.

1.14 Training of Equipment and Systems

.1 Training of Owners maintenance personnel to be done at end of project prior to formal turnover to Hospital. Training will not be required at the end of each phase as the contractor will be maintaining and operating the equipment/systems installed under this project until the systems are formally turned over to the Owner.

1.15 Equipment Warrantee

.1 Equipment and system warrantees to start after substantial performance even though equipment may be operating during early phases. Notify equipment supplier of this situation during bidding and include any additional costs related to operating the equipment during the construction period or include extended equipment warrantee to cover contract duration plus the standard warrantee period starting after substantial performance

1.16 Phased Occupancy

.1 Contractor will complete system testing and submit letters and certificates of completion for each phase to be occupied by the Owner.

1.17 Fire Watch and access to fire protection equipment

.1 In situations where fire protection and monitoring systems are taken out of service within the contraction area, the Contractor will provide fire watch services for the duration of time when the fire protection and monitoring system are out of service.

.2 For situations where fire protection and monitoring systems for the building are taken out of service outside of the construction area, the Contractor will provide fire watch services for the duration of time when the fire protection and monitoring system are out of service.

.3 Hoarding will not restrict access to fire hose cabinets. If hoarding cannot be constructed without blocking access, the contractor shall temporarily relocate fire hose cabinet of provide a temporary cabinet near the existing that is blocked.

END OF SECTION

FIRE STOPPING AND SMOKE SEALS
20 05 04

1 GENERAL

1.1 General Contract Documents

.1 Comply with the General Conditions of the Contract, Supplementary Conditions and other Sections of Division 1 and with Section 20 05 01, Basic Mechanical Requirements.

1.2 Work Included

.1 Work of this Section comprises firestopping materials and/or systems to provide closures to fire at openings around penetrations, at un-penetrated openings, at projecting or recessed items, and at openings and joints within fire separations and assemblies having a fire-resistance rating, including openings and spaces at perimeter edge conditions.

.2 Work of this Section also comprises smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material to form air tight barriers to retard the passage of gas and smoke.

.3 The installed firestopping/smoke sealant system shall provide and maintain a fire-resistance rating equivalent to the rating of the adjacent floor, wall or other fire separation assembly to the requirements of and as acceptable to the authorities having jurisdiction and to the Consultant.

.4 Firestopping and smoke seals within mechanical assemblies (i.e. between sleeve and pipe/wire/duct) shall be provided as part of the Work of Divisions 20 . Firestopping and smoke seals around the outside of such mechanical and electrical assemblies (ie sleeve and wall) where they penetrate fire-rated separations shall be part of the Work of this Section unless otherwise indicated by the Contractor.

.5 Confirm locations of exposed/non-exposed fireproofed surfaces with consultant prior to application.

.6 Penetrations will have single or multiple conduits passing through and Work will consist of firestopping all penetrations with pre-approved ULC assemblies.

1.3 Quality Assurance

.1 Provide experienced and competent installers, trained by material or system manufacturer.

.2 Applicator Qualifications:

.1 Applicator shall have at least three years experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.

.2 Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.

.3 Applicator shall be approved for this Work by Product Manufacturer or listed below:

Standard of Acceptance

- Profirestop (Tel: 416-293-0993)
- Custom Insulation Systems (Tel: 905-669-0002)
- Beverly F.S. (Tel: 905-659-3367)
- Dominion Caulking (Tel: 905-883-8355)
- RILI Firestopping (Tel: 905-349-3779

.4 Single source responsibility for firestopping materials:

(a) Obtain firestop materials from single manufacturer for each different product required.
(b) Manufacturer shall instruct applicator in procedures for each material.
(c) Refer to notes on Drawings for additional information, instructions and clarifications.

.5 Regulatory Requirements:

(a) Firestop System installation must meet requirements of CAN/ULC-S 115-95 tested assemblies that provide a fire rating equal to that of construction being penetrated.
(b) Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

.6 Arrange a pre-job conference between Contractor, applicator, inspection and testing representative, manufacturer's representative and Consultant.

.7 Fire Protection Consultant will test (Review) up to 2% of completed Work (Penetrations). Contractor to provide installer and enclosures at Consultant's discretion.

.8 Consultant may or may not require destructive testing to be done. Contractor shall cover costs of repairing fire separation after destructive tests are performed.

1.4 Submittals

.1 Shop Drawings:

.2 Submit drawings indicating the ULC or Warnock Hersey assembly number, the required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primer, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.

.3 Designate on shop drawings both fixed and moving penetrants, relative positions, expansion and control joints in rated slabs and walls, firestopping details at receptacles and similar poke-through devices and surrounding permanent materials. Identify re-entry locations.

.4 Manufacturer's Product Data: Submit data for materials and prefabricated devices, providing descriptions sufficient for identification on Site.

.5 Certificates: Submit manufacturer's certification that installed firestopping and smoke seal material comply with specified requirements.

.6 ULC or Warnock Hersey Listings: Submit copies of Listing cards for review.

.7 Samples: Submit only as requested various types of firestopping and smoke seal material.

1.5 Mock-Up

.1 Construct mock-up for each separation type prior to commencing Work at locations as designated by Consultant in accordance with Section 01300.

.2 Mock-ups shall be reviewed and approved by manufacturer and Consultant.

.3 Accepted mock-ups may remain as part of completed work.

.4 Mock-ups shall be modified as many times as necessary to obtain acceptance.

1.6 Delivery, Storage and Handling

.1 Deliver the materials to the job site in the manufacturer's unopened containers, containing the classification label, with labels intact and legible at time of use.

.2 Store material in accordance with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.

.3 Before handling, read product data sheets and material safety data sheets. Do not use damaged or expired materials.

1.7 Identification

.1 Identify, through-penetration fire stopping and smoke seal systems with pressure sensitive, self adhesive, printed vinyl labels. Attach labels permanently to surfaces of penetration construction on both sides. Labels must be visible from 5'-0" above the floor. Labels must show the following information:

.1 the words "Warning: through-penetration firestopping system, Do not disturb"

.2 the applicators name, address and telephone number

.3 designation of applicable testing and inspection agency

.4 date of installation

.5 manufacturers name for materials

1.8 Photography

.1 Provide digital photography of every fire separation penetration showing both the before and after installations. Picture must indicate day and time and be labelled to show exact location.

.2 Duplicate copies of digital photo records are to be submitted directly to the Hospital at the completion of the installation in each building/ wing.

2 PRODUCTS

2.1 Acceptable Manufacturers / Installation Specialists

.1 General: Manufacturers of firestopping products and installation specialist for this Work are limited to applicable assemblies as required for Project and having ULC or C-UL-US or Warnock Hersey labelled packaging.

.2 Approved manufacturers:

Standard of Acceptance

- 3M Canada
- Tremco Canada
- A/D Fire Protection Systems Inc.
- Grace
- Nuco Inc. (1-800-583-3984)

2.2 Materials

.1 Firestopping and smoke seals shall conform to the following:

.1 Asbestos free materials and systems;

.2 Provide a fire-resistance rating not less than the fire-resistance rating of the surrounding or adjacent floor, wall or other assembly.

.3 FTH Rated and certified in accordance with CAN/ULC-S115-95, and be labelled (WH, cUL, ULC).

.2 Sealants and putty for overhead and vertical joints shall be non=sagging; seals for floors, self-levelling, silicone based.

.3 Products shall be compatible with abutting dissimilar architectural coatings and finishes at floors, wall, ceiling, waterproofing membranes and the like. Check with requirement of Contract Documents and manufacturer of selected materials being installed.

3 EXECUTION

3.1 Manufacturer's Instructions

.1 Compliance: Comply with manufacturer's product data including product technical bulletins, product catalogue installation instructions and product packaging instructions.

3.2 Preparation

.1 Examine sizes, anticipated movement and conditions to establish correct thickness and installation of back-up materials.

.2 Clean bonding surfaces to remove deleterious substances including dust, paint, rest, oil, grease, moisture, frost and other foreign matter which may otherwise impair effective bonding.

.3 Remove insulation from insulated pipe and duct where such pipes or ducts penetrated a fire separation unless listed assembly permits such insulation to remain within the assembly, or where mechanical trades have installed special fire rated insulated sleeves.

.4 Prepare surfaces, prime, mask adjacent surfaces and clean in accordance with manufacturer's directions and to requirements of tested assembly.

3.3 Installation

.1 General

.1 Mix and apply firestopping, gas and smoke seals in strict accordance with manufacturer's instruction and tested designs to provide required flame rated seal, to prevent the passage of gas and smoke, and where specifically designated, the passage of fluids.

.2 Provide temporary forming and packing as required. Apply materials with sufficient pressure to properly fill and consolidate the mass to seal openings.

.3 Tool or trowel exposed surfaces.

.4 Notify Consultant when random completed installations are ready for review, as directed by Consultant, prior to concealing or enclosing firestopping and as applicable, smoke seals

.2 Identification

.1 Provide identification of all firestopping as specified.

.3 Photography

.1 Provide digital photography of every fire separation penetration showing both the before and after installations. Picture must indicate day and time and be labelled to show exact location.

.2 Duplicate copies of digital photo records are to be submitted directly to the Hospital at the completion of the installation in each building/ wing.

3.4 Clean-Up

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application. Remove and or correct staining and discolouring or adjacent surfaces as directed.

END OF SECTION

WIRING REQUIREMENTS FOR MECHANICAL SERVICES
20 05 12

1 GENERAL

1.1 Scope

.1 Provide wiring, conduit, fittings, supports, disconnect switches, service lights, and related devices and equipment for mechanical trades work, to the extent specified herein.

.2 As an alternative, specification section 20 05 29 may also be used for support of conduits.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 20 05 29 Hangers and Supports

.2 20 05 49 Seismic Restraint.

.3 20 05 14.13 Motor Controllers

.4 20 05 14.16 Variable- Frequency Drives

1.3 Definitions

.1 The following definitions apply to this section and referenced sections:

.1 ***Breaker panel (BP)*** - a 120/208 V mechanical power panel with overcurrent protection circuit breakers provided by Division 26.

.2 ***Control panels –*** an electrical device that controls or monitors mechanical equipment, or that interfaces with instrumentation devices.

.3 ***Control wiring*** - wiring for the purpose of communication or control of equipment and instrumentation.

.4 ***Electrical safety code -*** the edition with amendments of CSA C22.1 as adopted by applicable legislation at the location of the Work.

.5 ***Mechanical breaker panel (MBP)*** means a 120/208 V mechanical power panel with overcurrent protection circuit breakers provided as part of a MCC.

.6 ***Mechanical Power Panel (MPP) -*** 208 V or 600 V, 3 phase, power distribution equipment with branch circuit overcurrent protection devices provided by Division 26, and dedicated to supply power for equipment provided by mechanical trades work.

.7 ***Mechanical trades work -*** equipment and systems provided under Divisions 20 to 25.

.8 ***Motor controllers -*** constant speed motor controllers of the manual, magnetic or solid-state type in accordance with specification section 20 05 14.13.

.9 ***Motor Control Center –*** has the meaning as specified in section 20 05 14.13.

.10 ***Packaged equipment -*** equipment containing some or all of: motor(s), controls and/or other electrically powered equipment, such as but not limited to: electric heating equipment, water treatment equipment, packaged HVAC equipment, electric boiler, electric domestic water heaters, etc.)

.11 ***Power Panel (PP)***: 208 or 600 V, 3 phase, power distribution equipment with branch circuit overcurrent protection devices provided by Division 26, which serves general building loads and may also serve equipment provided by mechanical trades work.

.12 ***Power wiring*** means wiring that provides electrical power to equipment.

.13 ***VFD***: variable frequency drives in accordance with specification section 20 05 14.16.

.14 ***Wiring*** means conductors, cable, conduit, fittings, supports and accessories.

.2 With respect to these definitions, for equipment provided by Division 26 the actual terminology used in the Division 26 drawings and specification may differ but the intent remains the same.

.3 For clarity, any reference herein to Division 20 means Divisions 20 to 25.

1.4 Applicable Codes and Standards

.1 Legislation:

.1	O.Reg. 164/99	Electrical Safety Code

.2 Installation standards and codes:

.1	CSA C22.1	Canadian Electrical Code Part 1, as amended by “Ontario Amendment to the Canadian Electrical Code Part, C22.1”.
.2	CSA C22.1	Canadian Electrical Code Part 1

.3 Product standards:

.1	CSA C22.2 No. 4	Enclosed and Dead-Front Switches
.2	CSA C22.2 No. 38	Thermoset-Insulated Wires and Cables
.3	CSA C22.2 No. 39	Fuseholder Assemblies
.4	CSA C22.2 No. 106	HRC – Miscellaneous Fuses
.5	CSA C22.2 No. 124	Mineral Insulated Cable
.6	CSA C22.2 No. 131	Type TECK 90 Cable
.7	CSA C22.2 No. 208	Fire Alarm and Signal Cable
.8	CSA C22.2 No. 239	Control and Instrumentation Cables

1.5 Quality Control

.1 Electrical wiring for mechanical trades work to be performed by a specialist electrical contractor firm with an established reputation in the field of wiring of mechanical equipment and controls.

1.6 Permits, Fees and Inspections

.1 Arrange and pay for electrical permits and any required inspections for electrical work for mechanical equipment and systems.

.2 Submit to the electrical safety authority the required number of drawings and specifications for examination and approval prior to commencement of work.

.3 Notify Consultant of changes required by the electrical safety authority prior to making changes.

.4 On completion of the Work, furnish certificates of acceptance (or similar report) from the electrical safety authority to the Consultant.

1.7 Standard Details

.1 Device legend with list of abbreviations and schematic wiring diagrams are included at the end of this section that delineate the scope of work between Division 20 and Division 26 and as further specified herein.

.2 This material is to be used in the interpretation of specification requirements for power wiring and control wiring of Division 20 to 25 equipment.

1.8 Submittals

.1 Submit manufacturer catalogue cut-sheets for the following materials;

.1 VFD Inverter Duty cable,

.2 service lights.

1.9 Storage of Materials

.1 Store wire and cable in a clean, dry, well-ventilated area.

.2 Protect white insulated wire from exposure to NOx gas (eg: exhaust from propane fuelled equipment) by wrapping with shrink wrap, by locating away from sources of NOx and by maintaining adequate ventilation to minimize NOx levels.

.3 Where white insulated wire has discoloured:

.1 do not install,

.2 dispose of the wire,

.3 remove and replace wire that has been installed.

2 PRODUCTS

2.1 Motor Feeder and Control Wiring ("Building Wires")

.1 Application:

.1 motor and equipment power feeders that do not include VFD drives,

.2 control wiring including control valve and damper actuators, panel control wiring, motor controller interlock wiring, BAS control wiring, and switch-type instrumentation,

.3 convenience power outlets and service lights.

.2 Conductors:

.1 solid copper for No. 12 and 14 AWG,

.2 stranded conductors for 10 AWG and larger.

.3 Minimum wire size:

.1 No. 12 AWG for equipment power,

.2 No. 14 AWG, for control wiring at 120 VAC or lower.

.4 Insulation:

.1 chemically cross-linked thermosetting polyethylene (XLPE) material, RW90 or RWU90,

.2 1000 V insulation for 600 V systems,

.3 600 V insulation for 100 VAC to 480 VAC systems.

.4 300 V insulation for systems less than 100 VAC, and for systems 24 VDC and less.

.5 Colour coded conductors:

.1 colour impregnated into insulation at time of manufacture,

.2 phase conductors No. 8 AWG and larger with black insulation, may be colour coded with adhesive colour coding tape.

.6 Listed to CSA C22.2 No. 38.

Standard of Acceptance

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc.
- Prysmian Cables & Systems Ltd.
- Southwire

2.2 VFD Inverter Duty Cable

.1 Application: for motor power feeders between a VFD and its driven motor, specifically manufactured to reduce high frequency noise and grounding of common mode currents.

.2 Conductors: copper wire with 1000 V RW90 (XLPE) insulation.

.3 Bonding conductors: three (3) bare copper conductors, each sized to meet or exceed CSA C22.1 requirements, Table 16, for each conductor.

.4 Sheath: corrugated aluminum sheath.

.5 Shielding: 100% coverage by aluminum sheath or separate copper tape shield or similar.

.6 Jacket: PVC liquid-tight with FT4 and AG14 rating, and UV resistant.

.7 Voltage rating: 1000 V, and voltage spikes of not less than 2000 V.

.8 Listed to CSA C22.2 No. 38 and CSA C22.2 No. 131.

Standard of Acceptance

- NEXANS - Drive Rx - Variable speed drive cable
- LAPP USA - OLFLEX® VFD SLIM; Severe duty power cable for AFD drives
- ShawCor - Shawflex VFD cable

2.3 Instrumentation and Control Cabling

.1 Application: instrumentation and control wire suitable for analogue 4-20 mA and 0-10 VDC signaling.

.2 Conductors:

.1 solid copper wire,

.2 twisted-multipair, shielded cables with individually shielded pairs, overall shield, drain wires and overall rated jacket,

.3 insulation: XLPE, colour coded or numbered wires,

.4 minimum wire size: as specified by equipment manufacturer or controls vendor, unless otherwise shown.

.3 Shield: provide 100% shield coverage complete with drain wire.

.4 Armour:

.1 corrugated steel, or

.2 none required if installed in conduit or approved wireway.

.5 Jacket:

.1 FT4 flame retardant,

.2 FT6 when installed in open style cable trays in ceiling spaces that are used as return air plenums.

.6 Listed to CSA C22.2 N0. 239,

Standard of Acceptance

- General Cable (Carol)

- Belden
- Nexans Canada Inc.

2.4 Conduits and Fittings

.1 Conduits:

.1 rigid hot dipped galvanized steel threaded conduit,

.2 electrical metallic tubing (EMT), hot dipped galvanized with couplings,

.3 PVC coated hot dipped galvanized rigid steel conduit: with 40 mil PVC exterior coating, 2 mil urethane interior and thread coating,

.4 flexible metal conduit and liquid-tight flexible metal conduit.

.2 Conduit fastenings:

.1 single hole steel straps to secure surface conduits 50 mm (2") and smaller,

.2 two hole steel straps for conduits larger than 50 mm (2"),

.3 beam clamps to secure conduits to exposed steel work,

.4 channel type supports for two or more conduits,

.5 Ø6 mm threaded rods to support suspended channels.

.3 Conduit fittings:

.1 manufactured for use with conduit specified including coatings,

.2 factory "ells" where 90° bends are required for 25 mm (1in.) and larger conduits,

.3 insulated throat steel set screw or raintight insulated throat steel compression connectors and couplings for EMT,

.4 threaded or compression type raintight/concrete tight insulated throat zinc plated steel connectors and couplings for rigid steel conduit,

.5 raintight insulated throat steel connectors at all surface equipment enclosures and other electrical equipment in sprinklered areas for all conduit terminations.

2.5 Outlet Boxes

.1 Construction:

.1 hot dipped galvanized steel single and multi-gang flush device boxes for flush installation,

.2 Size:

.1 76 mm x 50 mm x 38 mm (3" x 2" x 1½") or as indicated,

.2 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

2.6 Safety (Disconnect) Switches

.1 Construction:

.1 listed to CSA C22.2 No. 4m

.2 fuseholder assemblies listed to CSA C22.2 No. 39,

.3 fused unless shown as unfused,

.4 fuseholders suitable for Class J fuses, sized to suit the fuse sizes without the use of adaptors,

.5 horsepower rated,

.6 type 3R painted metal enclosure,

.7 one, two or three pole as required for single phase or polyphase circuits,

.8 two pole with solid neutral or three pole with solid neutral for three wire and four wire circuits with neutral,

.9 six pole for two speed motor applications,

.10 provision for padlocking in the Off switch position,

.11 mechanically interlocked door to prevent opening when handle is in the ON position,

.12 heavy duty, quick-make, quick-break action,

.13 ON-OFF switch position indication on switch enclosure cover.

.2 Fuses:

.1 HRC Class J time delay up to 600A,

.2 HRC Class L for ratings above 600A,

.3 product of one manufacturer,

.4 ampere rating as indicated, where not indicated, the maximum rating permitted by the electrical code.

.3 Special requirements for disconnect switch located between a VFD and the controlled equipment:

.1 auxiliary status switch;

(a) rating: 10 A at 120 VAC,
(b) switch contacts open when disconnect switch is Not-Closed.

.4 Ratings:

.1 IEC 90 rotary switch for motors up to 18.6 kW (25 HP),

.2 NEMA flange mount for all ratings.

Standard of Acceptance

- Square "D"/Schneider Electric Company (Canada) Ltd.
- Eaton
- Siemens Canada Ltd.
- Klockner Moeller/Eaton

2.7 Equipment Service Lights (Marine Lights)

.1 Copper-free aluminium base, Pyrex globe, wire guard, stainless steel hardware, and watertight seal,

.2 100 watt incandescent or 18 watt compact fluorescent lamp.

.3 Power: 120 VAC.

.4 Wall or ceiling mount.

Standard of Acceptance

- Crouse Hinds - Type Pauluhn 700 series

2.8 Switches

.1 Toggle switch, with neon pilot light – light is On when switch is Off.

.2 Rating: 20 A at 120 Vac.

.3 Switch cover: weatherproof with silicone rubber gasket, and clear bubble over toggle.

Standard of Acceptance

- Hubbell - HBL1795

2.9 Receptacles

.1 Class A GFCI type, 15 A at 120 VAC indoors, and 20 A T-slot for outdoors.

.2 Receptacle outlet hood:

.1 in-use weatherproof, for both indoor and outdoor locations,

.2 die cast aluminum base and cover with gasket,

.3 vertical mount.

.4 self-closing lift cover.

.5 CSA 3R rated.

Standard of Acceptance

- Bryant Electric – WPB26EH

2.10 Conduit and Equipment Supports

.1 Carbon steel supports, hot dipped galvanized after fabrication,

.2 Manufacturer standard products suitable for support load rating of conduit and conductors,

Standard of Acceptance

- Burndy Canada Ltd.
- Canstrut
- Electrovert Ltd.
- E. Myatt & Co. Ltd
- Steel City Electric Ltd.
- Pilgrim Technical Products Ltd.

.3 Upper attachment – concrete inserts

.1 galvanized wedge inserts to MSS SP-58 type 18.

.2 maximum tension load rating: 4.4 kN (1000 lbs),

Standard of Acceptance

- Anvil - fig. 281
- Unistrut - fig. P-3245

.4 Upper attachment – existing concrete:

.1 surface mount clevis plate, for mounting to concrete,

.2 carbon steel plate with clevis and malleable iron socket with bolt, and weldless eye nut.

Standard of Acceptance

- Anvil - fig. 49 clevis plate, Fig. 290 weldless eye nut
- Myatt - fig. 535 socket, Fig. 480 weldless eye nut

.3 threaded inserts for drilled holes.

Standard of Acceptance

° Hilti - fig. HDI, Kwick Bolt, HSL

.5 Upper attachment – steel beams:

.1 carbon steel beam clamp (top flange), hook rod with locking jaw, fasteners and lockwashers, to MSS SP-58, type 25,

Standard of Acceptance

° Anvil - fig. 227
° Myatt - fig. 504, 505

.6 Upper attachment - steel joists:

.1 for installation of support rod in the interstice space of double-ell steel joists and open-web steel joints for support on the lower chord,

.2 carbon steel washer plate with double locking nuts on top-side of washer,

.3 second steel washer plate on underside of joist with nut where supported equipment is subject to vibration.

Standard of Acceptance

° Anvil - fig. 60
° Myatt - fig. 545

.7 Hanger rods:

.1 continuous threaded rod, carbon steel, USS national course thread,

.2 tension load ratings to MSS SP-58,

Standard of Acceptance

° Anvil - fig. 146
° Myatt - fig. 434

.8 Horizontal Pipe Support – Swivel Ring Hanger

.1 swivel ring hangers, carbon steel ring strap, zinc plated, adjustable knurled swivel nut, to MSS SP-58 Type 10,

.2 nominal conduit size: 12mmC to 100 mmC.

Standard of Acceptance

° Anvil - fig. 69, CT-69
° Myatt - fig. 41, 42, 43
° Unistrut

.9 Rooftop conduit supports:

.1 conform to specification section 20 05 29.

2.11 Wire Markers

.1 Printed, self-laminating vinyl wire and cable labels and sleeve-labels.

Standard of Acceptance

° Brady BMP21 Plus series

3 EXECUTION

3.1 General

.1 Install electrical wiring work under this specification section in accordance with the applicable electrical safety code and regulations applicable at the location of the Work.

.2 Support conduit from building structure in accordance with specification section 20 05 29.

3.2 Conduit Support and Hanger Installation

.1 Support conduit directly from or on structural building elements. Do not support conduit directly from other services.

.2 Provide all miscellaneous materials including nuts, washers, and backing plates to make a complete support installation.

.3 Where wall brackets are used, select brackets and size mounting bolts and backing plates to suit the supported load, allowing for a safety factor by not loading the bracket more than 80% of its published load rating.

.4 In steel framed construction, support conduit from structural members. Where structural members are not suitably located for upper hanger attachment locations, and where inserts of adequate capacity cannot be installed in concrete slabs, provide supplementary steel framing members;

.1 fabricate supplementary steel from standard HSS sections, single EL section, double C "strongback" sections, or pipe rolls,

.2 size supporting steel to limit span deflection to 1/250 (0.4%) between support points,

.5 Support horizontal conduit at intervals not exceeding 3 m (6 ft).

.6 Support vertical conduit at intervals not exceeding 3 m (6 ft).

.7 Where trapeze hangers are used, secure conduit to trapeze with U-bolts.

.8 Mechanically fasten supplementary steel to structural steel.

3.3 Installation of Power and Control Wiring – General Requirements

.1 [Wiring methods and standards to conform with those specified in Electrical Division 26 for the area of building in which installation is to be made, except as otherwise specified in this section.

.2 Except where fire rated cables or VFD Inverter duty cables are required, use building wire for:

.1 power wiring for motors and packaged equipment,

.2 power wiring to control panels, heat tracing and other non-motorized packaged equipment, and

.3 non-analog control wiring at 120 VAC or less, and 24 VDC or less.

.3 Provided polyphase motor and equipment power conductors' with the following colour coding:

.1 Phase A – Red,

.2 Phase B – Black,

.3 Phase C – Blue ,

.4 Neutral - White,

.5 Ground - Green,

.6 Control - Orange.

.7 Where colour coded tape is utilized, apply at least 50 mm (2") at terminations, junction boxes and pull boxes. Do not paint conductors.

.4 Provide single-phase motor and control wiring conductors with the following colour coding:

.1 Line – Red,

.2 Neutral – White,

.3 Ground – Green.

.5 Install all wiring in conduit or approved raceway.

.6 Conduit selection type:

.1 EMT: Use thin wall conduit up to and including 32 mm (1 ¼ in) size for wiring in ceilings, furred spaces, in hollow walls and partitions and where not exposed to mechanical injury, and as otherwise shown.

.2 Rigid : Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 40 mm (1½ in) size and larger.

.3 Liquid-tight flexible: use only for the last 1000 mm (3 ft) of motor feeder at connection to motor, and for instrumentation wiring to equipment subject to vibration.

.4 Select conduit size to be of sufficient size to allow easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

.7 Provide separate conduit for power wiring for each motor or starter. Do not install control wiring in the same conduit as power wiring.

3.4 Installation of Power Wiring for VFDs and Associated Motors

.1 Use VFD Inverter Duty cables for motor feeders between VFDs and associated motor.

.2 Feeder wiring to and from VFD to be in individual, separate, rigid steel conduit. Do not combine wiring from any other source or purpose within VFD feeder conduit.

.3 VFD Inverter Duty cables may be run in free air (without conduit) where all the following conditions are met;

.1 the cable is located in the same room as the VFD and the motor,

.2 the cable length does not exceed a total length of 5 m (15 ft); for longer cables, the 5 m (15 ft) free-air length is to be located at the motor end,

.3 the cable is supported on 300 mm (12 in) centers without sags or dips, and

.4 where the cable passes through the wall of air handling units,

(a) a 100 mm (4 in) long section of rigid conduit (sleeve) is installed through the wall,
(b) the sleeve is provided with escutcheons to seal the wall opening,
(c) the ends of the conduit are reamed and cleaned of burrs and sharp edges, and
(d) the cable/sleeve is sealed with a non-hardening mastic (i.e. firestop compound) at one end.

3.5 Harmonic Filter Control Power

.1 Provide 120 VAC power supply to passive harmonic filters installed for VFDs. Run power supply to VFD designed control relay (for low- or no-power control), and then to the harmonic filter capacitor contactor.

3.6 Installation of Instrumentation, Communications and Control Cabling

.1 Install wiring in conduit.

.2 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.

.3 Run instrumentation, communication and control cabling point to point and terminate on terminal strips. Do not splice communication or control cabling. Where long runs make a continuous point to point installation impractical, make splices on labelled terminal blocks in an accessible labelled terminal cabinet, installed at 1200 mm (48") above floor, and indicate cabinet location, terminal and wire numbers on the As-built drawings.

.4 Terminate control cables in equipment with suitable connectors.

.5 Clearly identify cables/conductors at both ends, with permanent wire markers, indicating device/panel identification and terminal numbers on the device/panel (refer to standard detail 20 15 12-021 at the end of this specification section):

.1 Use applicable reference name or ID tag for the device or control panel.

.2 Print the labels such that the applicable panel/device identification is closest to the end of the cable.

.3 Where individual wires are run in conduit, collect wires associated to the same control panel/device and apply a label to the group of wires inside each control panel/device. Where there is insufficient space inside a device (such as a transmitter), the label may be applied to the conduit at the point of connection to the device.

.4 Where there are multiple conductors, individually identify each wire by its termination reference on the panel or device to which it connects.

.5 Where there are only two wires and it is readily understood where each wire is to be terminated (i.e. white neutral, green ground), individually marking of the wires is not required.

3.7 Grounding

.1 Ground electrical equipment and wiring in accordance with the applicable electrical safety code and regulations applicable at the location of the Work except where greater requirements are specified herein.

.2 Provide insulated green bonding conductor in each power and control conduit sized per Table 16 of the Electrical Safety Code. Minimum bonding conductor size #12AWG copper.

.3 Install grounding conductors, outside electrical rooms and electrical closets, in conduit.

.4 Make connections to neutral and equipment with brass, copper or bronze bolts and connectors.

.5 Except for VFD Inverter Duty cables, ground all motors with separate green insulated copper ground conductor installed in power feeder conduit, wired from ground terminal in the motor controller to a ground lug bolted directly to the motor frame, located inside the motor terminal box. Size the ground conductor per Table 16 of the electrical safety code. Minimum conductor size to be #12 AWG.

.6 Ground VFD Inverter Duty cables using all three integral ground conductors, from the ground terminal in the VFD enclosure to the ground lug bolted directly to motor frame inside the motor terminal box.

3.8 Disconnect Switches

.1 For Type 3, 3R and 4 enclosures, provide watertight connectors complete with O rings for conduit connections.

.2 Motorized equipment:

.1 Provide disconnect switches for motor driven equipment provided under the mechanical trades work.

.2 Locate the disconnect switches as follows;

(a) within 9 m (29 ft) and in the line-of-site of motors serving non-refrigeration motorized equipment, and within 9 m (29 ft) of the motor controller or VFD controlling the equipment,
(b) within 3 m (9.5 ft) and in the line-of-site of equipment containing refrigeration compressors and related motorized equipment that forms part of a refrigerant circuit.

.3 Disconnect switch types:

(a) fused type for motor controllers and VFD's,
(b) fused type for motorized packaged equipment.

.4 Exception: a separate disconnect switch is not required where;

(a) a motor controller or VFD is provided with an integral disconnect switch with overcurrent protection and is located with respect to the controlled equipment as specified above, or
(b) packaged equipment is provided with an integral disconnect switch with overcurrent protection.

.5 Where a disconnect switch is required between a VFD and the driven motor due to distance limitations being exceeded or the VFD is not in site from the motor, provide an unfused disconnect switch with integral limit switch, at the motor. Wire the limit switch back to the VFD digital input for drive output protection.

.3 Non-motor equipment:

.1 Provide unfused disconnect switch for the following equipment provided under the mechanical trades work.

(a) terminal unit boxes,
(b) reheat coils,

.2 Locate disconnect switch immediately adjacent to equipment served.

(a) exception: for terminal unit boxes, a separate unfused disconnect switch is not required where a fused disconnect switch is provided as part of the terminal unit box control panel.

.4 Where fuse protection is specified, install fuses of the correct rating in fused disconnect switches,

.5 Where fuse protection is specified, provide a set of six spare fuses of each size used in the disconnect switches. Turn spare fuses over to the Owner and submit a copy of the receipt signed by the Owner.

3.9 Outlet Boxes

.1 Size boxes in accordance with CSA C22.1. Use 102 mm (4") square or larger outlet boxes as required for special devices.

.2 Gang boxes where wiring devices are grouped. Use combination boxes with barriers where outlets for more than one system are grouped.

.3 Provide nlank cover plates for boxes without wiring devices.

3.10 Service Lights, Switches and Receptacle

.1 Provide service lights inside of air plenums and as otherwise shown. Provide minimum of one service light per 3 m (10 ft) width or length of plenum.

.2 Mount switches for service lights in accessible location on outside of plenum and air handling units. Provide one switch for each fan system.

.3 Provide one receptacle wired ahead of each service light switch, located between 300 mm (12 in) and 1200 mm (4 ft) above the floor.

3.11 Seismic Restraint

.1 Provide seismic restraints for electrical conduit in accordance with specification section 20 05 49.

3.12 Coordination and Division of Responsibility – Division 20 and Division 26

.1 The following electrical work shall be provided under Division 20, including termination of conductors. For clarity;

.1 the Division 20 work may be performed by the Division 26 contractor, but the work is managed and paid for by Division 20.

.2 related work performed under Division 26 is listed in this table for reference.

.2 Coordinate power requirements for mechanical trades equipment with the contractor under Division 26 of the work, including;

.1 provide a list of all planned and ordered mechanical trades equipment with motor horsepower ratings or electrical power requirements, prior to the Division 26 contractor procuring their power distribution equipment,

.2 periodically update this power requirements list as mechanical trades equipment is ordered, and review with the Division 26 contractor to allow them to revise breaker ratings in a timely manner,

.3 Where the branch circuit breaker rating requirements change as a result of the actual ordered mechanical trades equipment, coordinate and pay for any breaker and feeder changes required whether the affected work is in Division 20 or Division 26 scope of work.

Reference	Work Element	Div. 20	Div. 26
All	Motor Control Centers, motor controller racks, motor controllers, VFDs, and disconnect switches	●	
Dedicated Power Panels for Mechanical Equipment (Note 1)	Mechanical Power Panels (MPP) and Mechanical Breaker Panels (MBP), including branch overcurrent protection devices.		●
	Power wiring from MPPs and/or MCCs to: - motors, including between motors and motor controllers, VFDs and/or disconnect switches as applicable, - packaged equipment, including disconnect switches as applicable, - equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc)	●	
	Power wiring from BP and/or MBP to: - motors, including between motors and motor controllers, - packaged equipment, including disconnect switches as applicable, - equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc)	●	
Non-dedicated Power Panels (Note 2)	Non-dedicated Power Panels (PP) and breaker panels (BP), including branch overcurrent protection devices.		●
	Distribution splitters		●
	Power wiring from PPs and/or distribution splitters to: - motor controller, - disconnect switch ahead of VFD, - disconnect switch for package equipment, - packaged equipment (with integral disconnect switch) - equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc)		●
	Power wiring from BP to: - motor controller or disconnect switch, - disconnect switch for package equipment, - packaged equipment (with integral disconnect switch),		●

Reference	Work Element	Div. 20	Div. 26
	- equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc)		
	Power wiring from: - disconnect switch to a VFD, - motor controller or VFD to the motor, - disconnect switch to packaged equipment	●	
Terminal Unit Boxes	Control power of 120 V, single phase terminating adjacent to designated building automation control panels.		●
	Control power of 120 V, single phase terminating in a junction box for each group of terminal boxes with maximum of 12 terminal unit boxes fed from one junction box [Note 3].		●
	Control power at 24 VAC/DC, from building automation control panels to terminal unit box controller [Note 3].	●	
	Control power of 120 VAC power wiring to each terminal unit box controller (from junction box provided by Division 26 for each group of controllers [Note 3].	●	
	3 phase, 208 V and higher voltage wiring direct to terminal unit box.		●
BAS Controls and OEM Controls	In service rooms: Dedicated 120 VAC breaker panels (BP) complete with 15 A breakers in service rooms for use by Division 20 to 25.		●
	In service rooms: where MCC's are used, dedicated 120 VAC mechanical breaker panels (BP) complete with 15 A breakers for use by Division 20 to 25.	●	
	Power wiring for controls in service rooms: fed from junction boxes to the BAS and OEM control equipment.	●	
	Other than service rooms: dedicated 120 VAC @15A breakers each for normal and emergency power, provided in each electrical distribution closet.		●
	Power wiring for controls other than in service rooms: fed from dedicated power panels and/or allocated breakers and/or junction boxes	●	
	120 V, single phase power supply with a junction box at specific control devices as shown.		●
	Breaker tamper-protection locks.	●	
	Instrumentation and actuator power and control wiring, for both BAS controls and OEM controls.	●	
	Control wiring to interlock motor controllers and to connect safety and operating controls.	●	
Plumbing Fixtures	120 V, single phase power supply with a junction box or pull box at plumbing fixtures requiring control power		●

Reference	Work Element	Div. 20	Div. 26
	Wiring from adjacent junction box or pull box to plumbing fixtures requiring control power	●	
	Control transformers and extra-low voltage wiring	●	
Medical Gas Equipment	Dedicated emergency power circuits 120 VAC, single phase for central and distributed medical gas alarm panels, terminated in the control panels.		●
	Control wiring between field installed instrumentation and medical gas alarm panels.	●	
Equipment Service Lights	120 VAC, 15A power circuits for equipment service lights, terminated in an outlet box on an adjacent wall, column or ceiling.		●
	Power wiring from adjacent junction boxes to light switches/service convenience outlets and fixtures	●	
	Equipment service lights, switches and convenience outlets.	●	

Notes:
[1] MPP and MBP will be located in mechanical services rooms.
[2] PP and BP are not dedicated for mechanical equipment and may be located in any type of service room or space.
[3] Refer to specification section 20 05 01 for specific wiring methods.

3.13 Wiring Diagrams

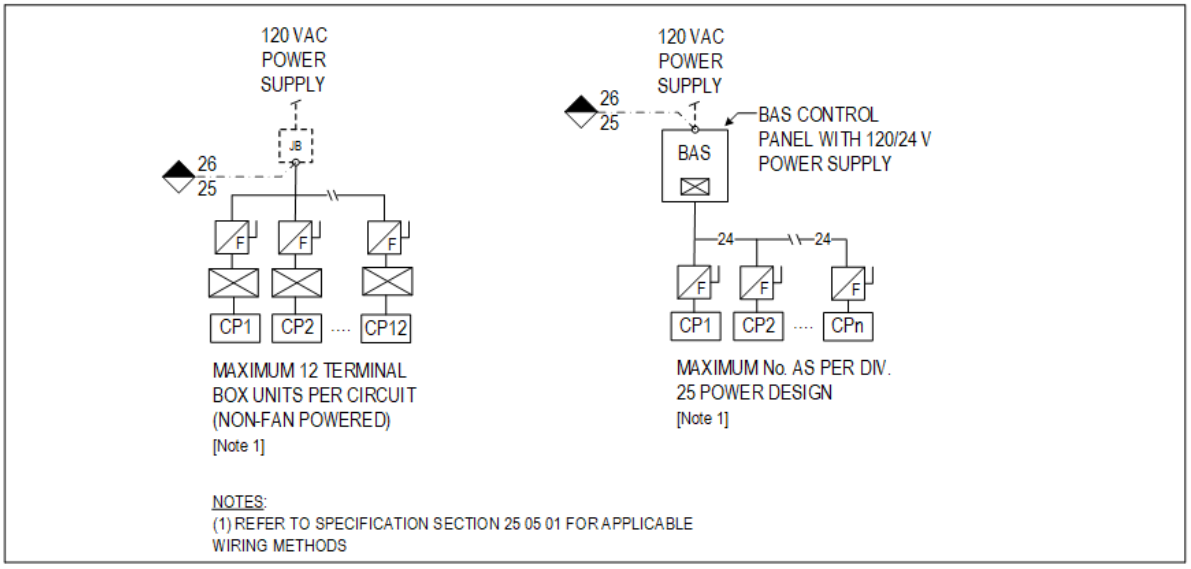
.1 Wiring diagrams following at end of this section:

.1 20 05 12 - 01 Mechanical – Electrical Coordination (Sheet 1 of 2)

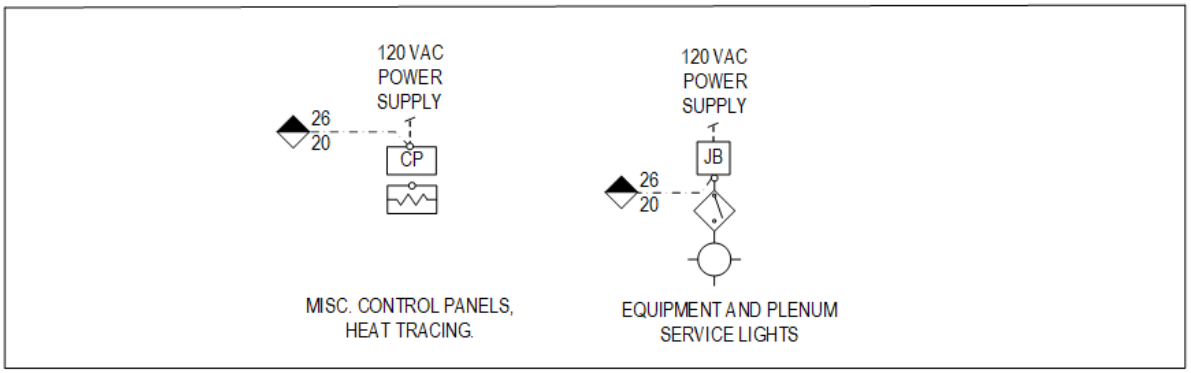
.2 20 05 12 - 02 Mechanical – Electrical Coordination (Sheet 2 of 2)

.3 20 05 12 - 03 Variable Frequency Drives Single Line Schematic

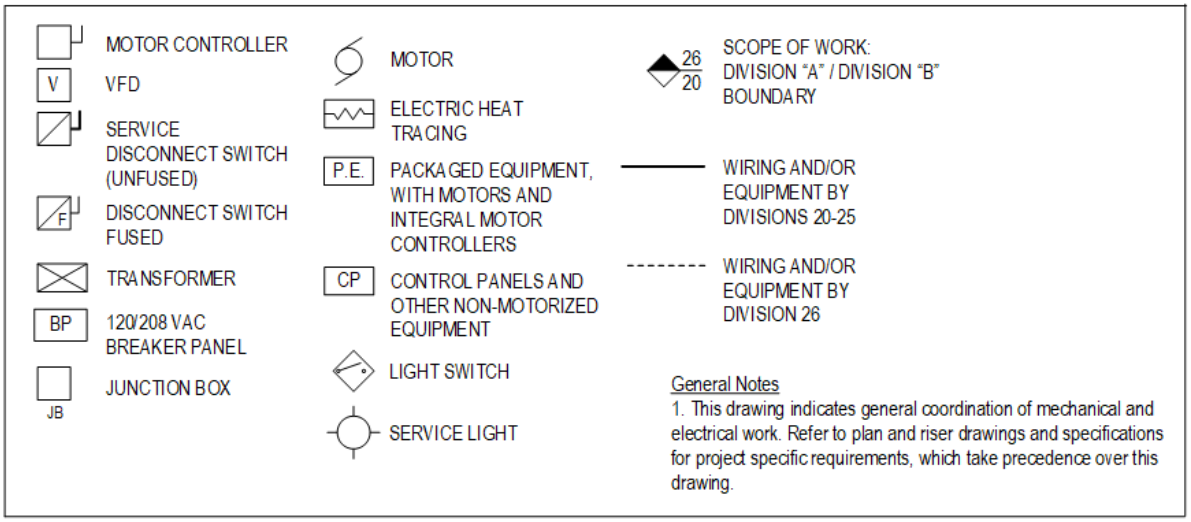
END OF SECTION



TERMINAL BOX UNITS

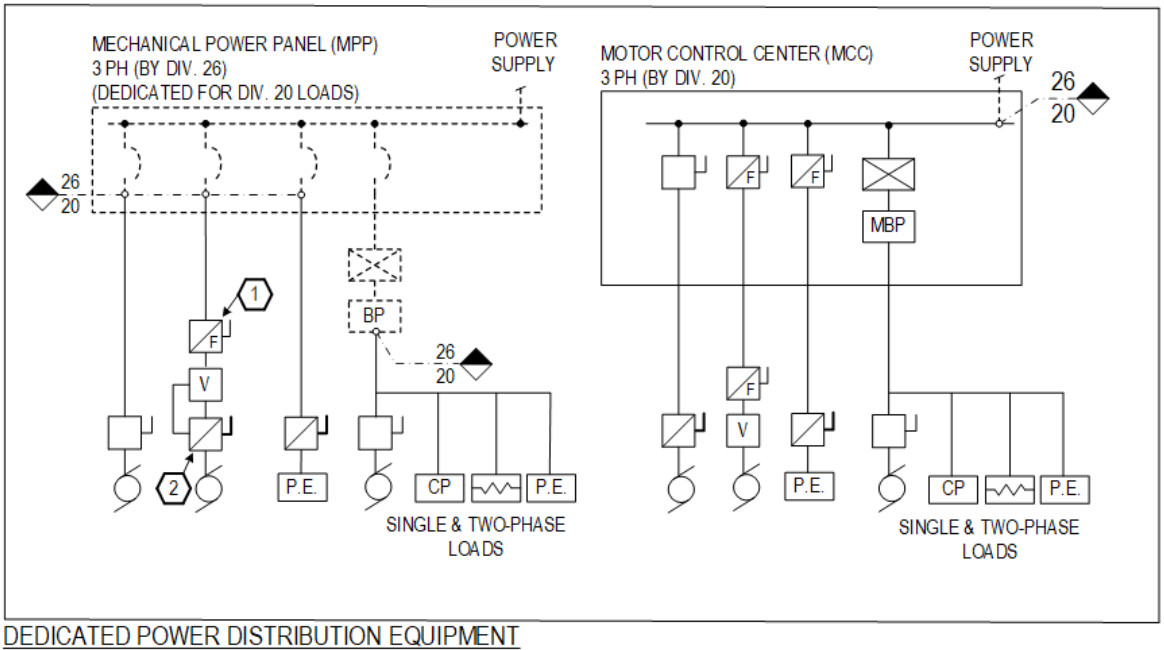


MISCELLENOUS NON-MOTORIZED EQUIPMENT

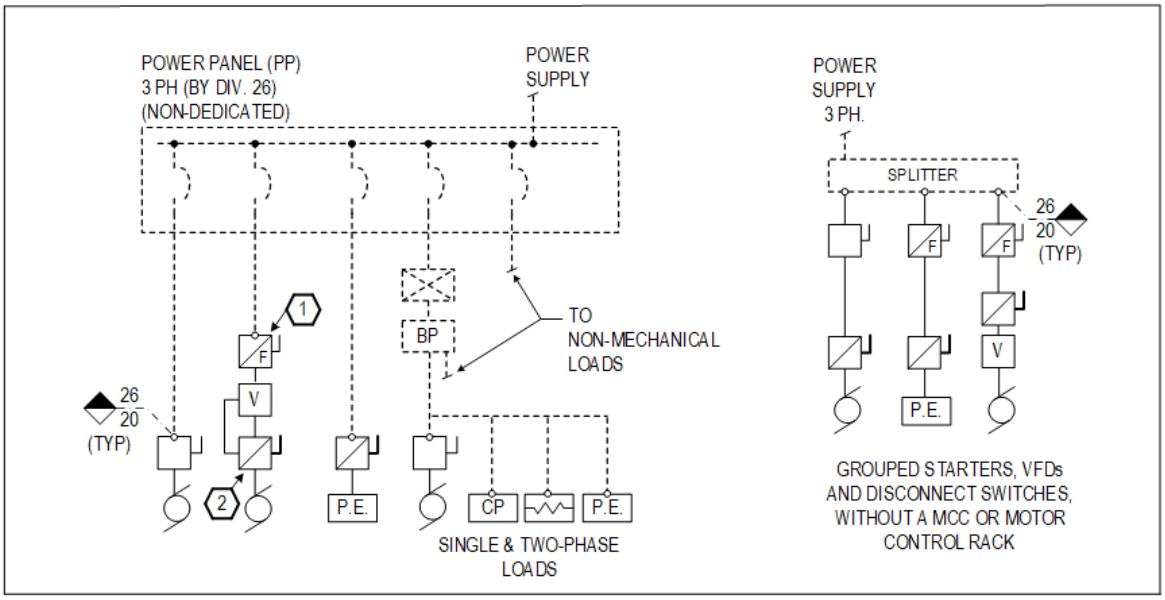


LEGEND

HHAngus	Sheet Title: MECHANICAL – ELECTRICAL COORDINATION (SHEET 1 OF 2)	Date: 12-NOV-2019	Rev. No.: 01	Checked: PS
		Standard Detail No. 20 05 12-001		



DEDICATED POWER DISTRIBUTION EQUIPMENT



NON-DEDCATED POWER DISTRIBUTED EQUIPMENT

KEY NOTES:

(1) SEPARATE FUSED DISCONNECT WHEN NOT PROVIDED INTEGRAL TO THE V.F.D. (TYP)

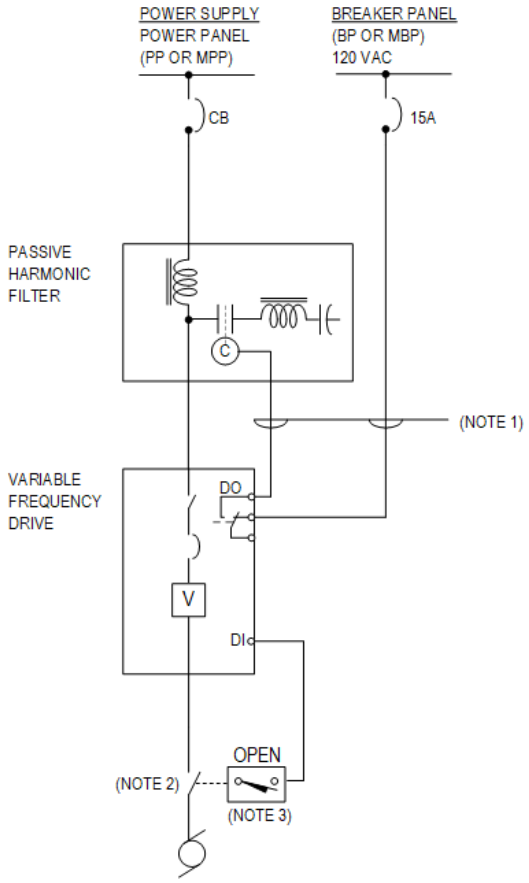
(2) SEPARATE UNFUSED DISCONNECT WHERE V.F.D. IS REMOTE FROM THE MOTOR. PROVIDE DISCONNECT SWITCH POSITION INTERLOCK WIRED BACK TO THE V.F.D. (TYP)

General Notes

1. This drawing indicates general coordination of mechanical and electrical work. Refer to plan and riser drawings and specifications for project specific requirements, which take precedence over this drawing.

2. Dedicated power distribution equipment is only located in mechanical service rooms.

HHAngus	Sheet Title: MECHANICAL – ELECTRICAL COORDINATION (SHEET 2 OF 2)	Date: 12-NOV-2019	Rev. No.: 01	Checked: PS
		Standard Detail No. 20 05 12-002		



NOTES:

1. 120 VAC CONTROL POWER TO HARMONIC FILTER CONTACTOR, 2#14-15mmC
2. DISCONNECT SWITCH AT MOTOR WHEN VFD IS LOCATED MORE THAN 9 M AND/ OR IS OUT-OF-SITE FROM THE MOTOR.
3. POSITION SWITCH WIRED TO VFD, 2#14-12mmC

THIS DRAWING ILLUSTRATES AUXILIARY POWER AND MINIMUM INTERLOCK REQUIREMENTS. REFER TO SPECIFICATION AND DRAWING DETAILS FOR OTHER CONTROL REQUIREMENTS. SEE ALSO STANDARD DETAIL 20 05 14-005.

HHAngus	Sheet Title: VARIABLE FREQUENCY DRIVE SINGLE LINE SCHEMATIC	Date: 08-DEC-2019	Rev. No.: 01	Checked: PS
		Standard Detail No. 20 05 12 - 003		

COMMON MOTOR REQUIREMENTS FOR MECHANICAL EQUIPMENT
20 05 13

1 GENERAL

1.1 Scope

.1 Provide single phase and three-phase low-voltage AC induction motors from fractional horsepower to 200 horsepower, and brushless DC ECM motors.

.2 This specification section applies to general purpose motors and inverter duty motors, except where otherwise specified by other specification sections of Divisions 20 to 25.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 20 05 14.13 Motor Controllers

.2 20 05 14.16 Variable- Frequency Drives

1.3 Definitions

.1 The following definitions apply to this section and referenced sections:

.1 ***ECM***: electrically commutated motor (AC supply, brushless DC motor).

.2 ***ODP***: open drip proof (motor enclosure).

.3 ***Soft start motor controller*****:** a solid-state electronic motor controller that regulates output current and voltage during motor starting.

.4 ***TENV***: totally enclosed non-ventilated (motor enclosure without motor driven cooling fan).

.5 ***TEFC***: totally enclosed fan cooled (motor enclosure with motor driven cooling fan).

1.4 Applicable Codes and Standards

.1 Legislation:

.1 O.Reg. 509/18 Energy and Water Efficiency – Appliances and Products

.2 U.S. DOE 10 CFR 431 Code of Federal Regulations Part 431 (to the extent adopted in O.Reg. 509/18)

1.5 Submittals

.1 Submit manufacturer data sheets with the following information for motors 50 HP and smaller:

.1 motor model/catalogue numbers,

.2 motor full load ratings: current, speed, voltage, horsepower, efficiency, and KVAR.

.2 Submit manufacturer data sheets with the following information for motors greater than 50 HP:

.1 associated driven equipment identification tag,

.2 motor model/catalogue numbers,

.3 motor full load ratings: current, speed, voltage, horsepower, efficiency, and KVAR,

.4 bearing data,

.5 acceleration time at maximum inertia,

.6 guaranteed efficiency and power factor at full load, 75% load, 50% load, and 25% load,

.7 dBA scale sound power levels.

.3 For inverter duty motors 5 HP and larger, submit manufacturer data sheets or similar documentation for the following information:

.1 confirmation of compliance to NEMA MG-1 for inverter duty,

.2 protection method for grounding of stray motor currents,

.3 motor frequency operating range (minimum to maximum),

.4 insulation winding class,

.5 details of motor bearing construction.

1.6 Shipping and Storage

.1 Ship motors from factory;

.1 packed in impact-absorbing material, or fastened to hardwood skid or pallet for fork truck handling. Do not use Styrofoam or similar plastic-based materials,

.2 protected against dirt and moisture during transit and outdoor storage,

.3 clearly identified with permanent ink marking on packing,

.2 Protect motors attached to equipment against dirt and moisture during transit and outdoor storage.

1.7 Operating and Maintenance Manuals

.1 Include in the operating and maintenance manuals the following data for all motors supplied ot the project:

.1 shop drawing data as specified herein,

.2 motor weight,

.3 sliding base dimensioned drawings,

.4 internal winding connection diagram,

.5 speed torque performance data for across line start, from stand-still to synchronous speed,

.6 installation and maintenance instructions.

2 PRODUCTS

2.1 Motors - General Requirements

.1 Listed to CSA C22.2 No.100.

.2 Listed to CSA C390 for NEMA MG-1 Premium efficiency ratings (three phase, 1 – 200 HP)

.3 Motors selected and marked with a power rating that is the greater of:

.1 not less than the input brake horsepower of driven equipment at both the specified operating condition and at maximum run-out conditions at design driven equipment operating speed, without operation in the motor service factor, and

.2 not less than the minimum horsepower rating as shown.

.4 Common motor characteristics:

.1 frequency: [60][50] Hz.

.2 voltage:

(a) 220 volt, for single phase motors,
(b) 575 volt, for three phase motors, or
(c) as otherwise shown.

.3 nominal rated-load speed: 1750 RPM unless otherwise shown,

.4 minimum ambient operating temperature at nameplate power rating: 40°C (104°F),

.5 vibration velocity: not to exceed 2.0 mm/s (0.08 inches/second) measured at bearing housing,

.6 motor generated noise, 10 HP and larger: not to exceed 85 dbA, measured at 3 m (10 ft) in accordance with IEEE 85.

.5 Permanently lubricated ball bearing rotor supports.

.6 Motor enclosure:

.1 cast iron, aluminum, or rolled steel construction,

.2 drain openings,

.3 shouldered lifting eye bolts (three phase TEFC motors),

.4 bi-directional, spark-proof, abrasion and corrosive resistant cooling fan keyed to shaft (three phase TEFC motors),

.5 compression type grounding lug or double ended cap screw of silicon bronze, mounted in conduit box by drilling and tapping into motor frame.

.7 Motor nameplate:

.1 stainless steel plate mounted on enclosure with stainless steel fastening pins,

.2 information as described in NEMA MG-1 including motor efficiency rating,

.3 motor bearing part numbers and motor wiring diagram instructions,

.8 Protective coating, TEFC motors:

.1 primer and 4-5 mils epoxy overcoat on external surfaces, and corrosion resistant coating of epoxy paint on internal surfaces, shaft, rotor, stator iron, and end bells,

.2 shaft extension protected with rust preventive strippable coating capable of being peeled off or unwrapped.

.9 Motor termination junction boxes and motor leads:

.1 cast iron or sheet steel diagonally split, tapped for conduit, and attached to motor frame with cadmium plated hex head cap screws,

.2 arranged for conduit entry from either side or bottom,

.3 gaskets between box and motor frame and between halves of box, with cover secured with cadmium plated hex head cap screws,

.4 motor leads in conduit box;

(a) identified in accordance with ANSI C6.1,
(b) with the same insulation class as windings,
(c) sized in accordance with EASA recommended minimum ampacity values,

.5 motor leads between motor frame and termination box to pass through tight fitting neoprene rubber seals.

2.2 Motor Efficiency

.1 Motor efficiency test method:

.1 CSA C747 or IEEE 114 for single phase ECM and AC motors,

.2 CSA C747 or IEEE 112 for polyphaser motors up to 3 HP, and.

.3 CSA C390 or IEEE 112 for three-phase motors 1 to 200 HP.

.2 Motor efficiency ratings:

.1 Minimum motor efficiency to be not less than the greater of the following:

(a) applicable legislation for energy efficiency,
(b) NEMA Premium® for three-phase integral horsepower motors, and
(c) as specified in the Schedules appended at the end of this specification section.

.3 These motor efficiency ratings do not apply to electric motor-driven fire pumps.

2.3 Single Phase Motors

.1 Single phase motor rating less than 375 W (1/2 hp):

.2 Types:

.1 PSC motor:

(a) permanent split capacitor type for AC power supply,
(b) suitable for variable speed applications.

.3 ECM motor:

.1 brushless DC electrically commutated motor with integral microprocessor based inverter and controller, for AC power supply,

.2 fctory programmed or field programmable for specific application,

.3 capable of accepting an external 0-20 mA or 0-10 V signal for remote variable speed operation including fan On/Off control.

.4 Winding insulation: Class B.

.5 Suitable for mounting in the horizontal or vertical orientation.

.6 Continuous duty rating with 1.35 service factor.

.7 ODP or TEFC enclosure, resilient mounts.

.8 Built-in overload protection.

.9 Motor over-temperature protection as specified herein.

2.4 Three Phase Motors, Fractional Horsepower

.1 Motors of 375 W (½ HP) and 560 W (3/4 HP).

.2 For use with magnetic motor controllers.

.3 Three phase squirrel cage induction type, NEMA T frame, general purpose type, to NEMA MG-1.

.4 NEMA B design.

.5 Winding insulation: Class B.

.6 Continuous duty rating with 1.15 service factor.

.7 ODP or TENV enclosure.

.8 Motor over-temperature protection as specified herein.

2.5 Three Phase Motors, Integral Horsepower

.1 Motors 745 W (1 hp) to 150 kW (200 hp).

.2 For use with magnetic motor controllers.

.3 Three phase squirrel cage induction type, NEMA T frame, general purpose type.

.4 NEMA design:

.1 Type B for centrifugal fans and pumps,

.2 Type C for positive displacement pumps and compressors.

.5 Winding insulation: Class B.

.6 Continuous duty rating with 1.15 service factor.

.7 TEFC enclosure.

.8 Suitable for horizontal, vertical or belt-driven mounting.

.9 Motor over-temperature protection as specified herein.

.10 Motor winding leads:

.1 three (3) leads for single speed operation,

.2 six (6) leads for two-speed operation (five lead two-speed motors are not acceptable).

2.6 Three Phase Motors – Inverter Duty

.1 Motors 745 W (1 hp) to 150 kW (200 hp).

.2 General Requirements:

.1 three phase squirrel cage induction type, NEMA T frame, general purpose type, suitable for pulse width modulated wave form,

.2 NEMA design: Type B,

.3 continuous duty rating and rated for 200% of full load starting torque,

.4 service factor: 1.5 on Sine Wave, 1.0 on pulse-width modulated power supply,

.5 TEFC enclosure,

.6 suitable for horizontal, vertical or belt-driven mounting,

.7 motor over-temperature protection as specified herein,

.8 motor winding leads: three (3) leads,

.9 motor over-temperature protection as specified herein except where the protection function is provided by the variable frequency drive.

.3 Special requirements:

.1 motors rated for inverter duty in accordance with NEMA MG-1 Part 30 and 31, and suitable for motor control with soft-start motor controllers and variable frequency drive's,

.2 speed range: minimum 20:1 (3 to 60 Hz) for variable torque applications,

.3 provided with stray rotor current grounding system consisting of;

(a) electrically conductive bearing grease for motors (3 HP and less only), or
(b) rotor shaft grounding system on the drive end, internal or external mount (AEGIS or similar), and
(c) for motors 100 HP and larger, insulated bearings on the non-drive end.

.4 motor to be compatible with type of soft-start motor controller or variable frequency drive supplied under other specification sections, and that the starter/motor system will be capable of providing rated torque over a frequency range from 15 to 60 hz while operating within motor temperature rise specification,

.5 motor to be capable of operating between 60 Hz and 90 Hz with torque reducing at drive frequency above 60 Hz,

.6 ball bearing rotor supports suitable for continuous low speed operation at minimum motor speed.

.7 drive end face drilled and tapped (4 places) for mounting of auxiliary devices.

.4 Motor stator winding:

.1 made up with copper magnet wire coated with moisture resistant triple-build Class F insulation, non-hygroscopic varnish, phase paper insulation, and with thermal rating of not less than 150°C for 30,000 hours life when tested in accordance with IEEE No. 57,

.2 insulation resistance greater than 100 megohms when measured at 25°C with 1000-volt direct current mega-ohm bridge,

.3 slot-wound installation, held in stator slots that have had sharp edges and burs removed prior to winding insertion,

.4 connection leads mechanically secured and silver soldered,

.5 designed for operation in either direction of rotation.

.5 Motor bearings:

.1 anti-friction single shield, vacuum-degassed steel ball bearings,

.2 lubricated bearings; extended pipe zerk fitting, and ½-lb relief fitting for external lubrication while machine is in operation, bearing seal, lubricated at factory after assembly,

.3 bearing shield on motor winding side of bearing,

.4 rated fatigue life of L'-10 (B-10) 150,000 hours for direct coupled applications and 50,000 hours for belted applications,

.5 belt drive-set rating based on radial loads and pulley sizes from NEMA MG1-14.43.

2.7 Motor Over-Temperature Protection

.1 Motor thermal protection for single phase motors mounted in air ducts, plenum chambers or in air stream inside air handling equipment:

.1 motor winding thermostats, normally closed contact, phenolic snap-acting disc thermal switch, temperature calibrated,

.2 automatic reset type.

Standard of Acceptance

° Texas Instruments - Klixon Phenolic Motor Protectors

.2 Motor thermal protection for three phase motors less than 37 kW (50 HP) that are mounted in air ducts, plenum chambers or in air stream inside air handling equipment:

.1 Winding sensors;

(a) three (3) Positive Temperature Coefficient (PTC) temperature sensors, one in each motor winding, wired in series, and compatible with Texas Instruments - Klixon model 42AA100E control unit,
(b) control unit provided under section 20 05 14.13 or 20 05 14.16.

.3 Motor thermal protection for three phase motors 37 kW (50 HP) and larger:

.1 Winding sensors;

(a) three (3) Positive Temperature Coefficient (PTC) temperature sensors, one in each motor winding, wired in series, and compatible with Siemens model 3RN10 12 control unit,
(b) control unit provided under section 20 05 14.13 or 20 05 14.16.

2.8 Field Applied Rotor Grounding System for Operation with Variable Frequency Drives

.1 Shaft-grounding ring system with contact brushes providing 360 degree coverage of drive shaft, to provide grounding of rotor to motor frame.

Standard of Acceptance

° AEGIS SGR series

2.9 Sliding Base for Motors with V-belt Drives

.1 Construction:

.1 fabricated from steel as a single unit with double supported slide and two adjusting bolts,

.2 finished with coating as specified above for motor exterior.

3 EXECUTION

3.1 Application

.1 Refer to other specification sections for motor style requirements for single phase motors and fractional horsepower polyphase phase motors (ODP, TENV or TEFC).

3.2 Field Applied Rotor Grounding System

.1 Install shaft-grounding system on motors operating on variable speed drives and not provided with OEM rotor grounding systems.

.2 For existing motors 100 HP and larger, in addition to the shaft-grounding ring system, replace the non-drive end bearing assembly with an electrically insulated bearing of a type in accordance with the motor manufacturer requirements.

3.3 Maintenance During Construction

.1 Rotate motors by hand at one month intervals while at the project site.

3.4 Schedules

.1 The following schedules of motor minimum electrical efficiency ratings apply:

.1 Schedule A – Single Phase Electric Motor Efficiency, 0.25 to 0.5 HP,

.2 Schedule B – Two-phase Electric Motor Efficiency 0.25 to 3 HP, and Three-phase Electric motor Efficiency 0.25 to 0.75 HP,

.3 Schedule C – Three Phase Electric Motor Efficiency, 1 to 200 HP.

Schedule A - Single Phase Electric Motor Efficiency, 0.25 to 0.5 HP

Motor HP (kW)	Single Phase, Permanent-Split Capacitor 0.25 to 0.5 HP Nominal Full-Load Efficiency (%) [Note 1]		
	Open Motors		
	6 Pole 1200 RPM	4 Pole 1800 RPM	2 Pole 3600 RPM
0.25 (0.18)	62.2	68.5	66.6
0.33 (0.25)	66.6	72.4	70.5
0.5 (0.37)	76.2	76.2	72.4

Notes:
[1] From U.S. DOE 10 CFT Part 431, SubPart X, §431.446(a)

Schedule B – Polyphase Electric Motor Efficiency, 0.25 to 3 HP

Motor HP (kW)	Polyphase Induction Motors 0.25 to 3 HP Nominal Full-Load Efficiency (%) [Note 2]			Remarks
	Open Motors			
	6 Pole	4 Pole	2 Pole	
0.25 (0.18)	67.5	69.5	65.6	2 Phase & 3 Phase
0.33 (0.25)	71.4	73.4	69.5	2 Phase & 3 Phase
0.5 (0.37)	75.3	78.2	73.4	2 Phase & 3 Phase
0.75 (0.55)	81.7	81.1	76.8	2 Phase & 3 Phase
1 (0.75)	82.5	83.5	77.0	2 Phase only
1.5 (1.1)	83.8	86.5	84.0	2 Phase only
2 (1.5)	---_	86.5	85.5	2 Phase only
3(2.2)	---	86.9	85.5	2 Phase only

Notes:
[2] From U.S. DOE 10 CFT Part 431, SubPart X, §431.446(a)

Schedule C – Three-Phase Electric Motor Efficiency, NEMA Premium, 1 to 200 HP

Motor HP (kW)	Three-Phase Induction Motors 1 to 200 HP Nominal Full-Load NEMA Premium Efficiency (%) [Note 3]							
	2 Pole 3600 RPM		4 Pole 1800 RPM		6 Pole 1200 RPM		8 Pole 900 RPM	
	Encl.	Open	Encl.	Open	Encl.	Open	Encl.	Open
1 (0.75)	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5 (1.1)	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.0
2 (1.5)	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3 (2.2)	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5 (3.7)	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5 (5.5)	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10 (7.5)	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15 (11)	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20 (15)	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25 (18.5)	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30 (22)	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40 (30)	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50 (37)	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60 (45)	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75 (55)	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100 (75)	94.1	93.6	95.4	95.4	95.0	95.0	93.6	94.1
125 (90)	95.0	94.1	95.4	95.4	95.0	95.0	94.1	94.1
150 (110)	95.0	94.1	95.8	95.8	95.8	95.4	94.1	94.1
200 (150)	95.4	95.0	96.2	95.8	95.8	95.4	94.5	94.1

Notes:
[3] From U.S. DOE 10 CFT Part 431, SubPart B, §431.25(h), Table 5, and NEMA MG-1 Table 12-12.

END OF SECTION

VARIABLE FREQUENCY DRIVE MOTOR CONTROLLERS
20 05 14.16

1 GENERAL

1.1 Scope

.1 Provide variable frequency drive ("VFD") motor controllers, and harmonic filtration equipment, for electric motor-driven equipment provided under mechanical trades work.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections;

.1 20 05 12 Wiring Requirements for Mechanical Services

.2 20 05 49 Seismic Restraint

1.3 Definitions and Abbreviations

.1 The following definitions apply to this section.

.1 ***ASCC***: the site-specific available short-circuit current (available fault current has the same meaning),

.2 ***SCCR***: the short-circuit current rating of the VFD, measured at the input to the VFD (short-circuit withstand rating has the same meaning).

.3 $\boldsymbol{THD_i}$: current total harmonic distortion.

.2 For other definitions, conform to definitions in specification section 20 05 12.

1.4 Applicable Codes and Standards

.1 Product standards:

.1	CSA C22.2 No. 5	Molded-case Circuit Breakers, Molded-case switches and Circuit-breaker Enclosures
.2	CSA C22.2 No. 14	Industrial Control Equipment
.3	CSA C22.2 No. 39	Fuseholder Assemblies
.4	CSA C22.2 No. 94.1	Enclosures for Electrical Equipment, Non-environmental Considerations
.5	CSA C22.2 No. 94.2	Enclosures for Electrical Equipment, Environmental Considerations
.6	CSA C22.2 No. 106	HRC – Miscellaneous Fuses
.7	CSA C22.2 No. 274	Adjustable Speed Drives
.8	ICC ES ACC-156	Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components

1.5 Submittals

.1 Submit shop drawing material in accordance with the requirements of Division 01.

.2 Submit shop drawings for VFD motor controller and include the following minimum information:

.1 outline dimensions, conduit entry locations and weight,

.2 power efficiency rating,

.3 input THDi,

.4 device SCCR value that will be marked on each drive unit,

.5 protection method used to meet the required short-circuit current rating,

.6 the interrupting rating of the required integral or external overcurrent protection device,

.7 included AC line reactor capacity to suit the available short-circuit (fault) current (ASCC),

.8 control and power wiring diagrams,

.9 complete technical product description including a list of options provided,

.10 termination diagrams for electrical contacts, relays, thermostats, timers and components in control circuits shown.

.3 Include SCCR data for each size of VFD supplied to the project, including:

.1 VFD model reference and HP rating,

.2 site-specific available short-circuit current value (ASCC) as specified herein,

.3 disconnecting means by type,

.4 overcurrent protection device by type,

.5 overcurrent protection rating, SCCR kA RMS symmetrical (at the input side of the drive),

.6 AC line reactor, size to suit the site-specific ASCC.

.4 Where an external disconnecting means with overcurrent protection equipment is being supplied (due to the VFD not being available with such integral devices), submit shop drawings of the overcurrent protection equipment with confirmation from the VFD manufacturer that it meets their protection requirements.

.5 Submit shop drawings for harmonic filters and include:

.1 certified factory test results for harmonic mitigation performance and energy efficiency under actual VFD drive loading, including product serial numbers.

1.6 Product Support

.1 Manufacturer to have factory trained application engineering and service personnel locally available at the installation locations and/or available through a toll free 24/365 technical support line.

1.7 Warranty

.1 VFD warranted for twenty-four (24) months from date of certified start-up by manufacturer's representative, not to exceed 30 months from date of shipment, but in no instance less than twelve (12) months from hand-over of equipment to the Owner (start of the Work warranty period).

.2 The warranty shall include all parts, labor, travel time and expenses.

2 PRODUCTS

2.1 Variable Frequency Drives (VFD)

.1 General;

.1 Electronic pulse width modulating type for speed control of NEMA Design B inverter-duty induction motors, using constant voltage/frequency control.

.2 Six-pulse drive, with

(a) input stage AC-DC rectifier: diode-based, or integrated gate bipolar transistor (IGBT) type,
(b) DC bus link capacitors, and
(c) output stage DC-AC inverter: IGBT power switches.

.3 Listed to CSA C22.2 No. 274 and conform to CSA C22.2 No. 14.

.4 Motor horsepower rated.

.5 Operating voltage:

(a) +30%, -35% of nominal supply voltage range to drive,
(b) protection circuitry to lock-in drive or bypass over this voltage tolerance,

.6 Environmental operating conditions:

(a) temperature: 0 - 40°C (32 - 104 F) continuous,
(b) altitude: 0 - 1000 m (0 - 3300 ft) above sea level,
(c) humidity: 5 to 95% relative humidity non-condensing.

.7 Seismic rating:

(a) designed to withstand the seismic loads in accordance with specification section 20 05 49,
(b) product-type seismically rated for structural and functional integrity based upon shake table test to ICC ES ACC-156.

.8 Supply VFDs from one manufacturer.

Standard of Acceptance
- ABB
- Danfoss
- Siemens
- Yaskawa
- Toshiba
- Cutler Hammer
- Allen Bradley
- Baldor
- Graham (Danfoss)
- Benshaw.
- Schneider Electric
- WEG

.2 Performance requirements:

.1 capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start),

.2 logic control board ride-through on mains power failure: minimum 0.5 seconds,

.3 adjustable switching frequency: minimum of three selections within the range of 1 to 12 kHz,

.4 operating speed range: minimum 10:1, except where specified in other specification sections for mechanical trades work,

.5 ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip,

.6 programmable number of restart attempts, trial time, and time between attempts,

.7 short circuit current rating (SCCR): 100,000 Amp with integral fuses.

.8 drive overload rating:

(a) 110% of its normal duty current rating for 1 minute every 10 minutes,
(b) 130% overload for 2 seconds

.9 VFD efficiency: output current not less than 97% of input current at 100% full load,

.10 power factor: not less than 0.98 lagging in operating range from 75% to 100% full load.

.11 input and output current ratings marked on the VFD nameplate.

.3 Short circuit protection rating (SCCR):

.1 Available short circuit (fault) capacity ("ASCC"): 100 kA RMS symmetrical.

.2 VFD SCCR rating: not less than the ASCC.

.3 SCCR rating may be met by;

(a) integral input overcurrent protection, or
(b) field installed external input overcurrent protection.

.4 For clarity, SCCR ratings based on VFD output (to motor) are not acceptable.

.5 SCCR value to be marked on the VFD nameplate. Where the SCCR nameplate rating references an instruction manual, provide a separate label that states the SCCR value.

.6 Where the VFD requires field installed external input overcurrent protection to meet the required SCCR rating, the drive manufacturer is responsible to provide information for the required circuit breaker or fuse type and rating that they require to be included in the external protection device.

.4 Electrical enclosure:

.1 listed to CSA C22.2 No. 94.1 and of the following types unless otherwise specified herein or in other specification sections of mechanical trades work:

(a) indoor installations: Type 3R

.2 cooling fans:

(a) designed to maintain operating function of VFD at maximum environmental temperature and humidity conditions,
(b) designed for easy replacement, and without requiring dismounting the VFD or removal of circuit boards,
(c) operate under temperature control.

.5 Disconnecting means:

.1 interlocked to disconnect all input power to the VFD, and lockable in the open position,

.2 door mounted or enclosure-flange mounted operating handle.

.6 Overcurrent protection:

.1 fuse: HRC type"J" time delay type, 200 kA interrupting rating.

(a) exception: if a fused disconnect switch is not available as an option, provide a field installed external fused disconnect switch.

.7 Input power harmonic mitigation:

.1 Harmonic mitigation methods:

(a) Internal Filters:
- dual (positive and negative DC bus) chokes and DC link, or
- 5% AC line reactor,

(b) Active Front End:
- input stage AC-DC rectifier using integrated gate bipolar transistors (IGBT) combined with a DC bus link capacitor and with integral AC line LCL filter.

(c) Passive Harmonic Filter:
- as specified herein, and supplied with the VFD,

- may be provided integral to the VFD or external to the VFD,
- provided with a contactor to switch capacitors On/Off at low load conditions.

(d) Active Harmonic Filter:

- integrated as part of the VFD,
- active control by use of contactors to switch filter on/off to automatically prevent leading power factor.

.2 Provide harmonic current mitigation in accordance with the following table, to not exceed the maximum current total harmonic distortion ("THDi") when measured at the line side of the filter/drive.

Motor Size HP	Filter Type	Maximum THD_i Rating
≤ 25	Internal Filter	45%
>25 and ≤ 100	Passive Harmonic Filter	8%
	Active Front End	5%
>100	Active Harmonic Filter	5%
	Active Front End	5%

.8 Output power conditioning:

.1 output LC load filter or equivalent, voltage "dV/dt"-overshoot mitigation device for drives with motor feeders exceeding 10 m (30 ft) developed length between drive and motor.

.9 Other power conditioning:

.1 RFI filters.

.10 Equipment and motor protection:

.1 under- and over-voltage protection, phase loss protection and phase unbalance protection,

.2 current limiting device adjustable from 70% to 100% of rated motor current,

.3 ground fault protection, suitable for operation on a high-resistance grounding system of not less than [5] A ground fault current,

.4 inherent short circuit protection for line-to-line and line-to-ground faults giving safe shut down without damage to power circuit devices,

.5 instantaneous electronic over current-protection,

.6 internal over-temperature protection,

.7 motor stall protection.

.11 Operator interface keypad and display:

.1 digital display with keypad, including quick-access for "Hand-Off-Auto" selection, fault reset, and "Help" functions,

.2 loss-of-load alarm,

.3 display unit:

(a) LCD display, text or graphic display,
(b) complete English words for programming and fault diagnostics,
(c) faults displayed in English words.

.4 “Help” button access to "on-line" assistance for programming and troubleshooting, including a minimum of 14 programming assistants:

(a) start-up
(b) parameter
(c) PID
(d) reference
(e) I/O
(f) serial communications
(g) option module
(h) panel display
(i) low noise set-up
(j) maintenance
(k) troubleshooting
(l) drive optimizer

.5 Operating values displayed in engineering (user) units, including the following:

(a) output frequency,
(b) motor speed (RPM, %, or Engineering units),
(c) motor current,
(d) motor torque,
(e) motor power (kW),
(f) DC bus voltage,
(g) output voltage.

.12 Control Inputs:

.1 Analog inputs; two (2) configurable inputs for current or voltage signals, 0-10 V or 0-20 mA;

(a) frequency/speed setpoint value command,
(b) actual feedback input.

.2 Digital inputs: six (6) inputs, 12 to 24 VDC, 10 to 24 VAC,

(a) Stop/Start command,
(b) constant frequency/speed selection bypass command,
(c) Start permissive interlock,
(d) 3 other programmable inputs.

.3 Emergency safety shut-down digital input:

(a) to allow an external safety shut-down device or control switch to prevent motor operation,
(b) two (2) separate safety interlock inputs,
(c) when either safety is opened, the motor coasts to stop and associated damper/valve commanded to close,
(d) operates in Fireman’s override / smoke control mode,
(e) provided with removable factory-installed jumpers (factory default: disables function).

.13 Control Outputs:

.1 Analog output: two (2) configurable outputs for 0-20mA and/or 0-10VDC;

(a) output frequency actual value,
(b) motor current actual value.

.2 Digital outputs: four (4) programmable Form-C relay outputs, 250 VAC/30 VDC, 2A RMS continuous;

(a) auxiliary output control (e.g, damper or valve command),
(b) motor run status,
(c) drive fault status,

(d) passive harmonic filter capacitor contactor control.

.14 Programming:

.1 built-in time clock in the VFD keypad with battery backup of 10 years minimum life span,

.2 time clock date-and-time stamp for faults and records operating parameters at the time of fault. On battery failure, the VFD automatically reverts to hours of operation since initial power up,

.3 time clock programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays,

.4 four (4) separate, independent timer functions that have both weekday and weekend settings,

.5 utilize pre-programmed application macros specifically designed to facilitate start-up,

.6 application macros provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time, and

.7 two (2) user macros to allow the end-user to create and save custom settings.

.15 General control functions:

.1 three (3) programmable critical frequency lockout ranges to prevent VFD from operating the load continuously at an unstable speed, fully adjustable, from 0 to full speed.

.2 two (2) PID Set point controllers allowing pressure or flow signals to be connected directly to the VFD;

(a) microprocessor for the closed-loop control,
(b) 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others,
(c) PID set-point adjustment from the VFD keypad, or via the communications bus,
(d) two (2) independent parameter sets for the PID controller and the capability to switch between the parameter sets via a discrete input, serial communications or from the keypad.

.3 the independent second PID loop able to utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (ie. valves, dampers, etc.),

.4 all set points, process variables, etc. to be accessible from the serial communication network,

.5 programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal,

.6 "bumpless transfer" of speed reference and ouput when switching between "Hand" and "Auto" modes – speed changes by controlled ramp rate,

.7 programmable loss-of-load (broken belt / broken coupling) with programmable time delay for motor start-up, via the serial communications bus,

.8 programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure / jam condition causing motor overload,

.9 loss of input reference (4-20mA or 2-10V): User option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued as selected by the user, with alarm output via the serial communication bus,

.10 password protection against parameter changes.

.16 Programmable Time Delay functions:

.1 VFD start delay and a keypad indication that this time delay is active,

.2 output relay provides a contact closure to signal a valve/terminal boxes to open prior to the motor starting,

.3 field programmable from 0 - 120 seconds,

.4 Start delay active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass (where bypass is specified).

.17 Speed Control functions:

.1 Minimum five (5) programmable preset speeds,

.2 two (2) independently adjustable acceleration and deceleration ramps with 1 - 1800 seconds adjustable time ramps.

.3 minimum speed setting adjustable from 0 to 70%,

.4 maximum speed setting adjustable from 50 to 150%,

.5 flying-start into a rotating load, to match output drive frequency to motor frequency before taking load,

.6 control-board kinetic energization protection: control deceleration of motor to use motor-load inertia to keep drive controller energized as long as possible during loss of mains AC failure,

.7 motor flux optimization circuit to automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise;

(a) selectable software for optimization of motor noise, energy consumption, and motor speed control.

.8 carrier frequency control circuit to reduce the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.

.18 Passive filter low-load function:

.1 digital output relay opens capacitor-bank contactor in passive harmonic filters on low-motor load (approximately < 30% maximum motor HP), to prevent leading power factor generated by the filter.

.2 adjustable trip setpoint.

.19 Fireman’s Override control function (constant frequency/speed selection bypass command):

.1 On receipt of a contact closure from the Fire Alarm System or Building Automation System, the VFD operates in one of two selectable modes:

(a) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward), or
(b) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback; setpoint adjusted over the serial communications bus.

.2 Operating mode overrides all other inputs (analog/digital, serial communication, and all keypad commands), except safety run interlocks, and force the motor to run in one of the two modes.

.3 "Override Mode" displayed on the keypad.

.4 Upon removal of the override signal, the VFD resumes normal operation, without the need to cycle the normal discrete input run command.

.20 Building Automation System Integration:

.1 EIA-485 port,

.2 BACnet MS/TP, BACnet/IP, or Modbus RTU,

.3 BACnet device protocols certified by BTL listing to ASHRAE Standard 135 BACnet as an Application Specific Controller,

.4 if additional hardware is required to obtain the BACnet interface, the VFD manufacturer to provide one BACnet gateway per drive; multiple VFDs sharing one gateway is not acceptable.

.5 serial communication functions include:

(a) run-stop control,
(b) speed set adjustment,
(c) proportional/integral/derivative PID control adjustments,
(d) current limit,
(e) accel/decel time adjustments,
(f) lock and unlock the keypad,
(g) allow the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature.
(h) BAS capable of monitoring the VFD relay output status, discrete input status, and all analog input and analog output values.
(i) all diagnostic warning and fault information,
(j) remote VFD fault reset.

.6 BAS may force digital and analog outputs via the serial interface; this control is independent of any VFD function except the local Emergency Shut-Down function.

2.2 Field-Installed Disconnecting Means

.1 Enclosure:

.1 To CSA C22.2 NO. 94.1,

.2 Enclosure type:

(a) indoor installation: Type 3R
(b) outdoor installation: Type 3R or 4.

.3 door or enclosure-flange mounted operating handle.

.2 Overcurrent protection:

.1 fused disconnect switch with HRC Class J fast acting uses to CSA C22.2 No.106,

3 EXECUTION

3.1 Variable Speed Drive Installation

.1 Install variable speed drives in accordance with manufacturer's requirements. Provide field wiring in accordance with specification section 23 05 12.

.2 Install VFD adjacent to controlled equipment or as otherwise shown. Position VFD so that the door front is readily visible and accessible, with center of the VFD located approximately 1200 to 1500 mm above the local work surface, and with a minimum clear space of 1000 mm (40 in.) in front of the controller.

.3 Mount motor controllers to building walls or structure, on Unistrut or similar rails; do not weld miscellaneous support steel to building structure. Secure with seismic-rated fasteners where seismic restraint is required in accordance with specification section 20 05 49.

.4 Where there is no adjacent or insufficient wall space or building structure upon which to mount the motor controller, provide a floor-mounted fabricated support assembly to mount the motor controller. Design the support assembly to:

.1 withstand a 220 N (50 lbf) horizontal force from any direction applied to the starter enclosure, with a maximum deflection of 3 mm (1/8 in).

.2 resist seismic movement where seismic restraint is required in accordance with specification section 20 05 49.

.5 Provide 120 VAC power wiring for stand-alone harmonic filter contactor operation.

3.2 Disconnecting Means

.1 Where VFDs are not provided with integral disconnecting means, provide external disconnecting means with overcurrent protection. The overcurrent protection device is as specified herein, and of a rating as specified by the VFD manufacturer to achieve the required SCCR required rating.

.2 Locate the disconnect switch immediately upstream of the VFD;

.1 install the disconnect switch within 9 m (29 ft) and in line-of-site of the VFD and the motor served by the VFD,

.2 where a VFD has an associated external harmonic filter installed immediately adjacent to the VFD, the disconnect switch may be mounted ahead of the harmonic filter.

.3 Where a separate disconnect is installed between the drive and the controlled equipment, provide interlock wiring between disconnect status contact switch and the VFD, to prevent drive from operating if the motor disconnect switch is open.

3.3 Driven Equipment Natural Frequency Setting

.1 Conduct a vibration test on driven equipment to determine its first natural frequency, and program VFD skip speed function to prevent operation at this speed.

.1 nominal skip speed range setpoint to be equal to ± 5% of measured harmonic frequency, or as determined on site.

3.4 Cleaning

.1 Do not start-up VFDs until the local area has been brought to final clean, floors are sealed, and any drywall in the same space is sanded and painted.

3.5 Start-Up and Testing

.1 VFDs are not to be used to operate equipment which is/are used for temporary construction heat, prior to final construction cleaning of the space in which the drives are located.

.2 If such heating equipment is to be used prior to final construction clean, provide temporary magnetic starters, or, provide enclosures around the drives and pressurized the enclosures with a source of clean air.

.3 Provide the services of a certified factory authorized representative for the start-up of each drive. Complete and submit a certified start-up form filled out for each drive.

3.6 Demonstration and Training

.1 Provide the services of a factory trained manufacturer’s representative to provide training to Owners staff. Include in training;

.1 installation instructions,

.2 programming of VFD,

.3 operation of VFD,

.4 at-site servicing of VFD,

.5 replacement of VFD keypad controller,

.6 manual and automatic operation of bypass, if applicable,

.7 serial communications,

.8 fireman's smoke control override.

3.7 Hand-Over

.1 Provide to the Owner the service and maintenance manuals, wiring and interconnection diagrams and the start-up reports prepared by a qualified manufacturer's service technician.

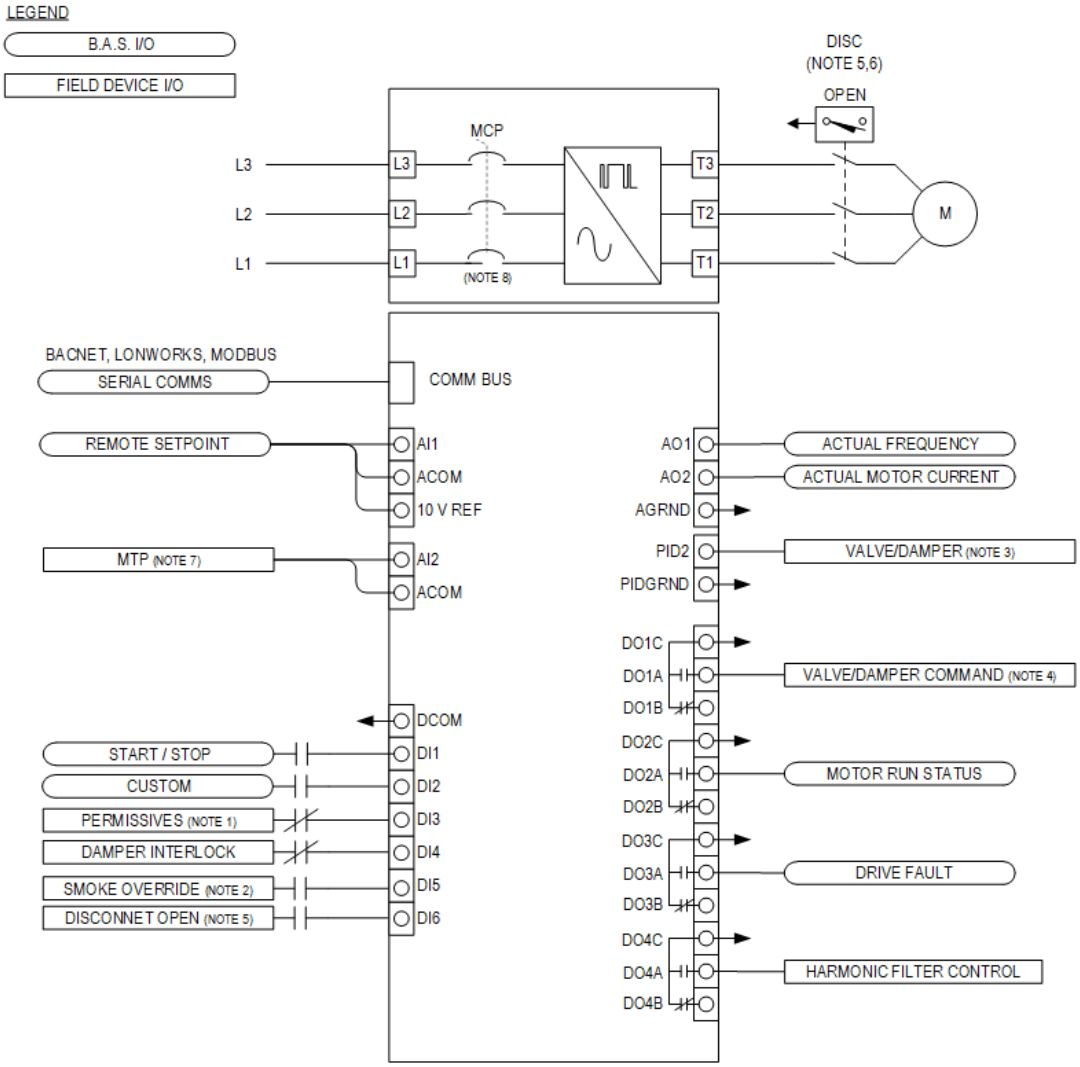
3.8 Wiring Diagrams

.1 The included VFD motor controller wiring diagrams are to be read in conjunction with equipment specifications, control sequences, and motor/starter schedules for implementation of control sequences and identification of components required in each in each motor controller.

.2 The following standard details provide indicative wiring requirements for motor controllers.

.1 20 05 14-005 Type "VFD" Three Phase Motor Controller

END OF SECTION



NOTES

(1) PERMISSIVES INCLUDE FREEZE-STAT, FIRESTAT, HIGH PRESSURE LIMITS, ETC.

(2) FROM B.A.S. OR F.A.S.; MOTOR RUNS AT PRE-SET SPEED (ONLY USED FOR NON-UUKL SMOKE CONTROL SYSTEMS)

(3) MODULATING CONTROL

(4) TWO POSITION CONTROL

(5) INTERLOCK TO REMOTE DISCONNECT SWITCH LOCATED ON LOAD SIDE OF VFD, TO PROVE DISCONNECT SWITCH IS CLOSED AS A RUN PERMISSIVE

(6) WHERE REQUIRED BASED ON LOCATION OF MOTOR CONTROLLER RELATIVE TO MOTOR.

(7) MOTOR THERMAL PROTECTION SENSORS. IF NONE REQUIRED, MAY BE USED FOR OTHER I/O FUNCTIONS.

(8) WHERE REQUIRED BASED ON LOCATION OF MOTOR CONTROLLER RELATIVE TO MOTOR.

HHAngus	Sheet Title: TYPE "VFD" THREE PHASE MOTOR CONTROLLER	Date: 24-NOV-2019	Rev. No.: 01	Checked: PS
		Standard Detail No. 20 05 14 - 005		

FLEX CONNECTIONS, EXPANSION JOINTS, ANCHORS & GUIDES
20 05 16

1 GENERAL

1.1 Scope

.1 Provide flexible connections, expansion joints, anchors and guides as shown.

1.2 Applicable codes and standards

.1 ASTM A53 Standard Specification for Pipe, Steel, Black and hot dipped, zinc-coated, welded and Seamless

.2 ASTM F1120 Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications

.3 ASME B31.1 Power Piping Code.

1.3 Design requirements

.1 Provide design services, sealed by a professional engineer licensed in the province of , for the design of pipe anchors including pipe stress design and resulting forces and moments at point of building attachment for the following pipe sizes and/or systems.

.1 any piping system using expansion joints,

.2	chilled water:	NPS 10 and larger
.3	condenser water:	NPS 10 and larger
.4	hot water heating, max 93°C (200 F):	NPS 8 and larger
.5	steam, low pressure <100 kPa (15 psig):	NPS 8 and larger
.6	steam >100 kPa (15 psig):	NPS 4 and larger

.7 glycol heating or cooling systems, in accordance with temperatures and pipe sizes described above.

1.4 Shop drawings

.1 Submit manufacturers product data sheets for expansion joint equipment showing

.1 Manufacturer, model number, piping service, pressure and temperature rating.

.2 Design allowances for axial, lateral and angular movement.

.3 Nominal size and overall dimensions.

.2 Submit sealed design drawings for pipe anchors, and include;

.1 plan drawings showing location of anchors and guides,

.2 fabrication details,

.3 pipe expansion forces,

.4 resulting reaction force and bending moments at building connection,

.5 building fastening details.

2 PRODUCTS

2.1 Slip type expansion joints:

.1 Application:

.1 for axial pipe movement,

.2 travel: 100 mm (4 in) to 300 mm (12 in) single unit, 200 mm (8 in) to 600 mm (24 in) for double units.

.3 size: NPS 1-1/2 to NPS 24

.4 Working pressure: 1030 kPa (150 psig) saturated steam.

.5 factory tested to 1½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 body and packing housings: Class 150 carbon steel pipe to ASTM A 53, Grade B,

.2 wall thickness to match service pipe with flanges or weld ends to match service pipe jointing specification.,

.3 adjustable packing gland or fixed packing gland arrangement with a packing injection assembly, arranged for repacking under full line pressure.,

.4 slip pipe of carbon steel pipe to ASTM A 53, Grade B, hard chrome plated,

.5 anchor base constructed of steel welded to body on double units,

.6 internal and external guides in packing housing with concentric alignment of slip pipe,

.7 extension limit stop of stainless steel, with accessible and removable pins,

.8 not less than six packing rings of teflon or graphite impregnated material,

.9 lubricating fittings with grease nipple, pet cocks, and lubricant gun with hose assembly or plunger body of heavy wall carbon steel and plunger of carbon steel with hex head for use with socket wrench.

.10 lubricant: to manufacturer's recommendations. .

.11 drip connection coupling with drain plug.

- Flexonics – style “Slip Pakt”
- Yarway – style “Gun Pakt”
- Adsco – style “Ram Pak”
- Hyspan - style 6500
- Advanced Thermal System – style Thermal Pak
- Flexpression – style “Perma-Pax”

2.2 Controlled flexing expansion joints

.1 Application:

.1 for axial and lateral movements,

.2 travel: up to 190 mm (7.5 in) axial and 8 mm (1.5 in) lateral depending on size.

.3 size: NPS 3 to NPS 18

.4 Working pressure: [1030 kPa (150 psig)][2070 kPa (300 psig)] at up to 425°C (800°F)

.5 factory tested to 1½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 bellows hydraulically formed, type 304 stainless steel for specified fluid,

.2 two piece nickel iron reinforcing or control rings,

.3 flanges or weld ends to match service pipe jointing specification,

.4 austenitic stainless steel liner oriented with direction of flow ,

.5 carbon steel tie rods,

.6 carbon steel painted shroud .

Standard of Acceptance

- Flexonics – style CSF/CSW
- Adsco
- Metraflex
- Badger
- Flex-Hose Co
- Flexpression.

2.3 Externally pressurized expansion joints

.1 Application:

.1 for axial movements, as shown.,

.2 travel: 100 mm (4 in) to 200 mm (8 in) single unit, 200 mm (8 in) to 400 mm (16 in) double unit.

.3 size: NPS 2 to NPS 12

.4 Working pressure: 2070 kPa (300 psig) at up to 425°C (800°F)

.5 factory tested to 1½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 external pressurized design,

.2 housing: ASME A53 Gr B carbon steel,

.3 connections: ASME/ANSI B16.5 flanges, weld ends to ASME/ANSI B16.9, or grooved ends as applicable.

.4 bellows: hydraulically formed, three ply laminated, ASTM A240 T321 stainless steel for specified fluid,

.5 internal steel liner,

.6 internal and external guides.

Standard of Acceptance

- Flexonics – style SX/ DX
- Adsco
- Hyspan
- Metraflex
- Flex-Hose Co

2.4 Expansion compensators (bellows type)

.1 Application:

.1 for axial movements, as shown.,

.2 travel: 50 mm (2 in) to 75 mm (3 in) carbon steel, 50 mm (2 in) for copper.

.3 size: NPS ¾ to 4 for carbon steel, and NPS 3/4 to 3 for copper

.4 Working pressure: 2070 kPa (300 psig) at up to 400°C (700°F)

.5 factory tested to 1½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 external pressurized design,

.2 pipe: schedule 40 ASME A53 Gr B carbon steel,

.3 bellows: hydraulically formed, three ply laminated, ASTM A240 T321 stainless steel or specified fluid,

.4 connections:

(a) steel pipe: ASME/ANSI B16.5 flanges with floating flange as required, weld ends to ASME/ANSI B16.9, or grooved ends as applicable.
(b) copper tubing: female copper solder type ends for copper pipe,

.5 flow liner: ASTM A240 T304 stainless steel,

Standard of Acceptance
- Flexonics – style HS/HS/HB
- Adsco
- Hyspan
- Metraflex
- Flex-Hose Co

2.5 Braided equipment connector

.1 Application:

.1 for axial and lateral movements and vibration isolation at pumps and equipment,

.2 size: NPS 2 to NPS 10

.3 Working pressure: 1100 kPa (160 psig) at up to 121°C (250°F)

.4 factory tested to 1 ½ times maximum working pressure; furnish test certificate.

.2 Construction:

.1 Type 304 stainless steel corrugate internal liner with braided stainless steel cover,

.2 flanges: to ASTM A36 carbon steel, ASME/ANSI B16.5 class 150,

Standard of Acceptance
- Flexonics – series PCS
- Hyspan
- Metraflex
- Flex-Hose Co

2.6 Flexible rubber joints

.1 Application:

.1 for axial, lateral and angular movements,

.2 travel:

(a) axial: up to 55 mm (2¼ in) for double arch, and 19 mm (¾ in) for single arch
(b) lateral: up to 35 mm (1⅛ in) for double arch, and 9.5 mm (⅜ in) for single arch
(c) angular: 35° for double arch, and 15° for single arch.

.3 size: NPS 1-1/2 to NPS 12 for double arch, NPS 14 to 20 for single arch.

.4 Working pressure: 1450 kPa (210 psig) at up to 37°C (100°F)

.5 factory tested to 1½ times maximum working pressure; furnish test certificate

.2 Construction:

.1 spool type, reinforced EPDM inner liner and outer cover, with wire reinforced flange collars.

.2 NPS 1½ to 12: two filled arches with stabilizing ring,

.3 NPS 14 to 20: one filled arch.

.4 tie rod control units with vibration isolation washers,

.5 retaining rings, and

.6 neoprene covers.

Standard of Acceptance
- Flexonics – style 101/102
- Garlock Canada Limited - Style 204
- Metraflex
- Proco
- Flex-Hose Co

2.7 Flexible metal hose connections

.1 Construction:

.1 inner hose: corrugated T304 stainless steel,

.2 outer jacket: braided T304 stainless steel wire mesh,

.3 threaded or female soldered end connections up to NPS 2, flanged NPS 2½ and larger,

.4 selected for 1034 kPa (150 psi) working pressure and 93°C (200°F) working temperature,

Standard of Acceptance
- Flexonics
- Metraflex
- Flex-Hose Co
- Flexpression Ltd

2.8 Guides

.1 Construction:

.1 fabricated from steel

.2 guide spider clamped to pipe

.3 guide body with split bolted housing and angle bracket base.

Standard of Acceptance
- Flexonics Series PGT
- Adsco Model E
- Hyspan Series 9500
- Advanced Thermal System Type GA
- Flex-Hose Co
- Flexpression

3 EXECUTION

3.1 General

.1 Provide expansion loops in preference to expansion joints, where space permits.

3.2 Expansion joints installation

.1 Select expansion joints to compensate for thermal expansion in pipe between anchors with not less than 25% safety margin, calculating expansion based on the following operating temperatures;

.1 for heating systems, from -18°C (0°F) ambient up to maximum possible operating fluid temperature, but not less than 93°C (200°F) for water and design saturation temperature for steam,

.2 for cooling systems, from 15°C (60°F) ambient down to 5°C (40°F).

.2 Provide expansion joint types as follows:

Service	Limits	Type
Steam piping	Over 1030 kPa (150 psig)	Slip
	501 - 1030 kPa (76 - 150 psig)	Slip, Ring Controlled or Externally Pressurized
	500 kPa (75 psig) and less	Ring Controlled or Externally Pressurized
Heating water piping Condensate piping Glycol heating piping Chilled water piping Glycol cooling piping	NPS 20 and larger	Slip
	NPS 10 to NPS 18	Ring Controlled
	NPS 2 to NPS 12	Externally Pressurized
	NPS 4 and smaller	Expansion Compensator
Domestic Hot Water piping Domestic Recirculation Water piping	NPS 2 and larger	Externally Pressurized
	NPS 3 and smaller	Expansion Compensator
Domestic Cold Water piping	NPS 2 and larger	Externally Pressurized

.1 Support and guide piping adjacent to expansion joints;

.1 support piping on each side of expansion joint as specified herein,

.2 support expansion joint when provided with mounting supports,

.3 do not rely on pipe guides to support piping and expansion joint

3.3 Equipment connector installation

.1 Install equipment connectors on piping connections to equipment as shown and select connector types as follows:

Service	Limits	Connector Type
Refrigeration equipment	Chilled Water Piping	Braided
	Condenser Water Piping	Braided or Flexible Rubber
	Refrigerant Relief Piping	Braided
Steam, heating and cooling coils, and humidifiers	Air handling units supported on spring vibration isolators	Flexible Metal Hose
	Other air handling units	None required
Hot water reheat coils	All sizes	Flexible Metal Hose or Teflon Hose

.2 Connector and hose sizing:

.1 nominal diameter: same size as pipe.

.2 length: selected at not less than manufacturers catalogued minimum active length for the configuration, and not more than 1.5 times this minimum recommended length.

.3 Support or guide piping firmly adjacent to equipment connectors and prevent pipes from swaying.

.4 Where equipment connectors are to be installed at steam coils, locate connectors;

.1 between control valve and coil on steam supply side, and

.2 after steam trap on condensate line.

.5 Where equipment connectors are to be installed at chilled and/or hot water coils, locate connectors;

.1 between strainer and coil on the supply side, and

.2 between coil and control valve on return side

.6 At reheat coils installed in terminal boxes or in ductwork, arrange equipment connectors so there are no bends, and no axial offsets greater than the OD of the connector measured from the centerline of the connector.

3.4 Piping anchors installation

.1 Design anchors suitable for locations shown;

.1 submit shop drawings sealed by a professional engineer licensed in the jurisdiction of the project,

.2 include connection loads to the building structure to be reviewed by the Structural Engineering Consultant

.2 Fabricate piping anchors from structural steel angles, channels, or plates secured directly to piping and the building structure unless otherwise shown:

.1 single leg design, for piping NPS 4 and smaller and where distance between side of pipe and building attachment point is 200 mm (8 in) and less,

.2 minimum four-contact point design for all other distances.

3.5 Pipe guides installation

.1 Design guides suitable for locations shown.

.1 submit shop drawings sealed by a professional engineer licensed in the jurisdiction of the project,

.2 include connection loads to the building structure to be reviewed by the Structural Engineering Consultant

.2 Guide locations:

.1 as shown, and

.2 for each expansion joint and expansion loop, provide two guides on each side of and adjacent to the joint or loop;

(a) locate the first guide within 4 x pipe diameters from joint or loop,
(b) locate the second guide within 10-14 x pipe diameter from first guide and additional guides as required to suite anchor design, and
(c) guide expansion joints as per expansion joint manufacturer requirements.

.3 Guide installation:

.1 factory fabricated type, pipe rolls, or structural steel shapes

.2 secured to building structure and arranged to restrict lateral displacement and bowing of pipe adjacent to expansion joint or loop,

.3 supported from building structure with structural steel angles, channels or plates,

.4 guide may be omitted between joint and anchor where an anchor is located within minimum distance in accordance with expansion joint manufacturer installation instructions.

3.6 Inspection of anchor and guide installation

.1 Make arrangements and pay for expansion joint manufacturer's field representative to review anchors and guides around expansion joints on;

.1 steam piping

.2 domestic hot water and recirculating water piping NPS 6 size and larger

.3 heating system and chilled water piping NPS 6 size and larger

.2 Submit written report, prepared by field representative, confirming that expansion joints, anchors, and guides are installed in accordance with joint manufacturer's recommendations.

3.7 Start-Up and Testing

.1 Prior to placing expansion joint in service, apply match-marks to joint flanges/connectors to record axial, lateral, rotation and angular movement of joint connections. After system is at operating temperature, inspect match-marks and record displacement of joint connections compared to pre-start conditions. Submit report including photos of displaced match-marks.

END OF SECTION

INDICATING GAUGES
20 05 19

1 GENERAL

1.1 Scope

.1 Provide temperature and pressure measuring devices and flow indicators as shown.

1.2 Shop drawings / product data

.1 Submit manufacturer's catalogue literature for;
  .1 Flow indicators
  .2 Thermometers
  .3 Pressure gauges

.2 Include schedule of thermometers, and pressure gauges showing for each instrument:
  .1 identification number,
  .2 location,
  .3 type,
  .4 range and
  .5 accessories.

1.3 Applicable codes and standards;

.1 ASME B40.200 Thermometers, Direct Reading and Remote Reading

.2 ASME B40.100 Pressure Gauges and Gauge Attachments

.3 ASME PTC 19.3 TW – Thermowells

.4 CSA B51 Boiler and Pressure Vessel Code

2 PRODUCTS

2.1 Flow indicators;

.1 Construction:
  .1 visual flow indication.
  .2 equipped with dual flow scale calibrated in l/s and USGPM.
  .3 protected against accidental breakage of the glass indicator.
  .4 in-line type for pipe sizes up to NPS 1½.

Standard of Acceptance
° ITT Bell & Gossett - Thermoflow

2.2 Thermometers and Pressure Gauges - Selection Criteria

.1 General:

.1 normal operating reading to be between half and two thirds of full scale range and

.2 expected maximum and minimum readings to be within scale range.

.3 thermometers to have [both Fahrenheit and Celsius][Fahrenheit][Celsius] scales.

.4 pressure gauges to have [both psi and kPa][psi][kPa] scales.

.2 Product identification

.1 Pressure gauges and thermometers to be selected from manufacturer's standard product line.

Standard of Acceptance
- Trerice
- Dresser - Ashcroft
- Weksler - Baker Instruments
- Winter's Thermogauges
- Weiss
- WIKA

.3 Model designations from Trerice catalogue are used to establish quality standards and construction details to allow assessment of products from other unlisted manufacturers.

2.3 Direct reading thermometers

.1 Solar powered 178 mm (7 in) industrial, variable angle type, passivated thermistor, cast aluminum epoxy coated case, with solar cell and 11 mm (7/16 in) LCD display.

Standard of Acceptance
- Trerice SX9

.2 125 mm (5 in) bi-metal dial type, variable angle, stainless shell case and stem with calibration screw, to CGSB 14.5

Standard of Acceptance
- Trerice - B85600 Series

2.4 Remote reading thermometers

.1 115 mm (4½ in) liquid filled or gas activated type, stainless steel capillary, stainless steel spring armour, stainless steel bulb and phenolic, cast aluminum, or stainless steel case for surface mounting.

Standard of Acceptance
- Trerice - L80300 Series (liquid filled)
- Weskler - Baker Instruments - 413BE (gas activated)
- Dresser - Ashcroft 600A Series (gas activated)

2.5 Thermometer wells

.1 Construction:

.1 Body material:

(a) in copper pipe : brass.
(b) in steel pipe : stainless steel.

.2 threaded connection, manufactured from bar stock or forged brass with cap and chain, compatible with temperature sensors used.

.3 pressure rating: 2000 kPa (300 psig) at 121°C (250°F)

.4 C.R.N. registered

Standard of Acceptance
° Trerice 5550 Series

2.6 Temperature well conversion kits

.1 Retrofit kit to convert straight liquid filled thermometer wells to accept bi-metal dial thermometers.

2.7 Pressure gauges

.1 For direct pressure measurement

.1 115 mm (4½ in) dial type, silicone-free dampening, black solid front case, ½% accuracy, adjustable pointer to ASME B40.100 Grade 2A.

Standard of Acceptance
° Trerice - 450B

.2 For differential pressure measurement

.1 115 mm (4½ in) dial type, silicone-free dampening, black solid front case, ½% accuracy, adjustable pointer and maximum registering pointer to ASME B40.100 Grade 2A, complete with impulse snubber and 3-way switching valve.

Standard of Acceptance
° Trerice - 450B

.3 Accessories:

.1 pressure snubbers, brass or T303 stainless steel construction:

Standard of Acceptance
° Trerice - 872

.2 needle valves, rising stem, brass or T316 stainless steel construction.

Standard of Acceptance
° Trerice - 735 / 740

.3 coil syphons, 1/4" NPT, welded 304SS Sch.40 body, 180° coil, 2060 kPa (300 psig) and 650°F max

Standard of Acceptance
° Trerice – 885

2.8 Test port plugs

.1 Piping test port plugs with gauge adaptors for pressure tests or insertion of pocket thermometer probes.

.1 material: brass or stainless steel T304.with BUNA N diaphragm core,

.2 size: 1/4” NPT to 1/2” NPT, with probe guard

.3 performance rating: 7000 kPa (1000 psi) from -40 to 150°C (-40 to 300°F)

Standard of Acceptance
° Winters – STP series

3 EXECUTION

3.1 Thermometer and Pressure Gauges - General installation criteria

.1 Install thermometers and gauges not more than 3 m (10 ft) from floor or platform, or install remote reading thermometers and gauges, with dial mounted at eye level, on steel or aluminum plate.

.2 Provide nameplates for each gauge and thermometer as specified in Section 20 19 00 Identification.

3.2 Thermometer installation

.1 Install thermometers in wells.

.2 Install wells with extension necks where piping and equipment to be insulated.

.3 Install thermometers on inlet and outlet of;

- .1 water heating and cooling coils.
- .2 as shown.

3.3 Pressure gauge installation

.1 Install pressure gauges on inlet and outlet of;

- .1 water heating and cooling coils,
- .2 steam piping to heating coils
- .3 as shown.

.2 Install needle valves on pressure gauges.

- .1 For differential pressure gauge, provide needle valve on each sensing line.

.3 Install pressure snubbers on pressure gauges at;

- .1 suction and discharge sides of oil pumps, and positive displacement pumps,
- .2 compressed air; at compressors, dryers and receivers.

.4 Install coil syphons on steam and condensate pressure gauges.

3.4 Test port plugs

.1 Install test port plugs in locations as shown. Test port plugs shall not be used in lieu of temperature or pressure gauges specifically shown.

END OF SECTION

GENERAL REQUIREMENTS FOR VALVES
20 05 23

1 GENERAL

1.1 Scope

.1 Provide valves in piping systems for shut-off service, manual flow balancing, check-stops and valve bodies for automatic flow control.

.2 This specification section provides general requirements for valves.

1.2 Related Sections

.1 Refer to the following valve specification sections for requirements for general-duty valves in addition to the general requirements specified herein.

21 05 23	General-Duty Valves for Water-Based Fire-Suppression Piping
22 05 23.13	General-Duty Valves for Plumbing Piping
23 05 23.13	General-Duty Valves for HVAC Water Piping
23 05 23.23	General-Duty Valves for Steam System Piping

.2 Refer to the following specifications sections for requirements for specific-duty valves in addition to the general requirements specified herein.

22 60 13.70	Medical Gas Piping
23 61 07	Refrigeration Piping – HVAC
25 35 01	B.A.S – Instrumentation and Actuators

1.3 Submittals

.1 Submit manufacturer product data-sheets for valves, including pressure-temperature ratings with confirmation that the valve meets the required MCPR rating specified for each valve.

.2 Where valves are specified to be listed (certified) to a standard, include the following information for each affected product:

.1 applicable standard by name and reference number,

.2 name of accredited testing organization or their mark who certified the product, and

.3 the testing organization file reference number.

.3 Where valves are required to have a CRN, include the CRN and its expiry date on each valve submittal.

.4 Where manufacturer pre-printed data-sheets do not include this information, a schedule may be submitted which includes the manufacturers name, model number and the required listing and/or CRN information described above. Where the product is name-branded for a manufacturer, include the name of the source manufacturer.

1.4 Applicable codes and standards

.1 Legislation:

.1 Valves installed in piping systems which are subject to provincial or federal pressure piping legislation shall have current Canadian Registration Numbers (“CRN”) in accordance with CSA B51.

.2 Installation standards, codes and guidelines:

.1 CSA B51 Boiler and Pressure Vessel Code.

.2 Refer to applicable piping specification sections for any other specific requirements.

.3 Product standards:

.1	ANSI/ASME B1.20.1	Pipe Threads, General Purpose, Inch
.2	ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings
.3	ASME B16.5	Pipe Flanges and Flanged Fittings
.4	ASME B16.10	Face-to-Face and End-to-End Dimensions of Valves
.5	ASME B156.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings
.6	ASME B16.34	Valves Flanged, Threaded and Welding Ends
.7	ASME B16.47	Large Diameter Steel Flanges: NPS 26 Through NPS 60
.8	ISO 5211	Industrial Valves – Part-turn Actuator Attachments
.9	MSS SP-25	Standard Marking System for Valves, Fittings, Flanges, and Unions
.10	MSS SP-42	Corrosion-Resistant Gate, Globe, Angle, and Check Valves with Flanged and Butt Weld Ends (Classes 150, 300, & 600)
.11	MSS SP-67	Butterfly Valves
.12	MSS SP-68	High Pressure Butterfly Valves with Offset Design
.13	MSS SP-70	Cast Iron Gate Valves, Flanged and Threaded Ends
.14	MSS SP-71	Cast Iron Swing Check Valves, Flanged and Threaded Ends
.15	MSS SP-72	Ball valves with Flanged or Butt-Welding ends for General Service
.16	MSS SP-78	Cast Iron Plug Valves
.17	MSS SP-80	Bronze Gate, Globe Angle and Check Valves
.18	MSS SP-85	Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
.19	MSS SP-110	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
.20	MSS SP-125	Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves
.21	MSS SP-126	In-Line, Spring-Assisted, Center-Guided Check Valves (Carbon, Alloy Steel, Stainless Steel, & Nickel Alloys)
.22	MSS SP-136	Ductile Iron Swing Check Valves
.23	MSS SP-139	Copper Alloy Gate, Globe, Angle, and Check Valves for Low Pressure/Low Temperature Plumbing Applications
.24	NSF/ANSI 61	Drinking Water System Components – Health Effects
.25	NSF/ANSI 372	Drinking Water System Components – Lead Content (formerly NSF/ANSI 61- Annex G).

1.5 Quality and Equivalence

.1 Valve selections are in general identified by model designations taken from manufacturers catalogues to indicate physical properties and quality requirements not otherwise described.

2 PRODUCTS

2.1 General

.1 Refer to related specification sections.

.2 Manufactures and/or trade names listed in Table 1 are acceptable for various indicated valve types, where products offered are essentially similar to those identified by manufacturer or model number under “Standard of Acceptance” designation in the related specification sections.

.1 Refer to the General-duty valve specification sections and specific-duty valve requirements contained in the related piping system specification sections.

.2 Additional specification requirements and/or certification requirements may be required by those sections.

Manufacturer	Gate, Globe, Angle, Check	Silent Check	DRV	Butterfly	Plug	Ball
A-Chem Valves & Controls	●			●		●
American Valve						●
APCO		●				
Apollo				●		●
Bonney Forge	●					
Beric	●					
Bray				●		●
Canadian Worcester Controls						●
Challenger				●		
Couplox				●		
Crane	●			●		●
Crane Centreline				●		
Crane Flowseal				●		
Dahl Bros	●					●
Demco				●		
DeZurik				!		
Durabla		●				
Grinnell				●		
Gruvlok				●		●
Hattersley Milliken (Crane)					●	
Jenkins	●			●		●
Keystone				●		
Kitz	●			●		●
MA Stewart (MAS)	●			●		●
Milwaukee Valve				●		●
Mueller		●		●	●	
Neo Valves	●					●
Nibco	●	●		●		●
Nordstrom					●	
Powell	●					

Manufacturer	Gate, Globe, Angle, Check	Silent Check	DRV	Butterfly	Plug	Ball
Preso			●			
S.A. Armstrong	●		●			
Shurjoint				●		●
Sure Seal				●		
Tour & Anderson			●			
Toyo Valve (Red &White)	●					●
Triad				●		
Trueline	●					●
Valmatic		●				
Velan	●			●		●
Victaulic				●		●
Watts	●			●		●
WKM				●		

3 EXECUTION

3.1 Valve Selection Criteria

.1 Select valves in accordance with function criteria as shown in Table 2.

Table 2: Valve Function Selection

Function	Gate	Butterfly	Ball	Globe	Plug	DRV
Shut-Off	●	●	●		●	
Flow balancing and shut-off					● [1] [2]	●
Flow Balancing only (excluding pumps)				●		●
Pump Balancing		● [1] [3]		●		●

Notes:

[1] Gear operator with position limit memory stops.

[2] Non-lubricated plug valve designed for flow balancing.

[3] Sized one (1) NPS line size smaller than pipe line size (not pump discharge size).

3.2 Piping System Drain Valves

.1 Provide drain valves on piping and at equipment as follows unless otherwise shown on drawings:

.1 On pipe mains and branches NPS 3 and under, and for equipment with pipe connections NPS 4 and smaller:

(a) NPS ¾ ball valve in accordance with pipe system specification with integral NPSH ¾ hose end with cap and chain.

.2 On pipe mains NPS 4 to NPS 6, and for equipment with pipe connections NPS 6 and larger:

(a) NPS 1 ball valve, with a NPT threaded brass Cam and Groove female coupler fitting with dust-plug

.3 On pipe ains NPS 8 and larger:

(a) NPS 2 ball valve, with a NPT threaded brass Cam and Groove female coupler fitting with dust-plug.

3.3 Valve Installation - General

.1 Install shut off valves at:

.1 branch take-offs,

.2 to isolate piping to each piece of equipment, and

.3 in locations shown.

.2 Remove internal parts of valves before soldering, welding or brazing pipe to valve body.

.1 Exception: where valve is provided with tube end extensions to allow soldering or brazing without removal of internal parts.

.2 For valves which do not permit disassembly including ball valves and inline check valves, comply with valve manufacturer instructions to protect valve internal components during soldering, brazing or welding.

.3 Install triple duty or throttling valves where shown in pump discharge piping with ten pipe diameters of straight pipe on the inlet side and two pipe diameters on outlet side.

.4 Install butterfly valves between weldneck or slip-on flanges.

3.4 Valve Orientation and Accessibility

.1 Arrange valve hand-wheels and operating levers to be accessible.

.2 In equipment rooms and service spaces provide chain operators for valves mounted more than 2m (6 ft) above floor or access platform. Provide sufficient chain length to extend to 1.5m (4 ft-6 in) above floor or platform and to be hooked on clips secured to building structure, clear of walking aisles.

.3 In horizontal piping (see figure 1);

.1 For OS&R valves, install the valve with stem vertical where the valve centerline is not more than 1200 mm above the adjacent floor or access platform. For greater heights, install the valve with stem horizontal. Where space is restricted, the valve may be installed with the valve spindle at a 45° angle from the vertical where the valve centerline is not more than 1500 mm above the floor or access platform.

.2 For gear operated valves, install with gear-box on top of the valve and hand-wheel shaft in the horizontal position.

.3 For lever operated valves, install with handle on top of valves where the valve centerline is not more than 1500 mm above the floor or access platform. Where spaces is restricted, the valve may be positioned with the lever handle shaft in the horizontal position. For greater heights, install valves with handle shaft in the horizontal position.

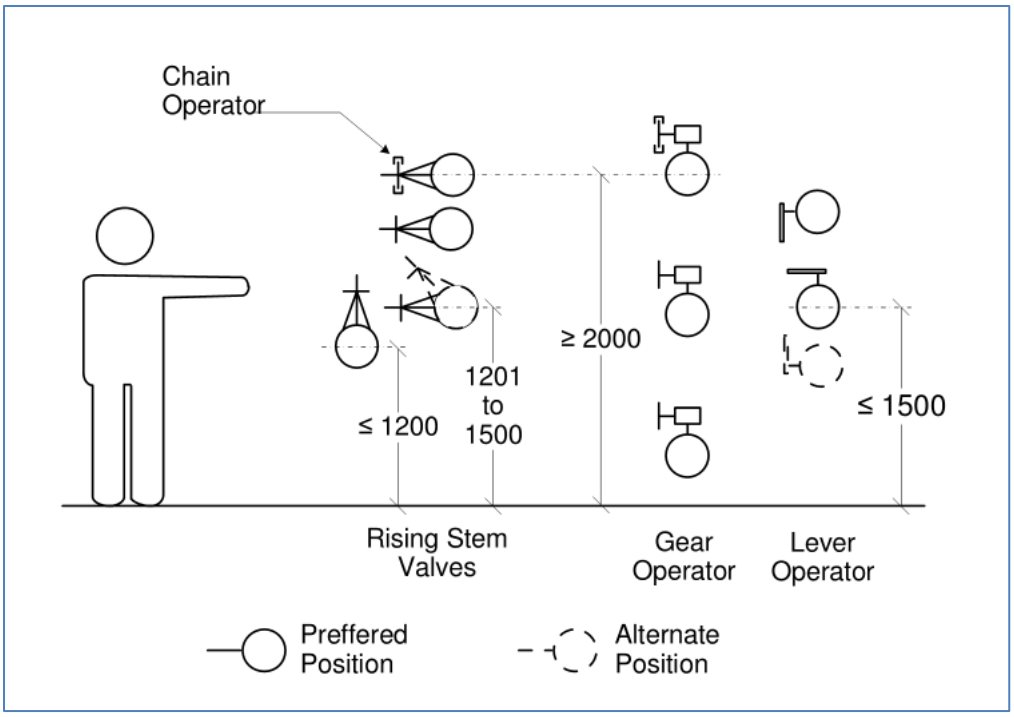


Figure 1: Valve Spindle Arrangement

.4 In vertical piping, install with valve stem facing directly towards the means of access. Where access space in front of the valve is less than 900 mm (36 in), rotate the valve 45° from the straight forward position.

3.5 Double Regulating Valves Installation

.1 Consult with double regulating valve manufacturer to ensure correct valve selection. Balancing valves to be sized according to design flow

.2 Size and select valves for flows as shown, based on at 6 kPa (2 ft) pressure drop across the valve in the fully open position, and in accordance with manufactures recommendation. Table 3 identifies the nominal valve size selection:

Table 3: Double Regulating Valve Nominal Sizing

Valve **Size (in)**	**Nominal Flow**			
	Min. (l/s)	**Max. (l/s)**	**Min. (gpm)**	**Max. (gpm)**
½	0.038	0.177	0.6	2.8
¾	0.126	0.379	2.0	6.0
1	0.246	0.631	3.9	10.0
1-¼	0.316	0.947	5.0	15.0
1-½	0.416	1.262	6.6	20.0
2	0.795	2.272	12.6	36.0
2-½	2.398	6.310	38.0	100.0
3	1.956	8.203	31.0	130.0
4	4.291	12.620	68.0	200.0
5	5.679	20.192	90.0	320.0

6	11.48	28.395	182.0	450.0
8	23.16	51.742	367.0	820.0
10	34.07	82.030	540.0	1300.0
12	60.58	94.650	960.0	1500.0

.3 Install double regulating valves with five pipe diameters of straight pipe on inlet side, two pipe diameters on outlet side and 10 pipe diameters from any pump.

.4 Install double regulating valves with ports facing horizontal or facing up. Do not install with ports facing down to prevent debris from falling and accumulating inside the ports.

END OF SECTION

WELDING AND BRAZING
20 05 24

1 GENERAL

1.1 Scope

.1 Weld or braze pipe and fittings for work of Division 20.

1.2 Definitions

.1 The following definitions apply to this specification section:

AHJ (BPV): *the authority having jurisdiction which is responsible for boiler, pressure vessel and pressure piping safety in the province of the project.*

.2 In this specification,

.1 the word “piping” also includes tubing as the case applies.

.2 the words “welding” or “welder” shall be read as to also refer to “brazing” or “brazer”

1.3 Applicable Standards

.1	CSA B51	Boiler, Pressure Vessel, and Pressure Piping Code
.2	ASME B31.1	Pressure Piping
.3	ASME B31.3	Process Piping
.4	ASME B31.9	Building Services Piping
.5	ASME BPVC Section V	Nondestructive Examination
.6	ASME BPVC Section IX	Welding and Brazing Qualifications

2 PRODUCTS

2.1 Not used

3 EXECUTION

3.1 Welding and Brazing Qualification and Welding Procedures

.1 Welding of piping systems which have specified design pressures greater than 100 kPa (15 psi) to be carried out using approved welding procedures by welders certified for pressure piping by the AHJ (BPV), whether or not the piping system is subject to registration as pressure piping.

.1 Welding procedures shall be registered with the AHJ (BPV), in accordance with CSA B51 and as qualified in accordance with ASME BPVC Section IX.

.2 Welders shall be certified for welding of pressure piping in accordance with the requirements of the AHJ (BPV). Welders shall be qualified by their employer on the employers welding procedures.

.2 For piping systems which have specified design pressure of 100 kPa (15 psi) or less, welding procedures and welders shall be qualified by the Contractor in accordance with the requirements of ASME B31.9.

.3 Welding, both shop and field, to be electric arc in accordance with recommendations of Canadian Welding Bureau unless other welding methods are specified in the piping specification sections.

3.2 Weld Quality

.1 Welds to be solid homogeneous part of metals joined and free from pits and incorporated slag and scale.

.2 Weld surfaces to be smooth and regular and weld metal deposition to achieve full penetration grove weld fused to the base metal throughout joint thickness.

3.3 Welded Connections to Existing Pressure Piping Systems

.1 At the commencement of the Work, where registration and/or inspection of the piping system is required in accordance with provincial boiler and pressure vessel regulations, review with the AHJ (BPV) inspector to determine their weld testing requirements to validate the proposed welding procedures for connecting to existing piping, including but not limited to:

.1 acceptable dimensional misalignment between old and new pipe;

.2 requirements, if any, for metallurgical analysis of exiting piping;

.3 sample guided bent test; and

.4 sample fillet weld test.

.2 After testing requirements are determined, provide a proposed schedule for tie-in connections and required existing service shut-down periods, for approval prior to commencing work.

.3 Prior to shut-down of existing piping systems for tie-ins, inspect the existing pipe O.D. dimensions to confirm their suitability for pipe attachment. Specifically, where the work requires a complete transection of an existing pipe, check the existing pipe for excessive out-of-roundness which would otherwise exceed the allowable misalignment as defined in the applicable ASME piping code. Where necessary, trim the pipe ends in accordance with the referenced piping code.

3.4 Welding Examination

.1 For piping systems which are specified to be constructed to ASME B31.1 or ASME B31.3, examination of piping, including both visual and other nondestructive examination performed in accordance with those piping codes shall be arranged and paid for by the Contractor, and are to be performed by a specialist testing company whose personnel are qualified to perform such examinations in accordance with ASME BPVC Section V.

.2 For piping systems which are specified to be constructed to ASME B31.9, examination of piping in accordance with that piping code shall be performed by the Contractor using personnel with suitably experienced for such examinations.

.3 Acceptance criteria for weld examination shall be in accordance with the specified ASME piping code.

3.5 Welding Inspection

.1 Arrange and pay for any required inspection of welds by the AHJ (BPV).

.2 Welders certificates and welding procedures used on the propject to be made available for inspection by the AHJ (BPV) on demand. Each weld to be stamped with welder's identifying numbe or a log may be used to record and identify each welders work.

3.6 Radiography

.1 Notwithstanding that a referenced ASME piping code may not require radiographic or other non-visual non-destructive examination methods based on the service conditions of a piping system, provide radiographic examination of piping systems as specified herein.

.2 Arrange and pay for services of an inspection company specializing in making and interpreting radiographic imaging of pipe welds.

.3 For piping systems where ASME B31.3 is the specified piping code, the following rules apply:

.1 The designated lots for radiographic examination are defined as follows:
(a) Lot 1: the aggregate of all piping within a boiler plant room or other mechanical service room.
(b) Lot 2: the aggregate of all piping located in a vertical service space (total of all such piping).
(c) Lot 3: the aggregate of all piping located above ceiling spaces.

.4 Submit copy of the radiograph results and analysis for every weld so examined.

.5 Radiography to be in accordance with ASME BPVC Section V, article 2.. Weld acceptance criteria shall be in accordance with the specified ASME piping code.

.1 Where a weld is found to be defective in a lot, conduct two additional tests in the same lot. If one of those additional tested welds is found defective, conduct an additional second set of two additional tests in the same lot. If one of those welds fail, then conduct 100% radiographic examination of all butt welds in the lot.

.6 Repairs to defective welds shall be performed in accordance to the requirements of the specified ASME piping code.

END OF SECTION

COMMON HANGER AND SUPPORT REQUIREMENTS FOR PIPING
20 05 29

1 GENERAL

1.1 Scope

.1 Provide hangers and supports for piping.

.2 The requirements of this specification section apply to all piping systems, except where required otherwise by specific piping specification sections including:

.1 21 05 01 for fire protection piping,

.2 Division 22 sections for plumbing and drainage piping,

.3 22 60 13.70 for medical gas piping,

.4 23 11 13 for fuel oil piping,

.5 23 11 23 for natural gas piping.

1.2 Related Work

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 20 05 16 Flex Connections, Expansion Joints, Anchors and Guides

.2 20 05 48 Vibration Isolation

.3 20 07 19 Piping Insulation

.4 20 05 49 Seismic Restraint

.2 The following definitions apply to this section.

.1 ***Cold piping***: piping with a service temperature at or below 16°C (61°F).

.2 ***Ambient piping***: piping with a service temperature greater than 16°C (61°F) and up to 40°C (104°F).

.3 ***Hot piping***: piping with a service temperature greater than 40°C (104°F).

.4 ***Service temperature***: the fluid maximum operating temperature.

1.3 Applicable Codes and Standards

.1 Product and installation codes and standards:

.1 ANSI/MSS SP-58 Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation

.2 ULC/ORD-S203 Pipe Hanger Equipment for Fire Protection Service

.3 UL 203 Pipe Hanger Equipment for Fire Protection Service

.2 Refer to each applicable piping specification section for supplemental requirements for pipe supports.

1.4 Design Criteria

.1 The support spacing and hanger rod size specified herein is based on supporting a single pipe directly from the structure in accordance with MSS SP-58. If multiple pipes are supported from trapeze hangers (or similar), or from common hanger rods supporting a tier of multiple piping, then;

.1 the total load on the support rods or similar elements shall not exceed 75% of its published tension load rating data,

.2 a trapeze hanger deflection shall not exceed 1/240th of the support span, and not exceed 60% of the trapeze material yield strength, under all static and dynamic loads.

.2 Provide complete engineered design services in accordance with the requirements of MSS SP-58 for support of vertical piping for the following parts of the Work:

.1 vertical piping located in vertical services spaces (shafts) where;

(a) piping is NPS 8 and larger,
(b) the vertical pipe length exceeds 20 m (65 ft),
(c) pipe expansion joints are shown, or
(d) variable spring supports or constant load supports are shown.

.2 horizontal piping is supported on;

(a) trapeze hangers or supported on/suspended from horizontal structural elements, or
(b) pipe racks.

.3 [][Pipe support spacing and/or selection of pipe support types may be other than as specified herein provided the pipe supports are determined by a completely engineered system in accordance with the requirements of MSS SP-58 and as follows:

.1 custom engineered systems are restricted to:

(a) service rooms or areas containing major equipment, including boilers, chillers, and cooling towers,
(b) piping supported on pipe racks,

.2 submit a materials substitution request in accordance with the requirements of Division 01 for review and approval by the Consultant,

.3 horizontal pipe vertical deflection at midpoint in the pipe span while in operation not to exceed 6.5 mm (0.25 in.),

.4 the supported loads do not exceed 90% of manufactured product published load data, or does not exceed 60% of the material yield strength for custom fabricated supports,

.5 rod hanger loads do not exceed 80% of the tabulated values in MSS SP-80,

.6 deflections of horizontal supporting elements does not exceed 1/240th of the span,

.7 maximum single point suspended tension load in concrete not to exceed [17 kN (3820 lbs),

.8 operating pipe stress not to exceed the maximum allowable stress in accordance with the requirements of the piping code specified for the piping system,

.9 submit complete shop drawings sealed by a professional engineer licensed in the province of the Work.

.4 Where custom engineered support systems are used, submit shop drawings designed and sealed by a professional engineer licensed in the province of the Work, and include details for each support system including load calculations.

1.5 Submittals

.1 Submit manufacturer product data sheets for all hanger components, and include:

.1 load ratings,

.2 typical composite detail drawings for complete hanger assembly, including upper attachment, hanger rods, hanger rod swivels, pipe attachments, shields and saddles, and load ratings, for each pipe condition and size.

.2 Submit support details for glass, fibre-reinforced plastic, and other plastic piping systems which are coordinated with the piping material manufacturer installation instructions.

.3 Where variable spring supports or constant load supports are shown, provide completely engineered design and fabrication drawings, including any supplementary steel requirements, and loads transferred to the building structure.

.4 Submit engineered design drawings for custom supports:

.1 fabricated trapeze hangers, and completely engineered support systems, including

(a) construction detail drawings for each loading condition,
(b) span deflection calculations,
(c) building attachment load calculations and type.

.2 shop drawings to be sealed by a professional engineer licensed in the project location jurisdiction.

1.6 Quality Control

.1 Where custom engineered supports are used, provide the services of a professional engineer licensed in the location of the Work, to conduct an inspection of the completed installation and prepare a report of these custom engineered supports, that they have been installed in accordance with the sealed shop drawing requirements. Submit a copy of the inspection report to the Owner and Consultant.

2 PRODUCTS

2.1 General

.1 Hangers, supports, sway braces and associated components, to be fabricated from stock or production parts, manufactured and fabricated in accordance with MSS SP-58, and the requirements of the piping code specified for each piping system.

.2 Select elements of pipe support systems to provide adequate factors of safety under loads applied by gravity, by temperature induced expansion and contraction, by internal pressure in mechanically jointed plain end pipe, and by fluid flow pressure thrust.

.3 Product finishes (unless otherwise specified for each product):

.1 outdoors: hot dipped galvanized,

.2 in mechanical service rooms, pipe tunnels and pipe trenches: hot-dipped galvanized,

.3 other indoor locations: plain finish, zinc plated, or painted finish.

(a) exception: do not use any zinc coated or electro-plated products in data center rooms.

.4 Pipe support products to be selected from manufacturers standard product line.

Standard of Acceptance
- Anvil
- E.Myatt & Co
- Unistrut
- Taylor
- Acrow Richmond
- Portable Pipe Hangers
- Hilti
- nVent Caddy
- Pipe Shields

.5 Model designations from these manufacturer's catalogue are used to establish quality standards and construction details to permit assessment of products from other manufacturers.

2.2 Upper Attachments – Concrete Inserts

.1 For new cast-in-place concrete.

.2 Concrete inserts –wedge type;

.1 single hanger support,

.2 galvanized wedge inserts to MSS SP-58 type 18.

.3 listed to ULC/ORD-C203 or UL 203 for fire protection piping, for pipe NPS ¾ through NPS 8.

.4 maximum tension load rating: 4.4 kN (1000 lbs),

(a) single rod support, for pipes NPS 6 and smaller,
(b) double rod support, for pipes NPS 10 and smaller,

Standard of Acceptance
- Anvil - fig. 281
- Unistrut - fig. P-3245

.3 Concrete inserts – tapped coil type;

.1 single hanger support,

.2 plated carbon steel insert, tapped coil design, with flat washer base and closed ferrule,

.3 constructed to receive tapped bolts or rods, or with manufacturer lag bolts.

.4 maximum tension load rating: 15.0 kN (3375 lbs) within 125 mm (5 in.) of nearest concrete edge.

(a) single rod support, for pipes NPS 8 and smaller,
(b) double rod support, for pipes NPS 12 and smaller.

Standard of Acceptance
- Acrow Richmond – fig. LF-W

.4 Concrete inserts –iron cross type;

.1 single hanger support,

.2 stainless steel body with two 300 mm (12 in.) long fiberglass reinforcing rods in a cross-pattern, to MSS SP-58 type 18,

.3 body reinforcing rods tied to concrete rebar,

.4 maximum tension load rating: 26.2 kN (5,900 lbs) based on rod size,

(a) single rod support, for pipes NPS 14 and smaller,
(b) double rod support, for pipes NPS 24 and smaller,

Standard of Acceptance
- Anvil - fig. 286
- Unistrut - fig. P-3246

.5 Concrete inserts – channel type;

.1 single hanger or multiple hangers support,

.2 12 Ga channels, hot-dipped galvanized, with concrete embedment tabs, open bottom channel allowing multiple support points and lateral position adjustment,

.3 with back plates, end caps and closure strips to prevent concrete spillage into channel space,

.4 minimum point load spacing: 300 mm (12 in.)

.5 maximum tension load rating:

(a) 200 mm (8 in) channel:	4.4 kN (1000 lbs)
(b) 300 mm (12 in) channel:	6.6 kN (1500 lbs)
(c) 450 mm (16 in) and longer channels:	28.8 kN/m (2000 lbs/ft), but not less than 17.8 kN (4000 lbs),

Standard of Acceptance
° Unistrut - fig. P-3249 to P-3270 series.

2.3 Upper Attachments – Existing Concrete

.1 Surface mount on existing concrete:

.1 surface mount clevis plate, for mounting to concrete,

.2 carbon steel plate with clevis and malleable iron socket with bolt, and weldless eye nut.

Standard of Acceptance
° Anvil - fig. 49 clevis plate, Fig. 290 weldless eye nut
° Myatt - fig. 535 socket, Fig. 480 weldless eye nut

.2 Piping or equipment supported from existing concrete construction:

.1 threaded inserts for drilled holes.

Standard of Acceptance
° Hilti - fig. HDI, Kwick Bolt, HSL

2.4 Upper Attachments – Steel Structure

.1 Steel beam (bottom flange) - for cold and ambient piping NPS 2 and smaller:

.1 malleable iron or carbon steel, symmetrically loading beam clamp to MSS SP-58, type 30,

.2 listed to ULC/ORD-C203 or UL 203 for fire protection piping.

Standard of Acceptance
° Anvil - fig. 218
° Myatt - fig. 500

.2 Steel beam (bottom flange) - for cold and ambient piping NPS 2½ and larger, and hot piping:

.1 forged steel, symmetrically loading heavy duty beam clamp, to MSS SP-58, type 28 or 29.

.2 with weldless eye nut when used with clevis supports.
° Anvil - fig. 228 or 292
° Myatt - fig. 510 X-HEAVY, or 511 X-HEAVY.

.3 Steel beam (top flange) - for conduit, piping NPS 2 and smaller, and ductwork:

.1 carbon steel, hook rod with locking jaw, fasteners and lock washers, to MSS SP-58, type 25,

.2 listed to ULC/ORD-C203 or UL 203 for fire protection piping.

Standard of Acceptance
° Anvil - fig. 227
° Myatt - fig. 504, 505

.4 Steel joists (lower chord) – for cold and ambient piping NPS 2 and smaller:

.1 for installation of support rod in the interstice space of double-ell steel joists and open-web steel joints,

.2 carbon steel washer plate with locking nuts on top-side of washer,

.3 second steel washer plate on underside of joist with nut.

Standard of Acceptance
- Anvil - fig. 60
- Myatt - fig. 545

.5 Steel joists (lower chord) – for cold and ambient piping NPS 2½ and larger, and hot piping:

.1 for installation of support rod in the interstice space of double-ell steel joists and open-web steel joints,

.2 carbon steel washer plate with double locking nuts on top-side of washer, with carbon steel welded beam clevis attachment, and forged steel weldless eye nut.

Standard of Acceptance
- Anvil - fig. 60 with fig. 66 and fig. 290.
- Myatt - fig. 545 with fig. 530 and fig. 480.

2.5 Upper Attachments – Wall Brackets

.1 Medium and heavy-duty wall mounting brackets:

.1 welded carbon steel plate or channel assembly, designed to allow at least 75 mm (3 in.) of horizontal adjustment of hanger rod position, to MSS SP-58, Types 32 and 33,

.2 carbon steel backplates for through bolting of concrete walls where required by supported load and wall material,

.3 for bolting into concrete wall, concrete block, or welding to building structure (where permitted by structural engineer).

Standard of Acceptance
- Anvil - fig. 195 and 199
- Myatt - fig. 321 and 322

.2 Light-duty wall mounting brackets:

.1 welded carbon steel plate or channel assembly, single point rod support, to MSS SP-58, Types 31,

.2 with carbon steel backplates for through bolting of concrete walls where required by supported load,

.3 FM approved,

.4 for bolting into concrete wall, concrete block, or welding to building structure,

Standard of Acceptance
- Anvil - fig. 194
- Myatt - fig. 320

2.6 Upper Attachment - Swivels

.1 Clevis swivel:

.1 to allow rotation movement of suspended clevis hangers,

.2 forged steel clevis with hanger pin, threaded rod socket, to MSS SP-58 type 14,

.3 tension load capacity not less than the connected rod load capacity,

.4 threaded end connected to concrete insert, with clevis end connected to weldless eye nut or welded eye rod.

Standard of Acceptance
° Anvil - fig. 299
° Myatt - fig. 470

.2 Weldless eye nut swivel:

.1 to allow rotation movement of suspended clevis hangers,

.2 forged steel eye nut, threaded rod socket, to MSS SP-58 type 17,

.3 tension load capacity not less than the connected rod load capacity.

.4 for connection to top of rod hanger, suspended from a clevis.

Standard of Acceptance
° Anvil - fig. 290
° Myatt - fig. 480

2.7 Hanger Rod

.1 Continuous threaded rod:

.1 carbon steel, USS national course thread,

.2 tension load ratings to MSS SP-58,

Standard of Acceptance
° Anvil - fig. 146
° Myatt - fig. 434

.2 Welded eye rod:

.1 carbon steel, USS national course thread,

.2 tension load ratings to MSS SP-58,

.3 tension load rating to be the same as continuous welded rod.

Standard of Acceptance
° Anvil - fig. 278
° Myatt - fig. 440

2.8 Horizontal Pipe Support – Pipe Roller

.1 Suspended support - adjustable:

.1 adjustable, trapeze or yoke style, pipe roller support to MSS SP-58, type 41 or 43.

Standard of Acceptance
° Anvil - fig. 171 or fig. 181
° Myatt - fig. 261 or fig. 258

.2 Bottom support - adjustable:

.1 adjustable pipe roller with bottom support rods, to MSS SP-58, type 41.

.2 with mounting rods and upper/lower retention nuts at both ends.

Standard of Acceptance

- Anvil Fig. 177
- Myatt Fig. 262

.3 Bottom support – pipe roll stand:

.1 cast iron pipe roller with drilled cast iron stand, to MSS SP-58, type 44,

.2 fixed base and adjustable base.

Standard of Acceptance
- Anvil - fig. 271 (fixed), fig. 274 (adjustable)
- Myatt - fig. 264 (fixed), fig. 266 (adjustable)

2.9 Horizontal Pipe Support – Clevis

.1 Clevis support:

.1 carbon steel, adjustable clevis, with yoke bolt reinforcing tube, to MSS SP-58 Type 1,

.2 listed to ULC/ORD-C203 or UL 203 for fire protection piping,

.3 sized for outside dimension of pipe and insulation,

.4 nominal pipe size:

(a) steel pipe: NPS ½ to NPS 30
(b) ductile or cast iron pipe: NPS 3 to 24

Standard of Acceptance
- Anvil - fig. 260
- Anvil - fig. 590 (for ductile or cast iron pipe)
- Myatt - fig. 124
- Myatt - fig. 126 (for ductile or cast iron pipe)

.2 Clevis support with integral non-metallic insulation saddle:

.1 carbon steel, adjustable clevis to MSS SP-58, type 1, ULC listed, with yoke bolt reinforcing tube,

.2 with glass-reinforced polypropylene saddle, sized to allow up to 50 mm (2 in.) insulation thickness,

.3 sized for outside dimension of pipe and insulation,

.4 nominal pipe size: NPS ¾ to NPS 6,

.5 piping system design temperature limits: 4.4 to 93°C (40 to 200°F).

Standard of Acceptance
- Anvil - fig. 260 ISS

.3 Clevis support for copper pipe and tube:

.1 carbon steel yoke and clevis, adjustable clevis to MSS SP-58, type 1, copper plated finish,

.2 nominal pipe size: NPS ½ to NPS 4,

.3 sized for outside dimension of pipe/tube, or outside diameter of pipe and insulation as applicable.

Standard of Acceptance
- Anvil - fig. CT-65
- Myatt - fig. 151 CT

.4 Light-duty, side-opening clevis support:

.1 for fire protection service only,

.2 galvanized carbon steel, adjustable clevis with fixed yoke,

.3 listed to ULC/ORD-C203 or UL 203 for fire protection piping,

.4 sized for outside dimension of pipe (and insulation if applicable).

.5 sized for outside dimension of pipe (and insulation where applicable),

.6 nominal pipe size: NPS 2 to NPS 8.

Standard of Acceptance
° Hilti - fig. MH-SLC Speed Lock]

2.10 Horizontal Pipe Support – Slides

.1 Sliding pipe base supports – welded attachment:

.1 Tee or H shaped pipe support for welding to pipe, to allow axial and lateral movements,

.2 carbon steel, structural shape or fabricated, to ANSI/MSS SP-58 Type 35,

.3 PTFE bonded to underside of slide,

.4 matching lower steel plate with bonded PTFE element (for fastening to structural support beam),

.5 operating temperature range: -28 to 200°C (-20 to 400°F),

.6 pipe guide variants:

(a) lug restraints to limit lateral movement to 1.6 mm (1/6 in) or 25 mm (1 in),
(b) lug restraints to limit uplift movement to 1.6 mm (1/6 in),

.7 nominal pipe size: NPS ½ to NPS 30.

Standard of Acceptance
° Anvil - figs. 257, 436, 439
° Myatt - figs. 705, 706

2.11 Horizontal Pipe Support – Swivel Ring Hanger

.1 For non-insulated stationary piping and tubing only.

.2 Pipe swivel ring hangers:

.1 carbon steel ring strap, zinc plated, adjustable knurled swivel nut, to MSS SP-58 Type 10,

.2 copper plated or epoxy-coated for use on copper tubing,

.3 listed to ULC/ORD-C203 or UL 203 for fire protection piping,

.4 nominal pipe size: NPS ½ to NPS 4.

Standard of Acceptance
° Anvil - fig. 69, CT-69
° Myatt - fig. 41, 42, 43

2.12 Horizontal Pipe Support – Trapeze

.1 Manufactured trapeze support:

.1 load ratings as per manufacturers data sheets,

.2 carbon steel, double-C channel (strong-backs), HSS shape and equal-leg angles.

Standard of Acceptance
° Anvil - fig. 45, 46, and 50

° Myatt - fig. 173, 600, and 650

.2 Fabricated trapeze support:

.1 designed and sealed by a professional engineer licensed in the jurisdiction of the work.

.2 performance:

(a) maximum deflection between supports: 1/250 (0.4%) of span
(b) minimum factor of safety: five (5) times load to ultimate tensile or compressive strength, but not to exceed 60% of yield strength.

.3 carbon steel shapes, to suit load application,

(a) hollow steel section,
(b) equal leg El section, or
(c) double C channel “strong-back”, with welded clips.

.3 Hanger rods:

.1 minimum of two support rods per trapeze,

.2 rods selected for minimum factor of safety of 4 times load for tensile or compressive strength of the rod.

.4 Pipe restraint:

.1 restrain pipes from lateral movement with:

(a) bolt-on angle brackets or pipe U-bolts for manufactured hangers,
(b) welded-on angles for fabricated hangers,

.2 restraints to permit axial linear movement and axial-rotation, except where otherwise shown to be a guide or an anchor.

2.13 Horizontal Pipe Support – Drainage MJ

.1 For horizontal cast iron drainage piping, as an alternative to clevis hangers.

.1 carbon steel, plain finish,

.2 pipe size: NPS 2 to NPS 6

Standard of Acceptance
° Anvil - fig. 250

2.14 Vertical Pipe Stanchions

.1 Pipe support stanchion, with welded attachment:

.1 fixed height, or telescoping two-piece design with height adjustment, field-welded to pipe elbow or horizontal pipe,

.2 carbon steel, structural cylinder shape,

.3 designed for static loads of pipe and contents, as well as dynamic loads and anchor loads as shown,

.4 nominal pipe size: NPS 2 to NPS 18.

Standard of Acceptance
° Anvil - fig. 62
° Myatt - fig. 702, 703

2.15 Vertical Pipe Riser Clamps

.1 Steel pipe, cast iron pipe:

.1 carbon steel clamps for carbon steel piping and cast iron piping,

.2 stainless steel clamps for stainless steel piping,

.3 listed to ULC/ORD-C203 or UL 203 for fire protection piping,

.4 supplied with field-welded pipe support lugs of same material as supported steel pipe (not including cast iron pipe).

.5 floor supported pipe riser clamps, to ANSI/MSS SP-58, type 8,

Standard of Acceptance
- Anvil - fig. 261
- Myatt - fig. 182 or 183

.6 suspended pipe riser clamps, 4 or 6 bolt patterns, to ANSI/MSS SP-58, type 42,

Standard of Acceptance
- Anvil - fig. 40, 40SS
- Myatt - fig. 190 or 191

.2 Copper pipe and tube:

.1 floor supported pipe riser clamps, carbon steel with copper plated finish, to ANSI/MSS SP-58, type 8,

Standard of Acceptance
- Anvil - fig. CT-121
- Myatt - fig. 150CT

2.16 Vibration Isolation Supports

.1 Provided under specification section 20 05 48.

2.17 Constant Load Supports

.1 General:

.1 maintains constant support load under variable pipe displacements,

.2 deviation in supported load due to thermal movement does not exceed 6% of the operating load,

.3 selected for piping loads and estimated travel under service conditions, with a minimum safety factor of 25 mm (1 in) extra travel or 20% of total travel, whichever is greater.

.2 Construction:

.1 carbon steel housing and spring, to MSS SP-58 types 54, 55 and 56

.2 combination hanger moment arm and balancing spring design,

.3 horizontal and vertical arrangements,

.4 load adjustment and load indicator scale,

.5 factory set for load and travel,

.6 welding to ASME Section IX

.7 welded attachment points

.8 finish: semi gloss primer coat.

Standard of Acceptance
- Anvil – fig R 80-V, 81-H
- Myatt - fig. C series]

2.18 Cast Iron Pipe Joint Restraint

.1 Joint restraint rodding assembly for cast iron and asbestos cement drain waste and vent pipe, for each branch, tee, wye and clean-out fittings on drainage piping NPS 5 and over.

.2 Clamp and rod joint restraint:

.1 carbon steel pipe clamps with four bolt fasteners and rod washers, plain finish, to MSS SP-58, Type 8,

.2 carbon steel threaded rods and load nuts,

.3 two pipe clamps and two restraint rods required for each joint.

Standard of Acceptance
- Myatt - fig. 595 with 594 and 146.

2.19 Saddles and Shields at Pipe Supports

.1 Insulation shields:

.1 galvanized steel protection shield, thickness and length as applicable to pipe size, to MSS SP-58 type 40.

Standard of Acceptance
- Anvil - fig. 167 (up to NPS 24)
- Anvil - fig. 168 - Riblok (up to NPS 8)
- Myatt - fig. 251

.2 Pipe saddles:

.1 Carbon steel or stainless steel (to match pipe material) saddle welded to pipe with insulation inserted between saddle and pipe, to MSS SP-58 type 39.

Standard of Acceptance
- Anvil - fig. 160 to 166
- Myatt - fig. 210 to 240

3 EXECUTION

3.1 General

.1 Where the specific requirements for pipe supports are specified in other sections of Division 20 to 25, the requirements of those sections take precedence over the requirements of this specification section. Refer

3.2 Coordination with Concrete Work

.1 Supply and deliver concrete inserts to site in ample time to be built into the work of Division 03.

.2 Correctly position and set concrete inserts onto concrete formwork for pipes and equipment hangers. Secure inserts firmly to formwork before concrete is poured.

.3 Do not use explosive drive pins in any section of the Work without obtaining prior approval from the Consultant.

3.3 Horizontal Pipe Support Spacing and Hanger Rod Size

.1 Provide horizontal pipe supports at the spacing and hanger rod size as detailed in the following tables, unless specified otherwise in other sections of Division 20 to 25:

.1 carbon steel, galvanized steel, and stainless steel pipe; standard weight, schedule 40 and schedule 80: to Table 1A.

.2 stainless steel pipe, schedule 10S: to Table 1B

.3 copper tube, stainless steel tube: to Table 1C.

Table 1A: Horizontal Pipe Support Spacing for Carbon Steel, Galvanized Steel, Stainless Steel Piping Standard Weight, Schedule 40 and 80			
Pipe Size NPS	Rod Diameter	Maximum Spacing, Liquids m, (ft)	Maximum Spacing Steam, Gases [Note 1] m (ft)
½	M10 (3/8 in)	1.8 (6)	1.8 (6)
3/4 to 1¼	M10 (3/8 in)	2.1 (7)	2.1 (7)
1½	M10 (3/8 in)	2.7 (9)	2.7 (9)
2	M10 (3/8 in)	3.0 (10)	4.0 (13)
2½	M12 (½ in)	3.3 (11)	4.3 (14)
3	M12 (½ in)	3.3 (12)	4.6 (15)
4	M16 (5/8 in)	4.2 (14)	5.2 (17)
6	M20 (3/4 in)	5.1 (17)	6.4 (21)
8	M20 (3/4 in)	5.7 (19)	7.3 (24)
10	M20 (7/8 in)	6.7 (22)	7.9 (26)
12	M20 (7/8 in)	7.0 (23)	9.1 (30)
14	M24 (1 in)	7.5 (25)	9.8 (32)
16	M24 (1 in)	8.0 (27)	10.7 (35)
18	M24 (1 in)	8.4 (28)	11.3 (37)
20	M30 (1-1/4 in)	9.0 (30)	11.9 (39.0)
24	M36 (1-1/2 in)	9.6 (32)	12.8 (42.0)

Notes:
[1] Where piping is hydrostatically tested with water, temporary pipe supports are required to limit pipe span to the "liquids" values.

Table 1B: Horizontal Pipe Support Spacing for Schedule 10S Stainless Steel Pipe		
Pipe Size NPS	Rod Diameter	Maximum Spacing
½	M10 (3/8 in)	2.1 m (6.7 ft)
¾	M10 (3/8 in)	2.4 m (7.7 ft)
1	M10 (3/8 in)	2.8 (9.0)
1-1/4	M10 (3/8 in)	3.2 (10.3)
1½	M10 (3/8 in)	3.2 (10.3)
2	M10 (3/8 in)	3.6 (11.6)
2½	M10 (3/8 in)	4 (12.8)
3	M10 (3/8 in)	4.3 (13.8)
4	M12 (1/2 in)	4.7 (15.1)
6	M12 (1/2 in)	5.4 (17.3)
8	M16 (5/8)	5.9 (18.9)
10	M16 (5/8)	6.5 (20.9)
12	M16 (5/8)	7 (22.5)
14	M20 (3/4)	7.0 (22.5)
16	M20 (3/4)	7.3 (23.4)
18	M20 (3/4)	7.5 (24.1)
20	M24 (1)	8.0 (25.7)
24	M24 (1)	8.6 (27.6)

Table 1C: Horizonal Pipe Support Spacing for Copper Tube, and Stainless Steel Tube		
Pipe Size NPS	Rod Diameter	Maximum Spacing
½	M10 (3/8 in)	1.5 m (5 ft)
3/4 to 1¼	M10 (3/8 in)	1.8 m (6 ft)
1½	M10 (3/8 in)	2.4 m (8 ft)
2	M10 (3/8 in)	2.4 m (8 ft)
2½	M12 (½ in)	3.0 m (10 ft)
3	M12 (½ in)	3.0 m (10 ft)
4	M16 (5/8 in)	3.0 m (10 ft)

.2 Hanger spacing and hanger rod diameter for steel pipe or copper tube with flexible roll groove joints;

.1 to be as shown in the above tables for the appropriate pipe material, with not less than one hanger between joints, and

.2 provided with anchors and guides located to maintain piping true to line and grade.

.3 Support plastic and other special piping, including anchors and guides, in accordance with the pipe manufacturer's requirements.

3.4 Vertical Pipe Supports

.1 Pipe riser clamps:

.1 provide pipe riser clamps at every second floor level for vertical pipe risers passing through two or more floors, unless other vertical pipe support types are shown,

.2 for steel pipe, provide support lugs welded to steel piping so that pipe lugs bear on the top-surface of the riser clamp,

.3 for copper tube and pipe, arrange vertical piping so that a pipe joint bears on the top -surface of the riser clamp.

.2 Support cold- and hot-piping and tubing risers at pipe anchors and provide additional supports as follows:

.1 for riser height of 25 m (82 ft) or less: provide spring vibration isolator supports attached to pipe riser clamps, at not less than every 10 m (32 ft),

.2 for riser height between 25 m (82 ft) and 50 m (165 ft): provide variable spring supports as follows;

(a) at least one per riser,
(b) for each length of pipe that is connected to an expansion joint in the riser,
(c) and as otherwise shown.

.3 for riser height greater than 50 m (164 ft): provide constant load supports as follows:

(a) at least one per riser,

(b) for each length of pipe that is connected to an expansion joint in the riser,
(c) at the top of the riser,
(d) and as otherwise shown.

3.5 Horizontal Pipe Hanger and Support Selection

.1 Swivel ring pipe hangers may only be used for;

.1 fire protection piping, NPS 4 and smaller,

.2 drain waste and vent (DWV) piping and tubing, NPS 4 and smaller,

.3 medical gas piping and laboratory gas piping, NPS 4 and smaller,

.4 compressed air piping and tubing located downstream of a refrigerated dryer, NPS 2 and smaller,

.5 chemical treatment piping NPS 2 and smaller

.2 For cast iron drainage and vent piping;

.1 use clevis hangers for suspended supports,

.2 drainage MJ type hangers may be used on hub-less cast iron piping,

.3 use roller or slide type supports for bottom supported piping. For slide supports, use a variant incorporating pipe band clamps in lieu of welded attachment.

.3 Do not use clevis hangers for piping subject to thermal movement, except under selected piping conditions specified herein.

.4 Select pipe support types in accordance with Table 2 based on pipe size, except where limited by Tables 3A or 3B based on pipe thermal movement.

.1 The following abbreviations apply to Table 2.

CL Clevis hanger

CL(Sa) Clevis hanger with integral polypropylene saddle

RL Roller support

SD(T) Slider, T shape

SD(H) Slider, H shape

TZ Trapeze

Table 2: Pipe Support Basic Selection, Based on Pipe Size (except cast iron drainage pipe)

Pipe Size	Support Type					
	CL	CL(SaD	RL	SD(T)	SD(H)	TZ
¾ - 4	●	●	●	●		●
6	●	●	●	●	●	●
8	●		●	●	●	●[1]
10 – 14	●			●	●	●[1]
16-18				●	●	●[1]
20 – 24					●	●[1]

Notes:
[1] When used in conjunction with a slide support.

.2 For pipe size NPS 16 to 24, a clevis hanger may be used to support a concentrated load, provided it is used only to support the concentrated load and there is a separate pipe run support within one-third of the maximum allowable span on each side of the concentrated load.

.5 The support types of Table 2 are limited based on the expected thermal movement of piping as follows:

.1 where the length of the hanger rod is 300 mm (12 in.) or less measured between the upper attachment and the rod attachment point to the pipe support element, the selection of pipe support type is limited as follows:

(a) for hot piping, do not use clevis hangers,
(b) for cold piping, clevis hangers may be used for pipes NPS 4 and smaller.

.2 for cold piping and hot piping where the length of the hanger rod is greater than 300 mm (12 in.) measured between the upper attachment and the rod attachment point to the pipe support element, the selection of support types is limited to the following:

(a) carbon steel and galvanized steel pipe: to Table 3A.
(b) copper tube, and stainless steel pipe and tube: to Table 3B.
(c) select support type based on piping system maximum operating temperature and spacing between adjacent pipe anchors on each system. For intermediate values, use the next higher criteria; do not interpolate.

Table 3A: Suspended Carbon Steel and Galvanized Steel Pipe
Pipe Support Selection Based on Thermal Movement
Support Rod Length 300 mm or Longer

Pipe System Maximum Operating Temperature		Pipe Run Distance Between Anchors m (ft)					
°C	(°F)	5 (15)	10 (33)	15 (49)	20 (65)	25 (82)	30 (100)
10	(50)						
20	(68)						
30	(86)						
40	(104)			Clevis,			
50	(122)			Trapeze,			
60	(140)			Roller, or			
70	(158)			Slide			
80	(176)						
90	(194)						
100	(212)						
120	(250)						
150	(302)					Roller or Slide	
200	(392)						

Table 3A: Suspended Carbon Steel and Galvanized Steel Pipe Pipe Support Selection Based on Thermal Movement Support Rod Length 300 mm or Longer							
Pipe System Maximum Operating Temperature		Pipe Run Distance Between Anchors m (ft)					
°C	(°F)	5 (15)	10 (33)	15 (49)	20 (65)	25 (82)	30 (100)
250	(482)						

Table 3B: Suspended Copper Tube, and Stainless Steel Pipe and Tube Pipe Support Selection based on Thermal Movement Support Rod Length 300 mm or Longer							
Pipe System Maximum Operating Temperature		Distance Between Anchors m (ft)					
°C	(°F)	5 (15)	10 (33)	15 (49)	20 (65)	25 (82)	30 (100)
10	(50)						
20	(68)						
30	(86)						
40	(104)			Clevis,			
50	(122)			Trapeze,			
60	(140)			Roller,			
70	(158)			Slide			
80	(176)						
90	(194)						
100	(212)						
120	(180)						
150	(302)					Roller,	
200	(392)					Slide	
250	(482)						

3.6 Support and Hanger Installation

.1 Support piping directly from or on structural building elements. Do not support pipe directly from other services.

.2 Provide all miscellaneous materials including nuts, washers, and backing plates to make a complete installation.

.3 Where wall brackets are used, select brackets and size mounting bolts and backing plates to suit the supported load, allowing for a safety factor by not loading the bracket more than 80% of its published load rating.

.4 Do not support piping or tubing in direct contact with hangers or supports of dissimilar metallic material.

.5 Coordinate location of pipe supports with pipe flexible connectors, pipe guides and pipe anchors provided under specification section 20 05 16.

.6 In steel framed construction, support piping from structural members. Where structural members are not suitably located for upper hanger attachment locations, and where inserts of adequate capacity cannot be installed in concrete slabs, provide supplementary steel framing members;

.1 fabricate supplementary steel from standard HSS sections, single EL section, double C "strongback" sections, or pipe rolls,

.2 size supporting steel to limit span deflection to 1/250 (0.4%) between support points,

.3 mechanically fasten supplementary steel to structural steel.

.7 Offset hangers so that rods are within 4° of vertical when in the operating position.

.8 Provide a pipe support within 300 mm (12 in.) of;

.1 an elbow or tee,

.2 a concentrated load, including but not limited to valves, strainers and flanges,

.3 a connection to equipment.

.9 Where hanger rods are used, provide load nuts on top and underside of attachment to the pipe support, including clevis hangers, roll supports, roll yoke hangers, and trapeze hangers.

3.7 Clevis Hangers

.1 Where clevis hangers are used for cold- or hot-piping, provide hanger rods with a clevis swivel and weldless eye nut at the building attachment connection, to allow free-rotation movement of the hanger rod in the same direction as axial movement of the associated pipe.

.2 Where clevis hangers are used for stainless steel pipe or tube and for copper tube;

.1 use copper or epoxy finished clevis hangers for copper pipe/tube,

.2 use stainless steel or alloyed steel clevis hangers (for stainless steel pipe/tube), or

.3 use a standard clevis hanger with integral non-metallic insulation saddles and hangers are sized for outside of the pipe and insulation.

3.8 Trapeze Hangers:

.1 Provide shim pipes on common trapeze hangers to slope each pipe in required direction, and mechanically fasten or tack-weld shim plates to the trapeze hanger,

.2 Provide U-bolts or fabricated angles to restrict lateral pipe movement; while allowing pipe thermal axial motion and rotation;

.1 fasten U-bolts or angles to the trapeze hanger,

.2 fabricated angles to extend vertically at least one-quarter the outside pipe/insulation diameter,

.3 where seismic restraint is required, only use U-bolts.

3.9 Pipe Saddles and Shields

.1 Provide pipe saddles and shields for insulated piping in accordance with the following table 4

Table 4: Insulation Hanger Protection				
Pipe Service	Service Temperature °C (°F)	Pipe Size NPS	Pipe Saddle	Insulation Shield [Note 1]
Hot Piping	> 93 to ≤ 205 (> 200 to ≤ 400)	≥ 1-1/2	Yes	---
		≤ 1-1/4	---	Yes
	> 60 to ≤ 93 (> 140 to ≤ 200)	> 6	Yes	---
		≥ 1-1/2 and ≤ 6	---	Yes
		≤ 1-1/4	---	Yes
	> 40 to 60 (≥ 104 to ≤ 140)	≥ 1-1/2	---	Yes
		≤ 1-1/4	---	Yes
Ambient Piping (Insulated)	> 16 to ≤ 40 (> 60 to ≤ 104)	All	---	Yes
Cold Piping	≤ 16 (60)	≥ 1-1/2	---	Yes
		≤ 1-1/4	---	Yes

Notes:
[1] Refer to specification section 20 07 19 for high density insulation insert requirements.

.2 Provide pipe shields for uninsulated glass and plastic piping NPS 1-1/2 and larger.

.3 Where piping is insulated and requires pipe shields, install the shields between pipe insulation and pipe support. Provide high-density insulation insert between pipe and insulation shields in accordance with specification section 20 07 19.

.4 Where piping is not insulated and requires a pipe shield, install the shields between the pipe and the pipe support.

.5 Where clevis hangers with integral insulation saddles are used, apply insulation sealant to the polypropylene saddle in accordance with the pipe hanger manufacturer's instructions;

.1 for hot piping, coordinate with the pipe insulation contractor to apply sealant coating to the integral saddle at the time pipe insulation is installed,

.2 for cold piping, seal the saddle's pipe contact surfaces with vapour-barrier sealant before the piping is installed. Finish sealing the remainder of the saddles' exposed faces when pipe insulation is installed.

3.10 Vibration Isolation Supports

.1 Provide vibration isolation for vertical pipe supports as previously specified herein. In addition, coordinate with the work under specification section 20 05 48 to provide vibration isolation pipe supports where specified in that section.

.2 When installed with clevis hangers, install the vibration isolators below and separate from the upper attachment clevis; do not use the vibration isolator for the purpose of rotation movement of the support rod.

3.11 Constant Load Supports

.1 Provide constant load supports for vertical pipe supports as previously specified herein. In addition, size, select and install constant load supports at the following locations;

.1 pipe risers, located at the top of the riser, and intermediate riser locations, where pipe thermal movement exceeds 6 mm (1/4 in.) at the support location,

.2 first hanger support for main steam piping connections NPS 6 and larger to steam boilers,

.3 first hanger support for water piping connections NPS 8 and larger to hot water boilers,

.4 first hanger support for water piping connections NPS 12 and larger to refrigeration equipment,

.5 first hanger support inside the building for water piping NPS 12 and larger for condenser water piping to a cooling tower.

.6 and as shown

.2 Where steam piping support spacing is greater than specified in Table 1A and water is to be used for hydrostatic pressure testing, provide temporary supports to meet the spacing requirements of Table 1A.

3.12 Set-up After Installation

.1 Adjust hangers to equalize hanger loads, to support piping true to line and grade, and to minimize loads transferred through connections to equipment and outlets.

3.13 Standard Details

.1 The following standard details are appended to the end of this specification section.

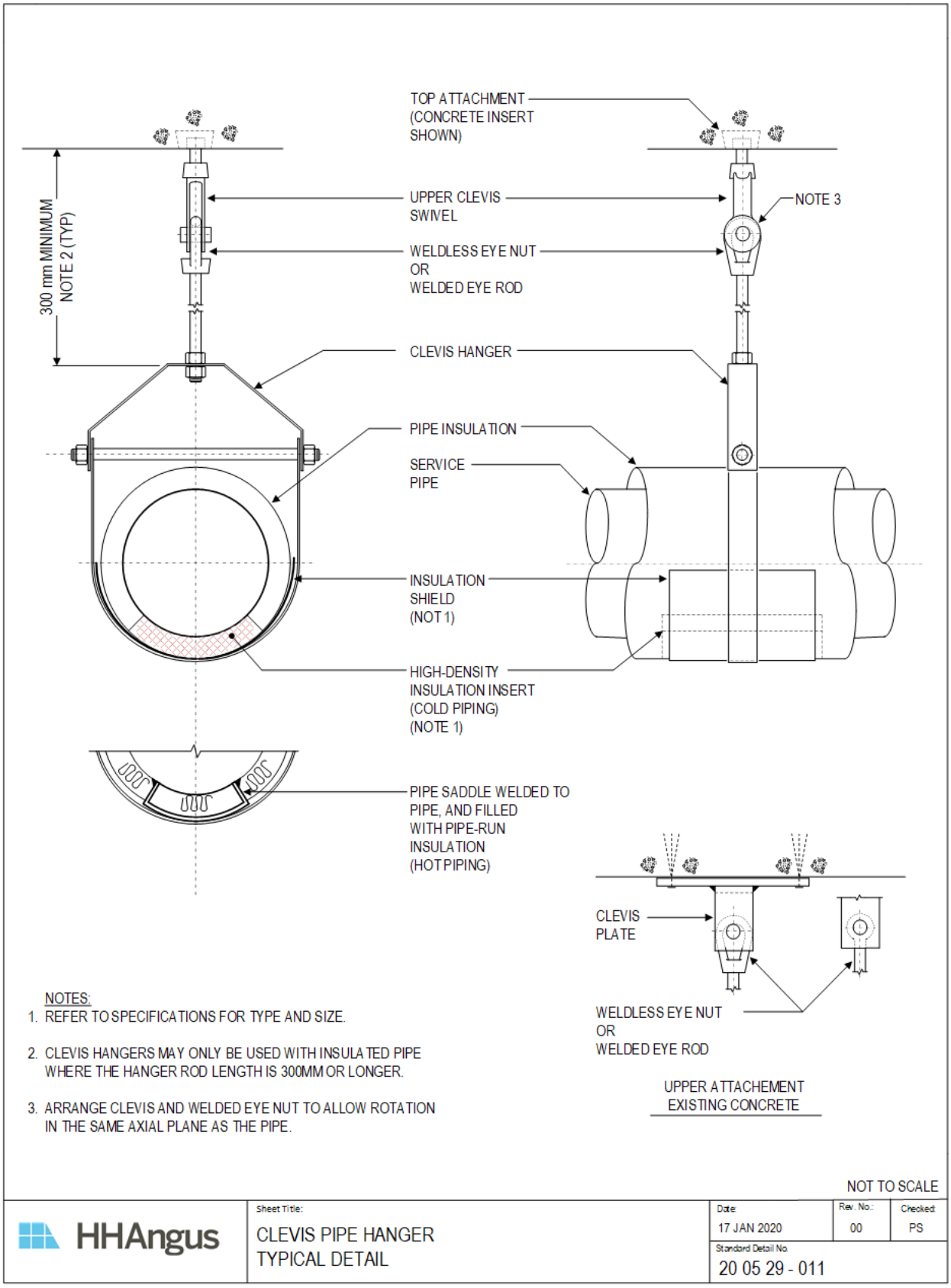
.1 20 05 29-011

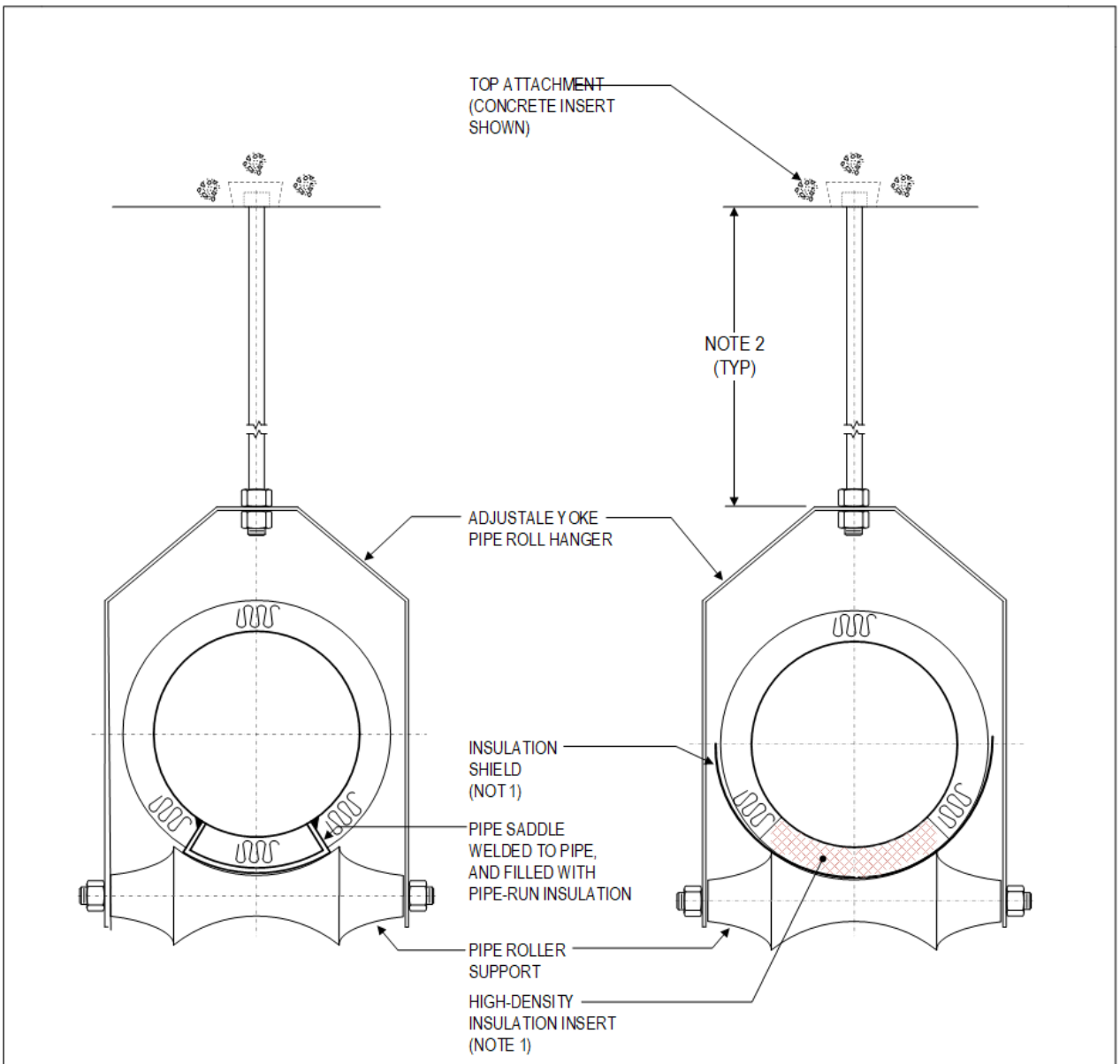
.2 20 05 29-012

.3 20 05 29-013

.4 20 05 29-014

END OF SECTION


TOP ATTACHMENT (CONCRETE INSERT SHOWN)
UPPER CLEVIS SWIVEL
NOTE 3
WELDLESS EYE NUT OR WELDED EYE ROD
300 mm MINIMUM NOTE 2 (TYP)
CLEVIS HANGER
PIPE INSULATION
SERVICE PIPE
INSULATION SHIELD (NOT 1)
HIGH-DENSITY INSULATION INSERT (COLD PIPING) (NOTE 1)
PIPE SADDLE WELDED TO PIPE, AND FILLED WITH PIPE-RUN INSULATION (HOT PIPING)
CLEVIS PLATE
WELDLESS EYE NUT OR WELDED EYE ROD
UPPER ATTACHEMENT EXISTING CONCRETE
NOTES:
1. REFER TO SPECIFICATIONS FOR TYPE AND SIZE.
2. CLEVIS HANGERS MAY ONLY BE USED WITH INSULATED PIPE WHERE THE HANGER ROD LENGTH IS 300MM OR LONGER.
3. ARRANGE CLEVIS AND WELDED EYE NUT TO ALLOW ROTATION IN THE SAME AXIAL PLANE AS THE PIPE.
NOT TO SCALE
HHAngus
Sheet Title:
CLEVIS PIPE HANGER TYPICAL DETAIL
Date: 17 JAN 2020
Rev. No.: 00
Checked: PS
Standard Detail No.
20 05 29 - 011

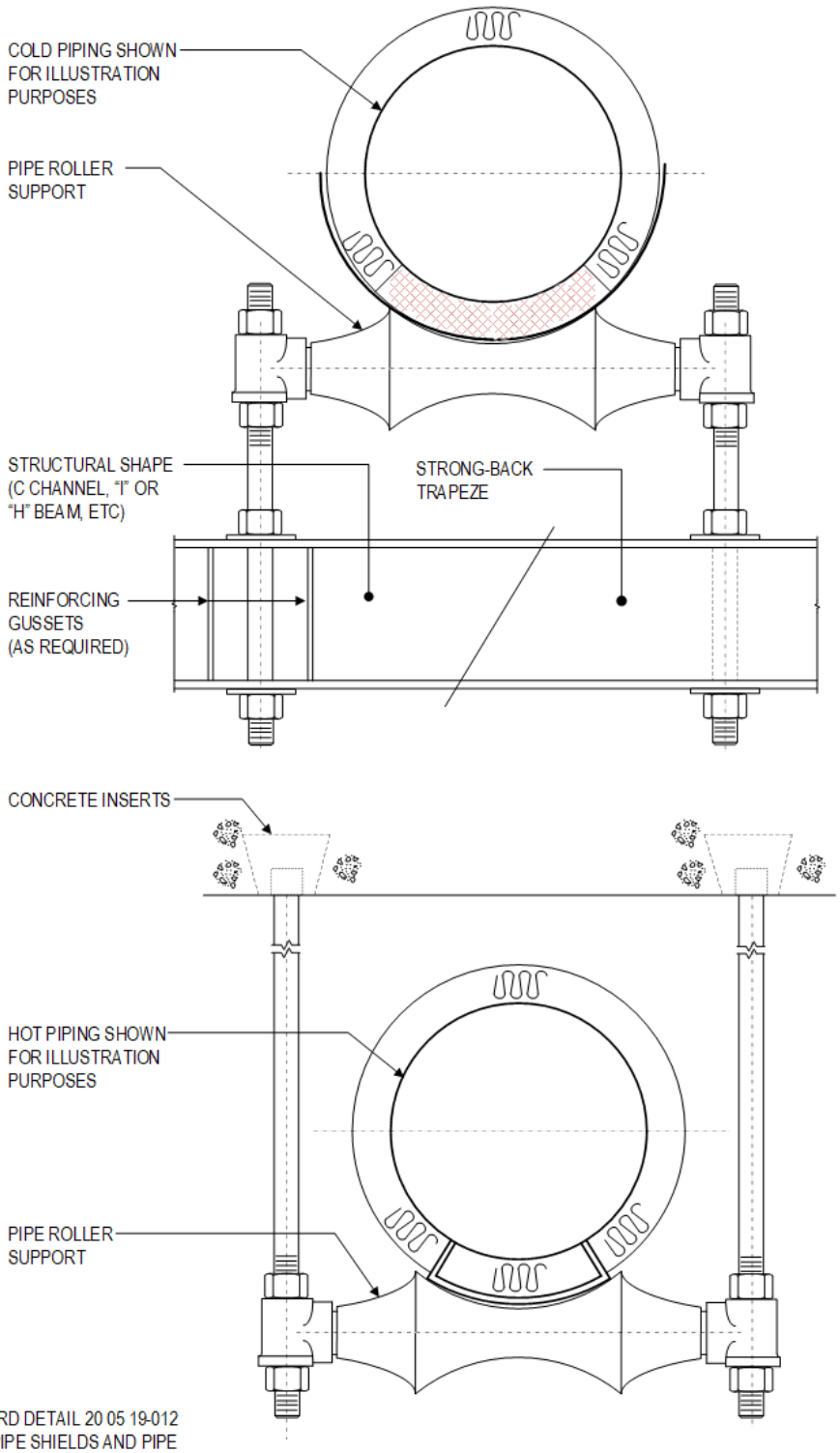


NOTES:

1. REFER TO SPECIFICATIONS FOR TYPE AND SIZE.
2. WHERE HANGER ROD LENGTH IS LESS THAN 300MM FOR INSULATED PIPING, ROLLER, SLIDE OR TRAPEZE HANGERS ARE REQUIRED
3. ARRANGE CLEVIS AND WELDED EYE NUT TO ALLOW ROTATION IN THE SAME AXIAL PLANE AS THE PIPE.

NOT TO SCALE

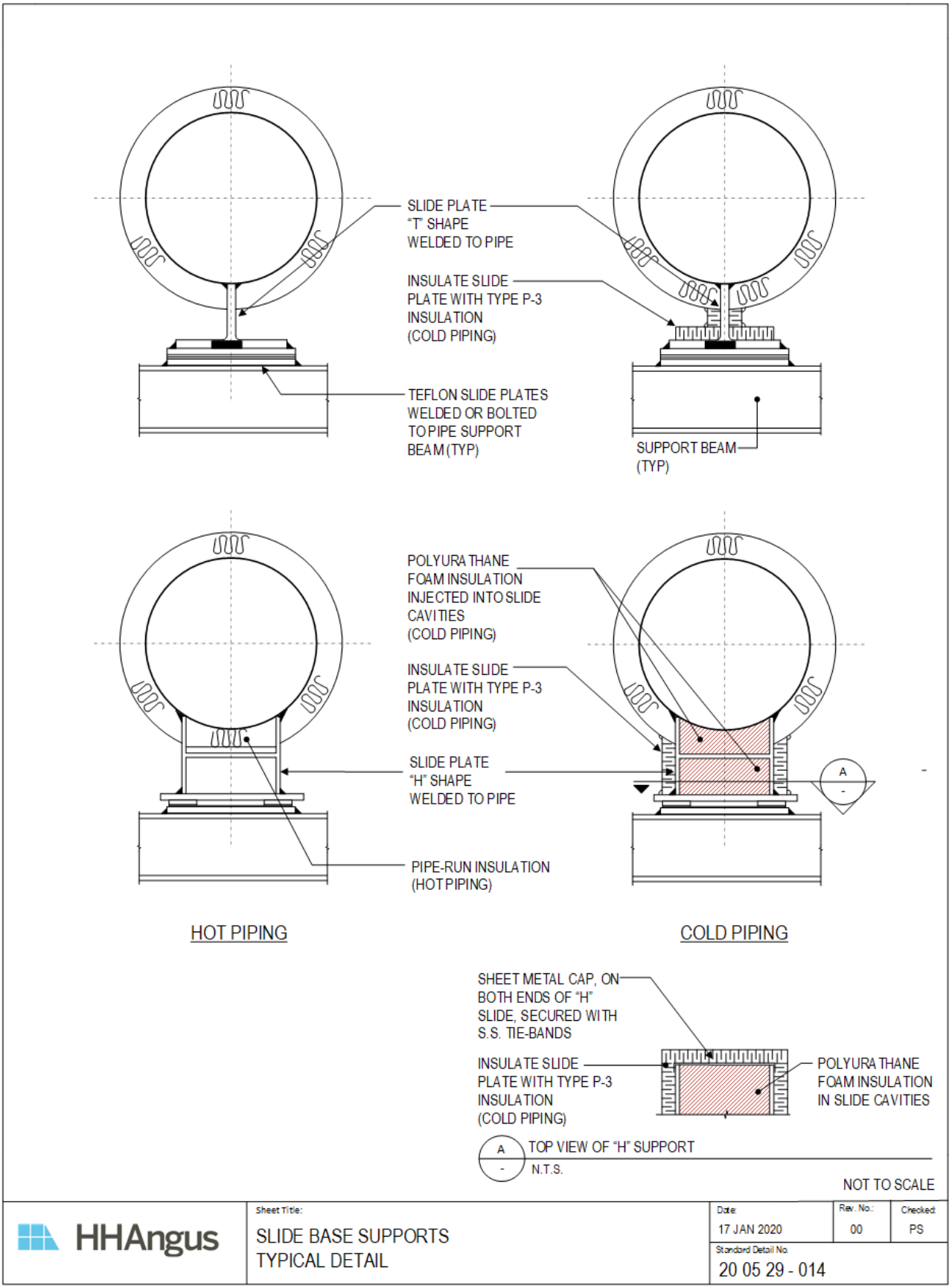
HHAngus	Sheet Title: YOKE PIPE ROLL HANGER TYPICAL DETAIL	Date: 17 JAN 2020	Rev. No.: 00	Checked: PS
		Standard Detail No.: 20 05 29 - 012		



NOTES:
1. REFER TO STANDARD DETAIL 20 05 19-012 FOR INSULATION, PIPE SHIELDS AND PIPE SADDLES REQUIREMENTS.

NOT TO SCALE

HHAngus	Sheet Title: PIPE ROLLER SUPPORT TYPICAL DETAIL	Date: 17 JAN 2020	Rev. No.: 00	Checked: PS
		Standard Detail No.: 20 05 29 - 013		


SLIDE PLATE "T" SHAPE WELDED TO PIPE
INSULATE SLIDE PLATE WITH TYPE P-3 INSULATION (COLD PIPING)
TEFLON SLIDE PLATES WELDED OR BOLTED TO PIPE SUPPORT BEAM (TYP)
SUPPORT BEAM (TYP)
POLYURATHANE FOAM INSULATION INJECTED INTO SLIDE CAVITIES (COLD PIPING)
INSULATE SLIDE PLATE WITH TYPE P-3 INSULATION (COLD PIPING)
SLIDE PLATE "H" SHAPE WELDED TO PIPE
PIPE-RUN INSULATION (HOT PIPING)
A
-
HOT PIPING
COLD PIPING
SHEET METAL CAP, ON BOTH ENDS OF "H" SLIDE, SECURED WITH S.S. TIE-BANDS
INSULATE SLIDE PLATE WITH TYPE P-3 INSULATION (COLD PIPING)
POLYURATHANE FOAM INSULATION IN SLIDE CAVITIES
A
-
TOP VIEW OF "H" SUPPORT
N.T.S.
NOT TO SCALE
HHAngus
Sheet Title:
SLIDE BASE SUPPORTS TYPICAL DETAIL
Date:
17 JAN 2020
Rev. No.:
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Checked:
PS
Standard Detail No.
20 05 29 - 014

VIBRATION ISOLATION
20 05 48

1 GENERAL

1.1 Scope

.1 Isolate motor driven mechanical equipment.

.2 Provide restraints for equipment mounted on vibration isolation to limit movement during start-up and normal operation.

.3 Isolator and base type designations are taken from appropriate chapter of current ASHRAE Applications Handbook.

.4 Base type, isolator type and minimum static deflection are shown in equipment schedules and equipment selection sheets.

.5 Information shown in equipment schedules is to establish minimum standards, vibration isolation equipment to be selected to maintain noise levels in building below RC levels in following schedule.

AREA	NOISE CRITERIA (NC level)
Offices - private	32 to 34
-open plan	36 to 38
-business machine areas	40 to 42
-conference/boardrooms	30 to 32
Operating Rooms	25 to 27
Private Bedrooms	26 to 28
Hospital Wards	30 to 32
Public Areas	38 to 40

.6 Coordinate vibration isolation with seismic requirements.

1.2 Related Sections

.1 Additional requirements for seismic restraint: to Section 20 05 49 Seismic Restraint

.2 Pipe movement control to Section 20 05 16 Flexible Connections, Expansion Joints, Anchors & Guides

.3 Piping constant load supports to Section 20 05 29 Hangers and Supports

1.3 Shop drawings

.1 Show vibration isolation for each piece of equipment hung from the structure or supported from the floor.

.2 Submit product data sheets for isolation components.

.3 Show fabrication details, location and size of anchor bolts and concrete requirements for inertia bases.

.4 Provide vibration isolation equipment by one manufacturer.

Standard of Acceptance
- Vibron / Kinetics
- BVA
- KorfundMason
- Tecoustics

2 PRODUCTS

2.1 Resilient isolator Type 1 (R1)

.1 Rubber waffle or ribbed pads:
- .1 30 durometer natural rubber, minimum of 13 mm (½ in) thick,
- .2 selected for maximum loading of 350 kPa (50 psi).

.2 Rubber-steel-rubber pads:
- .1 two layers of rubber waffle or ribbed pad, 13 mm (½ in) thick, as specified above,
- .2 bonded to 6 mm (¼ in) steel plate with holes sleeved and fitted with isolation washers.

.3 Neoprene jacketed pre-compressed moulded fibreglass.

2.2 Resilient isolator Type 2 (R2)

.1 Elastomer rubber:
- .1 threaded insert,
- .2 hold down bolts.

.2 Neoprene, 50 mm (2 in) free height:
- .1 natural frequency not to exceed 15 Hz at full load,
- .2 capable of sustaining load of 110 kg (250 lb) with maximum deflection of 5 mm (3/16 in).

2.3 Elastomeric mounts (E1)

.1 Construction:
- .1 colour coded neoprene in shear with
- .2 maximum durometer of 60,
- .3 threaded insert,
- .4 two bolt down holes,
- .5 ribbed top and bottom surfaces.

2.4 General requirements for spring mounts

.1 Isolator springs:

.1 designed so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height,

.2 selected for 50% travel beyond rated load,

.3 cadmium plated,

.4 colour coded.

.2 Mounts:

.1 zinc or cadmium plated hardware,

.2 rubber isolation washers,

.3 housings coated with rust resistant paint,

.4 levelling devices, and

.5 6 mm (¼ in) thick ribbed rubber sound pad bonded to load plate.

.3 Clearance between metal parts: 6 mm (¼ in) minimum.

2.5 Spring isolator Type 1 (S1)

.1 Open spring isolators:

.1 extra stiff springs with ratio of lateral to axial stiffness of 1.0.

2.6 Spring isolator Type 2 (S2)

.1 Controlled spring isolators with

.1 heavy rigid steel base frames,

.2 built-in vertical limit stops,

.3 removable spacers, and

.4 extra stiff springs with ratio of lateral to axial stiffness of 1.0.

2.7 Spring isolator snubber Type 3 (S3)

.1 Open spring isolators:

.1 horizontal arrangement

.2 heavy rigid steel equipment base mount, and structure mount

.3 open spring, with 25 mm (1 in) deflection range.

.4 isolator bushings.

2.8 General requirements for isolation hangers

.1 General

.1 swivel arrangement to permit hanger box or rod to move through 20 arc without metal to metal contact.

2.9 Hanger Type 1 (H1)

.1 Spring hanger:

.1 welded steel housing with one coat anti-rust paint,

.2 colour coded spring,

.3 retaining cups,

.4 elastomeric washers.

2.10 Hanger Type 2 (H2)

.1 Rubber isolation hanger:

.1 welded steel housing with one coat anti-rust paint,

.2 25 mm (1 in) colour coded neoprene in shear with maximum durometer of 60,

.3 threaded insert.

2.11 Hanger Type 3 (H3)

.1 Horizontal thrust restraint:

.1 spring and elastomeric element

.2 housed in box frame with rods and angle brackets to connect unit between isolated equipment and fixed object, and

.3 fitted with means to adjust maximum start-stop movement to 9 mm (⅜ in).[][

2.12 Acoustic barriers for anchors and guides

.1 Manufactured from 25 mm (1 in) thick neoprene isolation with duck reinforcing material.]

2.13 Equipment base Type A

.1 Direct isolation:

.1 used where equipment is unitary and rigid

.2 motor slide rails welded to unit.

2.14 Equipment base Type B

.1 Prefabricated steel base:

.1 welded from structural sections and

.2 reinforced for drive with;

(a) isolation elements attached to base brackets and
(b) adjustable motor slide rails.

.3 minimum vertical section of base selected on basis of motor size from following;

Motor Size Horsepower	Motor Size kW	Vertical Side mm (in)
up to 3	up to 2.2	75 (3)
7.5	5.5	100 (4)
20	15	150 (6)
50	37	200 (8)
over 50	37	250 (10)

2.15 Equipment base Type C

.1 Concrete filled inertia base:

.1 Type B base and,

.2 full depth perimeter structural section or formed plate channel frame with;

(a) welded in place reinforcing rods running in both directions and
(b) 1 mm (20 ga) metal pans,
(c) base section filled with concrete, vibrated into place.

.3 spring mount units carried by gusseted brackets welded to frame and

.4 'T' shaped bases to support pump elbows.

3 EXECUTION

3.1 General

.1 Install vibration isolation equipment in accordance with manufacturer's instructions and locate isolation for equipment to provide stable support under saddles, frames and projections of equipment.

3.2 Equipment vibration isolation

.1 Provide additional steel in bases and rails to obtain rigidity and uniform load distribution.

.2 Pumps, fans and motor driven equipment to be mounted on vibration isolation as shown

.3 Suspended fans to be supported on

.1 Type A or B base with

.2 Type H3 hangers.

.4 Provide Type S3 horizontal thrust restraints for high pressure horizontal discharge fans developing over 1.5 kPa (6 in wg), arranged symmetrically on either side of unit and attached at centre line of thrust.

.5 Block and shim bases level at correct operating height.

.1 Bases to clear housekeeping pads by:

(a) 25 mm (1 in) minimum for concrete and
(b) 50 mm (2 in) minimum for steel.

.6 Where isolation is bolted to floor, housekeeping slab or overhead structure:

.1 provide vibration isolation rubber washers.

3.3 Service connection vibration isolation

.1 Make pipe, duct and electrical connections to isolated equipment so as to maintain isolation system flexibility.

3.4 Piping vibration isolation

.1 Piping connected to isolated equipment:

.1 supported with;

(a) spring mounts or spring hangers with static deflection of twice deflection of isolated equipment at first point of support and
(b) 25 mm (1 in) minimum static deflection at remaining supports.

.2 installed with distance between support points selected as for regular pipe hangers and using spring type for

(a) first three supports for piping up to NPS 4.
(b) first four supports for piping NPS 5 to NPS 8

.3 Isolated, with acoustic barrier material, at anchors and guides within pipe shafts, duct shafts, equipment and fan rooms, and up to first anchor outside these rooms or areas.

.2 Where piping crosses building expansion joint

.1 provide spring hangers at first two support locations of piping at either side of joint line.

3.5 Start-up and set-up

.1 After installation of connections to resiliently mounted equipment;

.1 remove shims and blocking and adjust mountings to level equipment,

.2 adjust connections, hangers, snubbers, and restraints ,

.3 ensure that there is no physical contact between isolated equipment and building structure.

.2 On completion of installation and start-up of equipment;

.1 make arrangements for manufacturer/supplier of Vibration Isolation equipment to visit site, check performance of systems, inspect installation, adjust seismic restraints, and submit written recommendations,

.2 make corrections to installation in accordance with manufacturer/suppliers recommendations,

.3 provide notice 24 hours in advance of this site visit.

3.6 Testing

.1 Engage and pay for an experienced sound and vibration professional to take measurements of sound and vibration generated by HVAC systems.

.2 Co-operate with manufacturer/supplier of Sound Attenuation equipment in this measurement and testing.

.3 Sound measurements to extend over full audio frequency range and to be taken in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and main electrical rooms.

.4 Submit outline of tests to be performed, details of instrumentation to be used and floor plans showing test locations prior to commencing work.

.5 Provide notice one week in advance of commencement of tests.

.6 Submit complete report of tests addressing noise and vibration levels measured in occupied areas and adequacy of Sound Attenuation and Vibration Isolation equipment.

END OF SECTION

SEISMIC RESTRAINT
20 05 49

1 GENERAL

1.1 Scope

.1 Provide seismic restraint systems to limit movement of piping, ducts, conduits, bus ducts, cable trays and equipment.

.2 Provide design, selection and provision of materials, installation instructions, installation and inspection of seismic restraint of mechanical piping, ductwork, fire protection and equipment.

.3 The requirements under this Section are in addition to the requirements for equipment, piping and duct supports and vibration isolation specified in other Sections.

.4 Where specifications of materials of this Section differ from those in other Sections of Division 20, this Section governs, including but not limited to vibration isolation devices.

1.2 Systems

.1 Seismically restrain the following equipment and systems:

.1 Piping:

(a) medical gas, natural gas, vacuum, petroleum based liquids and compressed air, NPS 1 and larger,
(b) piping located inside of mechanical equipment and service rooms, NPS 1¼ and larger,
(c) all other piping NPS 2½ and larger.

.2 Fire protection piping – Sprinkler Systems:

(a) design and install systems in accordance with NFPA 13.

.3 Ductwork:

(a) rectangular and oval ductwork with cross sectional area 0.55 m^2 (6 ft^2) and greater,
(b) round ducts with diameters 710 mm (28 in) and larger.

.4 Electrical conduit:

(a) conduit 64 mm (2½ in) I.D. and larger,
(b) cable trays supporting conduit which is sized 64 mm (2½ in) I.D. and larger.

.5 Equipment:

(a) vibration isolated equipment,
(b) rigidly or gravity supported equipment.

1.3 Exemptions

.1 The following portions of systems do not require seismic restraint:

.1 piping suspended from hangers at a distance of 305 mm (12 in) or less, measured from the top surface of the pipe, to the underside of the supporting structure above,

.2 ductwork suspended by hangers at a distance of 305 mm (12 in) or less, measured from the top surface of the duct to the underside of the supporting structure above,

.3 electrical conduit or cable trays suspended by hangers at a distance of 305 mm (12 in) or less, measured from the top surface of the conduit / tray to the underside of the supporting structure above.

1.4 Applicable Codes and Standards

.1 Comply with the latest edition of the following:

.1 SMACNA - “Seismic Restraint Manual Guidelines for Mechanical Systems”

.2 NFPA 13 - “Installation of Sprinkler Systems”

.3 ASHRAE - “HVAC Applications, Seismic and Wind Restraint Design”

.4 Applicable Codes and Standards.

.2 Manufacturers Standardization Society of Valve and Fittings Industry (MSS):

.1 MSS SP-127 Bracing for Piping Systems Seismic - Wind - Dynamic Design, Selection, Application.

1.5 Design Criteria

.1 Design seismic restraint systems to conform to the Ontario Building Code for the project location.

.2 For Fire Protection systems constructed to NFPA 13, the horizontal force is:
F_p = “K” x W_p x 1.15, where W_p = weight of pipe and water

.3 For Fire Protection systems constructed to NFPA 13, the vertical uplift force is:

$F_v = 0.15 \times F_p$

.4 For all other pipework, and duct systems, the vertical uplift force is restrained by the systems as defined in the SMACNA standard.

1.6 Shop Drawings

.1 Submit shop drawings in accordance with Division 1.

.2 Submit test certificates for each seismic restraint device, identifying maximum tested load capacities.

.3 Submit calculations for each piece of restrained equipment, piping, ductwork and conduit, including seismic forces, restraint selection, and selection data.

.4 Provide a calculation analysis summary (spreadsheet is acceptable) for each piece of equipment, including the following information:

.1 Equipment ID

.2 Floor level

.3 Horizontal seismic force factor

.4 Equipment weight

.5 Horizontal seismic force

.6 Vertical uplift seismic force (where applicable)

.7 Equipment centre of gravity in three directions

.8 Design condition (worst case) overturning moment

.9 Number of restraint fastenings

.10 Pull-out tension per fastener

.11 Horizontal shear per fastener

.12 Pull-out tension load rating per fastener

.13 Horizontal shear rating per fastener.

.5 Include worst case combination of tension and shear loads at each snubber and restraint location.

.6 Include anchor bolt diameters, embedment depth, full welding details including type and length for field welds, and required housekeeping base dimensions.

.7 Calculations to be sealed by a Professional Engineer licensed in the province of Ontario.

1.7 Sample Materials

.1 None required.

1.8 Quality Assurance

.1 Pre-Construction meeting:

.1 Request and arrange a meeting with the Consultant to review seismic restraint approach, prior to any restraint installation. Obtain approval from the Consultant before commencing work.

.2 Testing and Review

.1 Install the first three lateral and three longitudinal braces for each of: each fire protection systems; one (1) building service piping system; and one (1) ductwork system.

.2 request and arrange for a review of the installation by the Consultant. Obtain approval of the installation before commencing remainder of the work.

.3 Provide services of the manufacturer's technical representative to conduct site inspections of the Work in progress, and to conduct a final inspection of the work. Provide a copy of the final inspection report to the Consultant for review.

.4 Request and arrange for a construction review by the Consultant of the completed seismic restraint installation, before any ceilings are installed.

2 PRODUCTS

2.1 Material

.1 Seismic restraint design and material supply

Standard of Acceptance
- Vibron/Kinetics Noise Control Inc.
- BVA
- VMC/Korfund
- Tecoustics
- Hilti

2.2 Seismic Snubber Restraints

.1 Type "SS1" – Single-Axis Limit Stop Snubber Assemblies:

.1 steel construction, attached to equipment structure and equipment, maximum of 6 mm (¼ in) seismic movement .

.2 designed to restrict movement in one axis.

.3 minimum 6 mm (¼ in) thick resilient neoprene pads to prevent metal-to-metal impact.

.4 minimum four (4) snubbers for each piece of equipment.

.2 Type “SS2 / SS3” – Multi-Axis Limit Stop Snubber Assemblies:

.1 interlocking steel construction, attached to equipment structure and equipment, maximum of 6 mm (¼ in) seismic movement .

.2 designed to restrict movement in two (2) or three (3) axis.

.3 minimum 6 mm (¼ in) thick resilient neoprene pads to prevent metal-to-metal impact.

.4 minimum two (2) snubbers for each piece of equipment.

2.3 Seismic Vibration Isolators

.1 Type “2-S” – All Direction Neoprene Isolator:

.1 molded, oil resistant neoprene compound, with encapsulated cast-in-place top steel load plate, and steel base plate with anchor holes

.2 designed for seismic loads in all directions with no metal-to-metal contact.

.2 Type “3-S” – Restrained Spring Isolator – Constant Load:

.1 colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm¼” neoprene pad.

.2 removable coil spring element without having to disturb supported equipment.

.3 lateral stiffness greater than 1.2 times rated vertical stiffness.

.4 minimum 50% overload capacity

.5 non-welded spring elements: epoxy coated, with a minimum 1000 hour rating when tested in accordance with ASTM B-117.

.6 steel housing design to limit lateral and vertical movement of the supported equipment.

.7 neoprene snubber, to limit maximum equipment movement in any direction to 6 mm¼”.

.8 adaptor base suitable sized for larger anchors, when required to suit anchorage capacity.

.3 Type “4-S” – Restrained Spring Isolator – Variable Load:

.1 colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm (¼ in) neoprene pad.

.2 removable coil spring element without having to disturb supported equipment.

.3 lateral stiffness greater than 1.2 times rated vertical stiffness.

.4 minimum 50% overload capacity

.5 non-welded spring elements: epoxy coated, with a minimum 1000 hour rating when tested in accordance with ASTM B-117.

.6 steel housing design to limit lateral and vertical movement of the supported equipment.

.7 top load plate with adjustable and leveling bolts.

.8 adjustable vertical restraints

.9 isolation washers

.10 bottom load plate with internal non-skid isolation pads and anchor holes

.11 hot dipped galvanized for outdoor installations.

.12 neoprene snubber, to limit maximum equipment movement in any direction to 6 mm (¼ in).

.13 adaptor base suitable sized for larger anchors, when required to suit anchorage capacity.

2.4 Piping and Ductwork Restraint

.1 Type “SCR” – Cable Restraints for Suspended Piping and Ductwork:

.1 manufactured system consisting of cable, building attachment, and vertical rod reinforcement assembly,

.2 field-built assemblies are not acceptable,

.3 steel wire strand cables:

(a) galvanized steel aircraft cable
(b) sized for seismic load with a safety factor of 2,
(c) arranged for restraint in both longitudinal and transverse directions.
(d) Rope connections: overlap wire “U” clips, or, tool-less wedge insert lock connectors.
(e) Connector strength rating equal to 90% of cable breaking strength rating.

.4 Building and equipment attachment brackets: designed to permit free cable movement in all directions up to a 45 degree misalignment:

(a) protective thimbles at sharp corners to protect against cable wear,
(b) Selected to exceed the cable working design load by 50%,
(c) Single sided “C” beam clamps are not acceptable.

.5 Vertical Suspension Rods:

(a) braced to avoid potential for buckling due to vertical up-lift forces,
(b) structural steel angle or formed channel brace selected to prevent support rod buckling,
(c) brace attached to support rod with a series of adjustable clips, without the use of hand-tools.

.2 Type “SRR” - steel angles or channels:

.1 sized for seismic load with a safety factor of 2,

.2 arranged for restraint in both longitudinal and transverse directions.

2.5 Rigidly Mounted Equipment Restraint

.1 Undercut or Heavy-Duty Sleeve type, for post concrete-cure installation:

.1 carbon steel bolt, nut and sleeve,

.2 selected for concurrent shear and tension loads with a safety factor not less than 2.0 x estimated load.

3 EXECUTION

3.1 General:

.1 Design seismic restraints to;

.1 keep equipment in place during and after seismic events in accordance with local building code,

.2 resist vertical loading simultaneously with transverse or longitudinal seismic loading .

.2 Give special consideration to design for adjacent connections, insulation treatment, thermal movement, vibration isolation, and relation to building seismic joints.

.3 Building structure attachments;

.1 concrete construction:

(a) cast in place anchor
(b) drill-in wedge anchor

.2 steel construction:

(a) double sided beam clamp, loaded perpendicular to beam, or
(b) specifically designed welded or bolted connection.

.3 single sided “C” type beam clamps for support rods for piping, ductwork, conduit, bus duct, cable trays or other equipment are unacceptable as seismic restraint anchor points.

.4 Brace installation;

.1 install cable restraints snug,

.2 install solid braces only in rigidly supported situations,

.3 brace hanger rods forming a part of seismic restraint to accept resulting compressive loads,

.4 transverse and longitudinal braces to be no more than 45° above or below centerline of pipe, duct, or tray.

.5 Equipment;

.1 equipment secured rigidly to wall, floor, or housekeeping pad to have resilient neoprene bushings and washers between equipment and anchor bolts.

3.2 Selection of Bracing Details

.1 Select application type;

.1 single hanger or

.2 trapeze support.

.2 Determine required force level, based on weight of equipment and specified factors.

.3 With required force level, develop transverse and longitudinal brace spacing for single or trapeze hanger in accordance with;

.1 break length into separate straight runs, which are considered to be single straight section between any bends except where bend is at an offset of less than 610 mm (2 ft),

.2 brace each straight run in transverse direction at both ends. Check required spacing for transverse bracing and compare it to the length of straight run. If length of straight run is greater than allowable distance for transverse bracing add transverse braces until spacing does not exceed allowable transverse brace distance,

.3 each straight run must have at least one longitudinal brace. Add longitudinal braces so that the spacing does not exceed allowable longitudinal brace spacing. Transverse brace may act as longitudinal brace for an adjacent run when it is located within 610 mm (2 ft) of adjacent straight run,

.4 where several short runs occur one after other, each straight run requires longitudinal brace when adjacent short runs exceed offset length of 610 mm (2 ft). When adjacent short runs do not exceed maximum offset length the longitudinal braces can act as transverse braces as long as allowable transverse brace spacing is not exceeded. Multiple offsets can be treated as single run when the total offset is less than maximum offset length,

.5 when flexible connection or swing joint is used, such as at pipe drop to mechanical equipment, pipe may cantilever at length equal to or less than half allowable transverse brace spacing. When

pipe drop cantilever is greater than half allowable transverse brace spacing, support to floor is required.

.4 Select brace anchorage detail.

.5 Calculate hanger rod load and select rod attachment to structure to suit.

.6 Check if rod stiffeners are required to prevent hanger rod from buckling under compressive load.

3.3 Installation

.1 Install seismic restraint devices in accordance with manufacturer's instructions.

.2 Install snubber devices only after equipment is installed and operating, to ensure no metal-to-metal contact.

.3 Seismic restraint manufacturer to provide training to the installation contractor on installation methods.

.4 Anchors on piping systems used for thermal expansion may be used as both a lateral and longitudinal restraint where they are designed for concurrent thermal and seismic loadings.

.5 Pipe and duct penetrations through floors are acceptable as lateral restraints, provided sleeves and fire stopping materials are installed correctly.

.6 Racked piping systems may have the rack braced (laterally, longitudinally, or combination thereof), provided each pipe supported by the rack is restrained to the rack.

.7 Each lateral or longitudinal brace must be secured to the building structure, and not any other building service.

.8 Pipe and duct penetrations through masonry and poured concrete wall partitions are acceptable as a lateral restraint, provided sleeves and fire stopping materials are installed correctly.

.1 Drywall partitions, including demountable partitions, are not to be used for lateral restraint.

3.4 Equipment Restraints - Floor Mounted Vibration Isolated Equipment

.1 Select basic vibration isolator as per Section 20 05 48.

.2 Select seismic restraint for each piece of equipment either:

.1 integrated seismic vibration restraint type 2-S, 3-S or 4-S, or

.2 vibration isolator as per 20 05 48 combined with seismic snubbers SS1, SS2 or SS3.

.3 Do not mix type of restraint on the same piece of equipment.

3.5 Equipment Restraints - Suspended Vibration Isolated Equipment

.1 Select basic vibration isolator as per Section 20 05 48.

.2 Provide hanger rod reinforcement.

.3 Provide SCR restraints in longitudinal and lateral directions.

.4 Do not include ductwork or piping restraints to restrain equipment.

3.6 Equipment Restraints - Rigidly Floor Mounted Equipment

.1 Anchor all floor mounted equipment with anchor bolts, minimum four bolts for rectangular equipment bases, and three bolts for circular equipment bases.

.2 For round equipment, such as expansion tanks with floor-support ring without mounting flanges, use type SS3 snubbers or custom seismic snubbers.

.3 Provide resilient neoprene bushings and washers between equipment and anchor bolt.

3.7 Equipment Restraints - Surface wall-mounted Equipment and Panels

.1 Select bolts for concurrent shear dead-weight without deduction for uplift load, and tension restraint load.

.2 In block-wall;

.1 up to three bolts, each bolt rated for 2.0 times estimated restraint load, or

.2 for four bolts or more, each bolt is rated for 1.0 times estimated concurrent load.

.3 In dry-wall;

.1 minimum of four self-tapping screws drilled into the studs, with each screw rated for 1.0 times estimated restraint load.

3.8 Equipment Restraints - Recessed wall-mounted Equipment and Panels

.1 Same as for surface mounted equipment, except fasten through top bottom and sides of panels to adjacent block wall or wall studs.

3.9 Piping, Ductwork and Conduit

.1 Provide restraint in accordance with the SMACNA guideline and manufacturers' instructions.

.2 Do not mix cable restraints and rigid bar restraints on the same piping or duct system, except:

.1 On piping or ductwork which is suspended on vibration isolators, use cable type SCR restraints and provide a small amount of slack in the cable to prevent vibration short-circuiting.

3.10 Manufacturer’s Services

.1 Review design drawings and specifications, and shop drawings.

.2 Provide design and selection of seismic restraints, and preparation of shop and installation drawings.

.3 Provide training of contractor personnel for the installation of seismic restraints.

.4 Conduct site inspections of the Work in progress, and to conduct a final inspection of the work. Provide a copy of the final inspection report to the Consultant for review, including photographs of representative installations of each type of restraint used in the Work.

END OF SECTION

IDENTIFICATION
20 05 53

1 GENERAL

1.1 Scope

.1 Provide equipment nameplates, piping and duct identification, and valve tags.

1.2 Shop Drawings

.1 Submit list of nameplates, with proposed wording, prior to engraving.

.2 Submit sample board with pipe and duct identification materials.

1.3 Applicable Codes and Standards

.1 Medical gas pipe marking: to CSA Z7396.1

2 PRODUCTS

2.1 General

.1 Manufactured identification systems:
- .1 laminated vinyl or polyester,
- .2 resistant to chemical, ultraviolet,
- .3 minimum operating temperature: -25°C (-12°F)
- .4 maximum operating temperature: 121°C (250°F)

Standard of Acceptance
- Brady - identification tapes, bands, and markers.
- Seton - Setmark Pipe Markers.
- Smillie McAdams Summerlin.
- Craftmark Identification Systems.

2.2 Equipment Identification Nameplates

.1 Identification plates are in addition to manufacturers plates.

.2 Identification plates:
- .1 provided for equipment identified with number designations in schedules and equipment selection sheets.
- .2 marked with equipment ID, service and power source using wording and numbering used in contract documents.

.3 Fabrication:
- .1 laminated plastic,
- .2 black lettering on white background for “Normal” power equipment
- .3 white lettering on red background for “Emergency” power equipment
- .4 minimum size 90 mm x 40 mm x 2.5 mm (3 in x 1½ in x ⅛ in),

.5 engraved with 10 mm (⅜ in) high lettering.

2.3 Piping Identification - Medical Gas Systems

.1 Self adhesive plastic marking tape:

.1 20 mm (¾ in) high, 75 mm (3 in) long, reversing text with integral arrow markers.

.2 width sized to overlap minimum 12 mm (½ in)

.3 text and field colour in accordance with CSA Z7396.1

.4 To CGA and NFPA

2.4 Piping Identification

.1 Flexible coil-wrap manufactured markers:

.1 plastic coated markers with integral printing, or plastic cover with field applied self-adhesive markers,

.2 applicable WHIMS pictogram for identification of material hazard.

2.5 Ductwork Identification

.1 Paint stencilled letters 25mm (1 in) high showing;

.1 duct service,

.2 fan number, and

.3 arrows showing direction of flow,

2.6 Valve and Steam Trap Identification

.1 Brass valve tags or plastic lamacoid:

.1 brass with stamped numbers and letters filled with black enamel,

.2 plastic lamacoid with black lettering on a white background,

.3 brass or stainless steel chain or S-hook,

3 EXECUTION

3.1 Equipment Identification

.1 Locate nameplates to be easily read.

.2 Do not paint over equipment manufacturer or field installed nameplates.

.3 Fasten securely with mechanical fasteners.

.4 Provide standoffs on insulated equipment.

.5 Examples:

.1 at equipment (fan, pump, etc.):

F-1
Auditorium Supply Fan

.2 at motor starter, adjustable frequency drive, and separate local disconnect:

P-3
Condenser Water Pump
Fed from PDP-12-1

3.2 Piping Identification - Except for Non-Medical Gas Systems

.1 Provide manufactured tape markers:

.1 self-adhesive type:

(a) indoor uninsulated piping,
(b) indoor insulated piping with PVC or smooth metal jackets,

.2 flexible coil-wrap:

(a) outdoor piping,
(b) indoor insulated piping with canvas or embossed metal jackets.

.3 Install markers on cleaned and prepared surfaces free of dirt and oil.

.2 Locations:

.1 maximum every 15 m (50 ft) along length of pipe, except for medical gas, natural gas and fuel oil,

.2 maximum every 6 m (20 ft) along length of pipe for natural gas and fuel oil,

.3 within 1 m (3 ft) of each side of barriers, floors and walls,

.4 within 1 m (3 ft) of and behind access doors ,

.5 within 1 m (3 ft) of piping termination point.

3.3 Piping Identification - Medical Gas Systems

.1 Provided identification markings on medical gas systems:

.1 maximum every 6 m (20 ft) along length of pipe,

.2 before and after barriers, floors and walls,

.3 at each valve,

.4 behind access doors ,

.5 inlet and outlet points including vents.

3.4 Ductwork identification

.1 Paint stencilled letters 25mm (1 in) high showing;

.1 duct service,

.2 fan number, and

.3 arrows showing direction of flow,

.2 Locations:

.1 exposed ducts,

.2 concealed ducts next to access doors, and

.3 throughout length of ducts at intervals not exceeding 15 m (50 ft).

.3 Stencil indication on prepared surfaces, and locate on both sides of any penetration.

3.5 Valve Identification

.1 Provide every valve on job with a numbered tag showing valve type and size, attached to valve stem or wheel handle with non-ferrous chain or S-hook.

.1 Valve identification is not required at the following valves:

(a) inside fire hose cabinets,
(b) radiation heating units, unit heaters, or fixture stops,
(c) within site of equipment or apparatus they control provided there is no branch piping between valve and equipment served.

.2 Identification information:

.1 indicating service, sequential valve number by service or specific equipment ID for control valves, location identifier, purpose of valve, valve type and size.

.2 valve type designation:

(a) **B** (ball valve), **GT** (gate valve), **GL** (globe valve), **CBV** (circuit balancing valve), **BF** (butterfly valve).

.3 valve size:

Domestic Cold Water #12
Riser C-1
Service Valve - B2

(a) for valve size, use NPS designation.

.4 examples:

(a) domestic cold water riser isolating valve, sequence number 12, located near column C-1, NPS 2 ball valve:

(b) hot water terminal reheat supply valve, sequence number 57, located in a corridor and not in site of equipment served, circuit balancing valve NPS 3/4:

Reheat Supply #57
Room 2-254
Balancing Valve - CBV ¾

(c) automatic control valve used for pressure balancing the system, with an equipment schedule ID of CV-15, and is globe style NPS 3:

Constant Pressure Differential Valve
CV-15
Automatic Control Valve - GL 3

.3 Provide a tag schedule for each system, designating number, service, function, size, and location of each tagged item and normal operating position of each valve.

.4 Submit two copies of valve tag schedules, encased in clear plastic, bound in vinyl covered, hardbacked 210 mm x 297 mm (8½ in x 11 in) three ring binders

3.6 Steam Trap Identification

.1 Provide every trap on job with an identifying tag, attached to trap with non-ferrous chain or S-hook.

.2 Identification information:

.1 indicating service, sequential trap number by service, trap type and size.

.2 trap type designation:

(a) **B** (bucket), **F&T** (float and thermostatic), **TH** (thermostatic), **TD** (thermodynamic), **BF** (butterfly valve).

.3 trap size:

(a) use NPS designation.

.4 examples:

(a) 700 kPa steam system, trap # 23, bucket style, NPS 2 size.

S-700-23 B2

.3 Include trap tag schedule for each system, designating number, type, function, location, size, selection pressure differential, capacity at selected differential, manufacturer and model number of each trap, and identifying numbers of associated traps in bank where redundant trapping is provided.[

.4 Submit two copies of trap tag schedules, encased in clear plastic, bound in vinyl covered, hardbacked 210 mm x 297 mm (8½ in x 11 in) three ring binders.

3.7 Pipe and Valve Identification Classification

END OF SECTION

DUCTWORK INSULATION
20 07 16

1 GENERAL

1.1 Scope

.1 Insulate and finish ducts, casing, and plenums;

.1 provide insulation, sealer coatings, finishes, and mechanical protection.

.2 insulation is not required on factory insulated and/or and acoustically lined ductwork except as otherwise shown.

1.2 Quality

.1 Manufacturers and products are listed in this Section to establish quality and manufacturing standards. Products from other manufacturers with explicitly similar characteristics may be acceptable but must be submitted as an alternative product submission.

1.3 Qualifications

.1 Provide insulation and covering by recognized specialist applicator with an established reputation for this type of work.

Standard of Acceptance
- Custom Insulation Systems
- Guaranteed Insulation Ltd
- White & Greer Co Ltd
- Dewpoint Insulation Systems

1.4 Sample Boards

.1 Submit sample assembly of each type of insulation and covering. Mount samples on PVC coroplast board with typewritten label beneath each sample indicating service and material specification.

.2 Include samples of vapor barrier installation including coatings (indoors), mastics (outdoors), reinforcing membranes, on a square surface sample minimum 300 mm x 300 mm (12 in x 12 in).

1.5 Material test criteria

.1 Insulation, adhesives, coatings, finishes, sealers, and tapes:

.1 maximum flame spread rating of 25 to CAN/ULC-S102,

.2 maximum smoke developed rating of 50 to CAN/ULC-S102.

.3 Exception: vapor barrier mastics installed outside of building.

1.6 Applicable codes and standards

.1 Material and method of application to comply with or be tested in accordance with following Standards;

.1 Thermal Insulation Association of Canada (TIAC) National Insulation Standard, excluding section 12

.2 NFPA 90-A Installation of Air-Conditioning and Ventilating Systems

.3 ASHRAE/IES 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

.4 NFPA 255 Test of Surface Burning Characteristics of Building Materials

.5 CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies

.6 ASTM C411 Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation

.7 ASTM C518 Standard Test Method for Steady State Thermal Transmission Properties by Means of Heat Flo Meter Apparatus

.8 ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

.9 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

.10 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation

.11 ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.12 ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.13 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation

.14 CGSB 51-GP-52MA Vapour Barrier, Jacket and Facing Material for Pipe, Duct, and Equipment Thermal Insulation.

.15 CGSB 51.53-95 Poly(Vinyl Chloride) Jacket Sheeting, for Insulated Pipes Vessels and Round Ducts.

1.7 Definitions

.1 In this Section;

.1 “**Ambient”**: as applied to temperatures means outdoor design temperature.

.2 "**Concealed**": as applied to mechanical services and equipment located in space above opaque suspended ceilings, and within trenches not in boiler rooms, pipe and/or duct shafts, and non-accessible chases and furred spaces.

.3 “**Ductwork”:** as applied to this section includes ducts, fans, supply unit casings, and plenums.

.4 "**Exposed":** as applied to remainder of mechanical services and equipment which are not "concealed" as defined above. For greater certainty, the following locations are Exposed:

(a) Services in tunnels,
(b) Services in space beneath raised floors,
(c) Trenches located in boiler rooms,
(d) Outdoors.

.5 “**Conditioned air**”: air supplied from air handling units which heats, cools, dehumidifies, or humidifies the air.

.6 “**Unconditioned space**”: rooms or spaces that are not supplied with conditioned air, including ceiling spaces which are not part of a ceiling return plenum system

.7 “**Outdoor**”: mechanical services and equipment located outside of the building envelope including services located beneath overhangs and soffits, and exposed to any outdoor condition including temperature, sun exposure, or precipitation.

.8 “**Mastic**”: heavy-consistency waterproof compound for outdoor applications used in conjunction with reinforcing fabric that remains adhesive and generally pliable with age, to provide either a breathable or vapour barrier finish to insulation.

.9 "**Coating**": light-consistency compound for indoor applications used in conjunction with reinforcing fabric, to provide either a breathable or vapour barrier finish to insulation.

.10 **"Finish Jacket"**: final finish protective layer for insulation, including lagging fabric, PVC, metal, and adhesive films; that provides weather-protective finish depending on application.

.11 "**Service temperature"**: for purpose of ductwork temperature, is equal to the design operating temperature.

2 SUBMIT MANUFACTURER PRODUCT DATA SHEETS AND MSDS SHEETS WHICH IDENTIFY COMPLIANCE WITH THIS VOC CONTENT LIMIT. PRODUCTS

2.1 Adhesives, Fasteners, and Tape

.1 Contact bond cement:

.1 for quick setting for metal surfaces.

.2 Volatile Organic Content: maximum 80 g/L.

Standard of Acceptance
- Bakor - No. 220-05
- Foster – Drion 85-75

.2 Adhesive for flexible closed cell foam insulation:

.1 Volatile Organic Content: maximum 80 g/L.

Standard of Acceptance
- Armaflex 520BLV
- Armaflex Low VOC Spray Contact Adhesive
- Rubatex R-373

.3 Lap seal adhesive:

.1 for joints and lap sealing of vapour barriers.

.2 Volatile Organic Content: maximum 250 g/L.

Standard of Acceptance
- Bakor 220-05
- Childers CHIL-STIX FRN CP-82

.4 Fibrous insulation adhesive:

.1 Volatile Organic Content: maximum 250 g/L.

Standard of Acceptance
- Childers CHIL-STIX FRN CP-82
- Foster No. 85-70

.5 Vapour barrier tape:

.1 colour matched and foil faced

.2 UL 181A listed.

Standard of Acceptance
- Johns Manville - Zeston Z-Tape
- MacTac Canada Limited - Vinyl Scrim or Foil Scrim Kraft

- Compac Corp.
- Fattal Canvas Inc. - Insultape

.6 Weld Pins, Studs and Clips

Standard of Acceptance
- Midwest Fasteners
- Continental Studwelding

.7 Staples

.1 Monel, flare type, minimum size 12 mm (½ in).

.8 Tie Wire

.1 1.6 mm (16 ga) stainless steel with twisted ends.

.9 Caulking for sheetmetal jackets (outdoor use only)

.1 fast-drying, aluminum colour finish, flexible butyl elastomer based vapour barrier sealant.

Standard of Acceptance.
- Foster 95-44

2.2 Coatings and Membranes

.1 Reinforcing Membrane:

.1 synthetic fibre:

(a) Leno weave,
(b) indoor and outdoor use.

Standard of Acceptance
- Foster Mast-A-Fab

.2 glass-fibre fabric:

(a) indoor use.

Standard of Acceptance
- Childers Chil-Glas #5/#10

.3 glass-fibre fabric for use with elastomeric closed cell foam:

(a) indoor use.

Standard of Acceptance
- Childers Chil-Glass #10

.2 Breather Coating - Indoors:

.1 for breather coatings and lagging adhesive,

.2 Volatile Organic Content: maximum 50 g/L.

.3 white in colour,

Standard of Acceptance
- Childers CP-50A HV2
- Foster 30-36

.3 Vapor Barrier Coatings - Indoors:

.1 Volatile Organic Content: maximum 50 g/L.

.2 for vapor barrier coatings and lagging adhesive except for elastomeric closed cell foam,

(a) permeance rating 0.02 perms maximum,
(b) white in colour

Standard of Acceptance
° Childers Chil Perm CP-34/35
° Foster 30-80, 30-90

.3 for use with elastomeric closed cell foam.

Standard of Acceptance
° Childers CHIL-SPRAY WB CP-56 Adhesive

2.3 Insulation Cement

.1 Hydraulic-setting finishing type.

2.4 Field Applied Finishes

.1 Fabric finish jacket:

.1 ULC listed plain weave cotton fabric at 220 g/m2 (6 oz/sq yd), treated with fire retardant lagging adhesive, or

.2 re-wettable fiberglass lagging fabric with water activated self-adhesive.

.3 suitable for field painting.

Standard of Acceptance
° Fattal's Thermocanvas
° Alpha-Maritex 3451-RW
° Clairmont Diplag 60
° Glass-Cell FR
° Newtex - Zetex Rewettable

.2 Protective finish for elastomeric cellular foam insulation

.1 indoors and outdoors:

Standard of Acceptance
° Armaflex WB Finish

2.5 Ductwork Insulation

.1 Type D-1 glass fibre blanket:

.1 to ASTM C1290

.2 service temperature: up to 121°C (250°F)

.3 flexible blanket,

.4 FSK jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.

.5 noncombustible,

.6 thermal performance: R = 0.74 m^2 °C/W @ 24°C (4.2 btu ft^2 °F /Btu @ 75°F)

.7 density: 12 kg/m^3 (0.75 pcf)

.8 vapor transmission : maximum 0.02 perms

Standard of Acceptance

- John Manville Microlite XG Duct Wrap
- Owens Corning SOFTR Duct Wrap
- Knauf Fibreglass Friendly Feel Duct Wrap

.2 Type D-2 glass fibre board:

.1 to ASTM C612,

.2 service temperature: up to jacket surface temperature (air contact) up to 66°C (150°F) and un-jacketed surface temperature (equipment contact) up to 232°C (450°F).

.3 rigid for flat surfaces or,

.4 scored board for curved surfaces 250 mm (10 in) dia and over,

.5 jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn,

.6 thermal performance: 0.033 W/m/C @ 24°C (0.23 btu/hr/in/sq ft/F @ 75°F),

.7 vapor transmission: maximum 0.02 perms

.8 density: 48 kg/m3 (3.0 lb/cu ft),

.9 suitable for jacket surface temperature (air contact) up to 66°C (150°F) and un-jacketed surface temperature (equipment contact) up to 232°C (450°F).

Standard of Acceptance

- Johns Manville - Manville 814 Spin-Glas
- Owens Corning - 703 Board
- Knauf Fiberglass - Insulating Board

.3 Type D-3 flexible elastomeric closed cell foam:

.1 to ASTM C534,

.2 service temperature: up to 82°C (180°F).

.3 sheet self-adhering, roll type,

.4 thermal performance: 0.04 W/m/C @ 24°C (0.28 btu/hr/in/sq ft/F @ 75°F),

.5 manufacturer specific sealer/adhesive.

Standard of Acceptance

- Armstrong - AP Armaflex Self-Adhering Sheet Insulation
- Rubatex

.4 Type D-4 low temperature phenolic board:

.1 to ASTM C1126 (Gr.1),

.2 service temperature: -73ºC to+121ºC (-100ºF to 250ºF).

.3 rigid for flat surfaces,

.4 meeting 25/50 flame spread/smoke development when tested to ASTM E84,

.5 thermal performance: 0.021 W/m/Cº@ 10ºC (0.145 btu/hr/in/sq ft/Fº @ 50ºF),

.6 density: 37 kg/m3 (2.3 Ib/cuft),

Standard of Acceptance

- Kingspan - Koolphen K

3 EXECUTION

3.1 Insulation Limits

.1 Externally insulate air handling system components:

.1 Conditioned air with cooling coils: supply unit casings and plenums, and free standing supply fans for both recirculating and non-recirculating type systems,

.2 Conditioned air with heating only: supply unit casing and plenums, free-standing supply fans, and supply air ducts and plenums up to the space served but not in the space itself,

.3 Conditioned air supply ducts including downstream of reheat coils,

.4 un-conditioned supply air ducts and plenums that pass through unheated rooms or spaces,

.5 the first 300 mm (12 in) length of acoustically lined ductwork,

.6 return air ducts and plenums in unheated spaces,

.7 exhaust air ducts and plenums in unheated spaces,

.8 exhaust air ducts between exhaust air damper and point of discharge to outside of building,

.9 outside air intake ducts and plenums;

(a) for non-recirculating type ventilation systems without cooling coils, terminate plenum or casing insulation 300 mm (12 in) downstream of final heating coil,

.10 mixed air plenums and ducts;

(a) for recirculating type ventilation systems without cooling coils, terminate outside air intake insulation 300 mm (12 in) downstream of mixing plenum,

.11 sheet metal blank-off plates behind unused sections of air intake louvres.

.2 Externally insulate ductwork located outdoors:

.1 supply ducts.

.2 conditioned supply ducts.

.3 return ducts,

.4 exhaust ducts,

(a) excluding fan discharge duct,

.5 kitchen exhaust ducts with more than 3 m (10 ft) length of duct on roof.

(a) excluding fan discharge duct.

.3 External insulation is not required on:

.1 casings, ducts or plenums which have been lined with acoustic insulation, except as described above,

.2 free standing unconditioned supply fans, supply ducts and plenums,

.3 portions of intake ducts or plenums, unit casings and conditioned air plenums which are of double wall insulated construction,

.4 pre-insulated flexible ducts.

.5 factory insulated air handling units.

3.2 General Requirements

.1 Insulate ductwork in accordance with Table 1 at the end of this section.

.2 Store and use adhesives, mastics, and insulation cements at ambient temperatures and conditions recommended by product manufacturers.

.3 Surfaces to be clean and dry before application of insulation. Apply insulation after pressure and leakage testing is completed and accepted.

.4 Place insulation with joints staggered and tightly butted, with no visible gaps.

.5 Neatly finish insulation at supports, protrusions, and interruptions.

.6 Seal exposed insulation with reinforced vapor barrier or breather coating/mastic as shown.

.7 Finish ductwork with field installed finish jackets as shown.

3.3 Application

.1 Rigid insulation - fans, ducts, and casing:

.1 overlap horizontal boards over vertical boards, and butt edges tightly together.

.2 impale insulation on weld pins, studs, and clips at 300 mm (12 in) centres in both directions, with not less than 2 rows per side and bottom.

.3 secure insulation laps with mechanical fasteners (staples).

.2 Rigid insulation - outside air duct and plenums - glass fibre:

.1 as above for fans, ducts, and casings, and;

(a) apply first layer of insulation without integral vapour barrier,
(b) apply second layer of insulation with integral vapour barrier with staggered joints.

.3 Rigid insulation - outside air duct and plenum - phenolic board:

.1 as above for fans, ducts, and casings, but with only one layer of insulation board.

.4 Rigid insulation - exhaust air plenums:

.1 as above for fans, ducts, and casings.

.5 Flexible insulation:

.1 overlap insulation 50 mm (2 in) on each lap joint, and butt end edges tightly together,

.2 on rectangular ducts 600 mm (24 in) and wider, and round ducts 450 mm (18 in) and wider;

(a) secure insulation to the underside of duct with weld pins, studs, and clips at 300 mm (12 in) centres in both directions, with not less than 2 rows per side and bottom,
(b) secure insulation laps with mechanical fasteners (staples),
(c) for round ductwork, the underside of duct is measured as being half the circumference of the duct.

.6 Flexible elastomeric:

.1 wrap tightly onto ductwork and drain pans, and secure with 100% adhesive coverage.

.2 on round ducts, overlap insulation 50 mm (2 in) on each lap joint, and butt end edges tightly together,

.7 Cover angles or standing seams on the outside of plenums, casings and ducts which extend beyond face of applied rigid insulation;

.1 with same material and thickness as adjacent ductwork,

.2 extend this insulation 75 mm (3 in) on each side of the angle and place tight around the projecting leg of the angle.

.3 apply rigid insulation overlapping edge of flexible insulation on angle so that outstanding part of insulated angle projects through work.

.8 Cut and mitre rigid insulation at elbows and fittings and attach to ductwork with 50% coverage of adhesive, and mechanical fasteners with weld pins, speed clips and washers.

.9 Attach speed washers when insulation has been placed on metal pins and cut off excess pin length flush with speed washer. Cover washers with vapour barrier tape.

.10 At junctions between external insulation and acoustic insulation, overlap external insulation 300 mm (12 in) over acoustic lining.

.11 Outdoor rectangular and flat-oval ductwork:

.1 build-up and slope insulation on top of ductwork to provide a 1:100 drainage slope,

.2 where width of ductwork exceeds 600 mm (24 in), slope insulation in both directions.

3.4 Sealing Insulation

.1 Hot ducts, casings, and plenums - Indoors:

.1 service temperature: 20°C to 65°C (70°F - 150°F)

.2 apply vapour barrier tape to butt joints, overlapping my minimum 50 mm (2 in) each side,

.3 do not tape lap joints.

.2 Cold or dual temperature ducts, casings, and plenums - Indoors:

.1 service temperature: Ambient to 20°C (Ambient to 70°F)

.2 apply reinforced vapor barrier coating to all corners, lap edges and butt edges, overlapping joint by minimum 50 mm (2 in) each side,

.3 cover mechanical fastener (staple) penetrations with reinforced vapour barrier coating

.4 insulate flanges and standing seams with overlapping strips of flexible insulation, and cover with reinforced vapour barrier coating.

.3 Apply mastics and coatings when ambient temperature is above 4°C (40°F), unless manufacturer's instructions permit colder ambient installation conditions.

3.5 Insulation Finish

.1 Install protective finish on insulation in accordance with Table 2 at the end of this Section, after breather and vapor barrier sealing is completed.

.2 Install finish jacket materials used for covering to allow 50 mm to 100 mm (2 in to 4 in) overlap on longitudinal and circumferential edges.

.3 Fabric:

.1 Cotton lagging:

(a) apply cotton lagging with minimum two coatings of breather or vapor barrier coating adhesive as applicable to the duct system, and finish to provide a smooth surface free of wrinkles and sags.
(b) where cotton lagging with appropriate coating is used this satisfies the requirements of a sealer coating for Hot or Cold/Dual temperature ducting systems.

.2 Fibreglass lagging:

(a) apply re-wettable fibreglass lagging in accordance with manufacturer instructions. Finish to provide a smooth surface free of wrinkles and sags.
(b) where re-wettable fiberglass lagging is used this satisfies the requirements of a breather sealer coating for Hot piping systems.

.4 Flexible elastomeric closed cell foam insulation:

.1 apply thin coat of lagging adhesive, and apply glass mesh,

.2 when dry apply indoor or outdoor finish at 400 square feet per gallon,

.3 apply second coat of same material, at same rate of application, after four hours.

3.6 Mechanical Damage Protection - Indoors

.1 Protect exposed insulated ductwork from floor level up to 1200 mm (4 ft) above floor with 1.2 mm (18 ga) stainless steel jacket, secured to floor slab.

.2 Do not overlap fire damper slip joint with protective sheeting.

3.7 Field Quality Control

.1 The Consultant reserves the right to have protective finish coverings removed on up to 5% of all fittings and flanges to review the sealing of the insulation, at no change in cost.

.2 If insulation sealing is found to be incorrect at any one location, remove the protective finish on all fittings and flanges for review.

.3 Repair defective sealing and replace protective coverings at no change in cost.

3.8 Insulating and Finishes Tables

.1 Tables 1, and 2 follows.

Table 1 : Ductwork and Plenum Insulation Type and Thickness mm (in)			
Nominal Surface Temperature	**Equipment Description**	**Insulation Type**	**Insulation Thickness**
5°C to 65°C (40F to 150F)	Supply unit casings and plenums Free standing supply fans Rectangular, exposed Rectangular, concealed	D-2	25 (1)
	Rectangular, concealed Round and Oval, exposed Round and Oval, concealed	D-1	38 (1-1/2) *note (1)*
Ambient to 65°C (Ambient to 150F)	Plenums and Casings - Air Intake	D2	Two layers each 50 (2)
		D4	75 (3)
	Plenums and Casings - Exhaust	D2	50 (2)
		D4	38 (1-1/2)
	Rectangular - Outdoor - Supply	D2	50 (2)
	Rectangular - Outdoor - Return Rectangular - Outdoor - Exhaust	D2	38 (1-1/2)
	Round - Outdoor	D3	Two layers each 25 (1)
	Drain pans	D3	20 (3/4)

Note (1): thickness is “out of box” before installation.

Table 2 : Ductwork Insulation Protective Finishes			
Location	**Weather Exposure**	**System/Space**	**Finish**
Concealed	Indoors	All	None
Exposed	Indoors	Service Rooms	Fabric
	Indoors	Public Spaces	Fabric
	Outdoors	All	N/A

END OF SECTION

PIPING INSULATION
20 07 19

1 GENERAL

1.1 Scope

.1 Insulate and finish piping, valves, fittings, and pipeline accessories.

.1 provide insulation, coatings, finishes, and mechanical protection.

.2 Provide fire rated insulation on piping as shown, including fire protection standpipes.

.1 coordinate with the contractor under Division 21 for location and extent of standpipes to be protected.

1.2 Related Work

.1 The following Work is specified in other Section of Division 20:

.1 supply of insulation shields for cold and dual temperature piping:

.2 provision of welded saddles for hot piping.

1.3 Quality

.1 Manufacturers and products are listed in this Section to establish quality and manufacturing standards. Products from other manufacturers with explicitly similar characteristics may be acceptable but must be submitted as an alternative product submission.

1.4 Qualifications

.1 Provide insulation and covering by recognized specialist applicator with an established reputation for this type of work.

Standard of Acceptance
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- White & Greer Co Ltd
- Dewpoint Insulation Systems

1.5 Sample Boards

.1 Submit sample assembly of each type of insulation and covering. Mount samples on PVC coroplast board with typewritten label beneath each sample indicating service and material specification.

.2 Include samples of vapor barrier installation including coatings (indoors), mastics (outdoors), reinforcing membranes, on a sample of a pipe butt joint and one elbow.

1.6 Material test criteria

.1 Insulation, adhesives, coatings, finishes, sealers, and tapes:

.1 maximum flame spread rating of 25 to CAN/ULC-S102,

.2 maximum smoke developed rating of 50 to CAN/ULC-S102..

.2 Exception: vapor barrier mastics installed outside of building.

1.7 Applicable codes and standards

.1 Material and method of application to comply with or be tested in accordance with following Standards;

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.3 ASHRAE/IES 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

.4 NFPA 255 Test of Surface Burning Characteristics of Building Materials

.5 CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies

.6 ASTM C411 Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation

.7 ASTM C518 Standard Test Method for Steady State Thermal Transmission Properties by Means of Heat Flo Meter Apparatus

.8 ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

.9 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

.10 ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation

.11 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation

.12 ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.13 ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.14 ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

.15 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation

.16 CGSB 51-GP-52MA Vapour Barrier, Jacket and Facing Material for Pipe, Duct, and Equipment Thermal Insulation.

.17 CGSB 51.53-95 Poly(Vinyl Chloride) Jacket Sheeting, for Insulated Pipes Vessels and Round Ducts.

1.8 Definitions

.1 In this Section;

.1 “**Ambient”**: as applied to temperatures means outdoor design temperature.

.2 "**Concealed**": as applied to mechanical services and equipment located in space above opaque suspended ceilings, and within trenches not in boiler rooms, pipe and/or duct shafts, and non-accessible chases and furred spaces.

.3 "**Exposed"**: as applied to remainder of mechanical services and equipment which are not "concealed" as defined above. For greater certainty, the following locations are Exposed:

(a) Services in tunnels,
(b) Services in space beneath raised floors.
(c) Trenches located in boiler rooms.

.4 "**Conditioned air**": air supplied from air handling units which heats, cools, dehumidifies, or humidifies the air.

.5 "**Unconditioned space**": rooms or spaces that are not supplied with conditioned air, including ceiling spaces which are not part of a ceiling return plenum system

.6 "**Outdoor**": mechanical services and equipment located outside of the building envelope including services located beneath overhangs and soffits, and exposed to any outdoor condition including temperature, sun exposure, or precipitation.

.7 "**Mastic**": heavy-consistency waterproof compound for outdoor applications used in conjunction with reinforcing fabric that remains adhesive and generally pliable with age, to provide either a breathable or vapour barrier finish to insulation.

.8 "**Coating**": light-consistency compound for indoor applications used in conjunction with reinforcing fabric, to provide either a breathable or vapour barrier finish to insulation.

.9 **"Finish Jacket"**: final finish protective layer for insulation, including lagging fabric, PVC, metal, and adhesive films; that provides weather-protective finish depending on application.

.10 "**Service temperature"**: for purpose of piping temperature, is equal to the gas or vapour design operating temperature, or the liquid supply operating temperature.

.11 "**Pure water"**: water which has been treated with filtration equipment, including but not limited to reverse osmosis, deionization, ultra-filtration, ultra-violet, distillation or any combination of such or similar equipment, to achieve water quality significantly free of impurities.

2 PRODUCTS

2.1 Adhesives, Fasteners, and Tape

.1 Contact bond cement:

.1 for quick setting for metal surfaces.

.2 Volatile Organic Content: maximum 80 g/L.

Standard of Acceptance
- Bakor - No. 220-05
- Foster – Drion 85-75

.2 Adhesive for flexible closed cell foam insulation:

.1 Volatile Organic Content: maximum 80 g/L.

Standard of Acceptance
- Armaflex 520 BLV
- Armaflex Low VOC Spray Contact Adhesive
-

.3 Lap seal adhesive:

.1 for joints and lap sealing of vapour barriers.

.2 Volatile Organic Content: maximum 250 g/L.

Standard of Acceptance
- Bakor 220-05
- Childers CHIL-STIX FRN CP-82

.4 Fibrous insulation adhesive:

.1 Volatile Organic Content: maximum 250 g/L

Standard of Acceptance
- Childers CHIL-STIX FRN CP-82
- Foster No. 85-70

.5 Vapour barrier tape:

.1 colour matched and foil faced

.2 UL 181A listed.

Standard of Acceptance
- Johns Manville - Zeston Z-Tape
- MacTac Canada Limited - Vinyl Scrim or Foil Scrim Kraft
- Compac Corp.
- Fattal Canvas Inc. - Insultape

.6 Weld Pins, Studs and Clips:

Standard of Acceptance
- Midwest Fasteners
- Continental Studwelding

.7 Staples:

.1 Monel, flare type, minimum size 12 mm (½ in).

.8 Tie Wire:

.1 1.6 mm (16 ga) stainless steel with twisted ends.

2.2 Coatings and Membranes

.1 Reinforcing Membrane:

.1 synthetic fibre:

(a) Leno weave,
(b) indoor and outdoor use.

Standard of Acceptance
- Foster Mast-A-Fab

.2 glass-fibre fabric:

(a) indoor use.

Standard of Acceptance
- Childers Chil-Glas #5/#10

.3 glass-fibre fabric for use with elastomeric closed cell foam:

(a) indoor use.

Standard of Acceptance
- Childers Chil-Glass #10

.2 Breather Coating - Indoors:

.1 for breather coatings and lagging adhesive,

.2 Volatile Organic Content: maximum 50 g/L

.3 white in colour,

Standard of Acceptance
- Childers CP-50A HV2
- Foster 30-36

.3 Vapor Barrier Coatings - Indoors:

.1 Volatile Organic Content: maximum 50 g/L.

.2 for vapor barrier coatings and lagging adhesive except for elastomeric closed cell foam,

(a) permeance rating 0.02 perms maximum,
(b) white in colour

Standard of Acceptance
- Childers Chil Perm CP-34/35
- Foster 30-80, 30-90

.3 for use with elastomeric closed cell foam.

Standard of Acceptance
- Childers CHIL-SPRAY WB CP-56 Adhesive

2.3 Insulation Cement

.1 Hydraulic-setting finishing type.

2.4 Field Applied Finishes

.1 PVC (Polyvinyl Chloride) finish jacket:

.1 minimum 20 mil thickness with permeability not more than 0.09 perms,

.2 fitting covers, one or two piece, pre moulded,

.3 glass-fibre insulation inserts for elbows, tees, valves, end-caps, mechanical pipe couplings,

.4 self sealing longitudinal joints.

Standard of Acceptance
- Johns Manville - Manville Zeston 2000
- ACWIL Insulations
- Sure Fit Systems
- Proto PVC - LoSMOKE

.5 pressure sensitive, colour matching vinyl tape.
- Newtex - Zetex Rewettable

.2 Metal finish jacket:

.1 straight pipe, duct or plenum:

(a) stucco embossed aluminum not less than 0.45 mm (0.016 in) thick sheet or,
(b) corrugated stainless steel not less than 0.25 mm (0.010 in) thick sheet.

.2 fittings:

(a) Custom made swaged ring or lobster back covers on bends and die shaped fitting covers over fitting, valves, strainers, flanges, and grooved couplings.

.3 bands:

(a) 12 mm (½ in) wide stainless steel with mechanical fasteners.

Standard of Acceptance
- Alcan Canada Products - Thermaclad Type 1
- Childers Products Inc. - Fab Straps

.3 Protective finish for elastomeric cellular foam insulation

.1 indoors and outdoors:

Standard of Acceptance
- Armaflex WB Finish

2.5 Pipe Insulation

.1 Type P-1 molded glass fibre:

.1 to ASTM C547,

.2 pipe size application: up to and including NPS 24:

.3 service temperature: -18°C (0°F) to jacket surface temperature (air contact) of 66°C (150°F) and un-jacketed surface temperature (equipment contact) up to 232°C (450°F).

.4 factory molded rigid pipe insulation,

.5 ASJ jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.

.6 self sealing longitudinal jacket with integral vapour barrier, and matching butt joint sealer strips.

.7 noncombustible,

.8 thermal performance: 0.033 W/m/C @ 24°C (0.23 btu/hr/in/sq ft/F @ 75°F)

.9 vapor transmission : maximum 0.02 perms

.10 reduced environmental impact feature of either: bio-based binders, 25% minimum recycled glass content, and/or paper-free ASJ jacket material.

Standard of Acceptance
- John Manville Micro-Lok HP (25% recycled content)
- Owens Corning Fiberglas Evolution (paper-free ASJ)
- Knauf Fiberglass Redi-Klad 1000 Ecose (bio-based binders)

.2 Type P-2 glass fibre semi-rigid board:

.1 to ASTM C795,

.2 pipe size application: NPS 16 and larger:

.3 service temperature: up to 454°C (850°F)

.4 scored and folded board,

.5 ASJ jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn, maximum 0.02 perms to ASTM E96 Procedure A.

.6 noncombustible,

.7 thermal performance: 0.050 W/m/C @ 93°C (0.35 btu/hr/in/sq ft/F @ 200°F)

.8 vapor transmission : maximum 0.02 perms

Standard of Acceptance
- John Manville Spin-Glas 813
- Owens Corning Pipe and Tank

- Knauf Fibreglass Pipe and Tank

.3 Type P-3 flexible elastomeric closed cell foam:

.1 to ASTM C534,

.2 pipe size application: up to and including NPS 1-1/2

.3 service temperature: -183°C (-297°F) to 82°C (183°F)

.4 tubular with self sealing seams,

.5 thermal performance: 0.04 W/m/C @ 24°C (0.28 btu/hr/in/sq ft/F @ 75°F),

.6 manufacturer specific sealer/adhesive.

Standard of Acceptance
- ARMACELL - AP Armaflex SS Pipe Insulation
- Rubatex

.4 Type P-4 molded phenolic rigid:

.1 to ASTM C1126 (Gr.1),

.2 pipe size application: up to and including NPS 16

.3 service temperature: -73ºC to +121ºC (-100ºF to 250ºF).

.4 molded pipe, fitting, and hanger supports,

.5 meeting 25/50 flame spread/smoke developed when tested to ASTM E84,

.6 thermal performance: 0.019 W/m/Cº@ 24ºC (0.13 btu/hr/in/sq ft/Fº @ 75ºF),

Standard of Acceptance
- Kingspan - Kooltherm K/Kooltherm

.5 Type P-5 cellular glass:

.1 to ASTM C552,

.2 pipe size application: up to and including NPS 16

.3 service temperature: -268°C (-450°F) to 480°C (900°F)

.4 density 120 kg/m3 (7.5 lb/cu ft),

.5 molded or block type,

.6 thermal performance: 0.043 W/m/C @ 0°C (0.32 btu/hr/in/sq ft/F @ 75°F).

Standard of Acceptance
- Pittsburgh Corning Foamglas

.6 Type P-6 calcium silicate:

.1 to ASTM C533,

.2 pipe size application: up to and including NPS 16

.3 service temperature: to 649°C (1200°F).

.4 density 232 kg/m3 (14.5 lb/cu ft),

.5 molded or block type,

.6 asbestos-free,

.7 thermal performance: 0.058 W/m/C @ 149°C (0.40 btu/hr/in/sq ft/F @ 300°F),

Standard of Acceptance
- Industrial Insulation Group - Thermo-12/Blue

.7 Type P-7 molded mineral wool fibre:

.1 to ASTM C547,

.2 pipe size application: up to and including NPS 30,

.3 service temperature: up to 650°C (1200°F),

.4 rigid molded type,

.5 thermal performance: 0.04 W/m/C @ 50°C (0.25 btu/hr/in/sq ft/F @ 100°F),

Standard of Acceptance
- Roxul Techton 1200
- Fibrex Coreplus 1200 Pipe Insulation

.8 Type P-8 molded mineral wool fibre high temperature:

.1 to ASTM C547,

.2 pipe size application: up to and including NPS 30

.3 service temperature: up to 730°C (1350°F),

.4 rigid moulded type,

.5 thermal performance: 0.04 W/m/C @ 50°C (0.25 btu/hr/in/sq ft/F @ 100°F),

Standard of Acceptance
- Roxul SturdiRock
- Fibrex Dura K Pipe Insulation

.9 Type P-9 removable/reuseable high temperature insulated jackets:

.1 custom fabricated, removable insulation covers for hot surfaces,

.2 suitable for outdoor use,

.3 maximum touch-safe temperature protection : 95°C (203°F) to UL2200.

.4 insulation: high density, fire resistant mineral or fibreglass insulation suitable for system operating temperature.

.5 cover: silicone impregnated fibreglass cover, for temperatures up to 260°C (500°F).

.6 internal liner: silicone impregnated fibreglass fabric, or stainless steel knitted wire mesh.

.7 single piece construction

.8 metal identification tag, referenced equipment served.

.9 tie-straps with D-rings, or Velcro™ closures.

Standard of Acceptance
- Firwin Corporation
- Thermohelp Canada Inc.

.10 Type P-11 molded phenolic rigid pipe support inserts:

.1 molded pipe hanger supports on cold and dual temperature piping,

.2 to ASTM C1126 (Gr.1),

.3 pipe size application: up to NPS 24

.4 service temperature: -73ºC to+121ºC (-100ºF to 250ºF).

.5 meeting 25/50 flame spread/smoke developed when tested to ASTM E84,

.6 density: 120 kg/m^3 (7.5 lb/ft^3)

Standard of Acceptance
- Kingspan - Kooltherm K/Kooltherm High Density
-

3 EXECUTION

3.1 General Requirements

.1 Apply insulation after pressure and leakage testing is completed and accepted, and heat tracing is installed.

.2 Surfaces to be clean and dry before application of insulation.

.3 Store and use adhesives, mastics, and insulation cements at ambient temperatures and conditions recommended by product manufacturers.

.4 Do not apply insulation on chrome plated surfaces of piping, valves, fittings, and equipment.

.5 Cut and bevel insulation around nameplates and pressure vessel stamps.

.6 Neatly finish insulation at supports, protrusions, and interruptions.

.7 Seal exposed insulation with reinforced vapor barrier or breather coating or mastic.

.8 Finish piping with field installed finish jackets as specified herein.

3.2 Hot Piping Systems Insulation

.1 Insulate hot piping systems including pipe, valves, fittings, and pipeline accessories in accordance with Table 1 at the end of this Section.

.2 Insulate Condensate piping to the same criteria as its associated steam system.

.3 Insulate Safety Relief valve piping located between floor or elevated work surface and up to 2400 mm (8 ft) above same, and passing within 1200 mm (4 ft) of a floor or elevated work surface.

3.3 Cold and Dual Temperature Piping Systems Insulation

.1 Insulate cold and dual temperature piping systems including pipe, valves, fittings, and pipeline accessories in accordance with Table 2 at the end of this Section.

.2 For drainage systems insulate:

.1 storm water roof drain body,

.2 storm water piping from roof drain body to the floor level of the story below the drain body,

(a) and within operating rooms

.1 sanitary piping in the following locations,

(a) All within operating room
(b) horizontal sanitary drainage piping NPS 3 and larger in ceiling spaces,

(c) exposed sanitary drainage piping in wet areas including sterile processing, dishwashing, cart-washing
(d) exposed sanitary drainage piping in IT/Data rooms,
(e) exposed sanitary drainage piping in service tunnels
(f) exposed sanitary drainage piping serving spaces located above a parking garage open to the outdoors,
(g) and where shown on drawings

.3 For greater clarity, domestic hot water, domestic hot water recirculating, non-potable hot water, and non-potable hot water recirculating piping systems are treated as “cold and dual temperature” for the purpose of application of vapor barriers to both hot and cold domestic and non-potable water piping.

3.4 Piping

.1 Insulate straight pipe sections by staggering adjacent longitudinal seams 1/4 turn each butt joint.

.2 Secure insulation at centre of each section, at each end, and at not more than 600 mm (2 ft) intervals with:

.1 vapor barrier tape in addition to jackets with self-adhering lap joints for type P1 and P2 insulation on Cold and Dual Temperature piping,

.2 mechanical fastened (stapled) or jackets with self adhering lap joints on type P1 and P2 insulation on Hot piping,

.3 bands or wire for type P4 to P8 insulation,

.4 self-adhered or provide 100% coverage of contact adhesive for type P3 insulation,

.5 in accordance with listing requirements for type P10 insulation.

3.5 Fittings, Flanges, Couplings, and Strainers

.1 Insulate fittings including elbows and tees:

.1 NPS 1½ and smaller:

(a) mitre cut insulation to create tight fit,
(b) for PVC cover, trim backside of insulation on elbows to suit cover but do not reduce total thickness less than that of adjacent pipe insulation.

.2 NPS 2 and larger:

(a) use matching preformed insulation inserts, or fabricate mitred insulation segments made from same material as pipe insulation,
(b) number of mitred segments to be sufficient to maintain thickness of insulation around throat of elbow,
(c) secure inserts and fabricated segments with wire prior to application of coatings or finishes.

.2 Insulate flanges and grooved joint couplings:

.1 Insulate with preformed inserts or build-up insulation with same material as on adjacent pipe:

(a) butt pipe insulation to each side of flange, coupling, valve, or strainer,
(b) build up rigid insulation blocking on each side of fitting, coupling, valve or strainer, with a width dimension same as pipe insulation thickness, and
(c) apply insulation layer over outside of flange, coupling, valve or strainer to a thickness equal to pipe insulation thickness.
(d) provide removable insulation section on strainer head.

.2 Where phenolic insulation is used;

(a) same as above except use factory made insulation inserts, or fabricate inserts to suit fixture.

.3 Where elastomeric insulation is used;

(a) same as above except adhere insulation to flange, coupling, or strainer with full coverage of °C adhesive,
(b) do not adhere insulation across bolted connections - insulate on each side of connection and add additional insulation layer across connection and fix in place with bands.

3.6 Pipeline Accessories

.1 Insulate pipeline accessories:

.1 valves

.2 strainers

.3 pressure reducing valves

.4 safety valves

.5 meters

.6 steam separators

.2 Insulate accessories for Hot Piping systems with design temperatures greater than 93°C (200°F):

.1 [where located within 2100 mm (7 ft) above a floor or work surface

.2 with type P-9 removable fitted insulation covers,

.3 allow free movement of valve actuator.

.3 For pipe sizes NPS 1 and smaller, no insulation is required on pipeline accessories for Hot Piping systems with design temperatures of 93°C (200°F) or less.

.4 Insulate accessories for Cold and Dual Temperature Piping systems for chilled water and liquid refrigerant piping:

.1 detachable insulated box type with embossed aluminum or stainless steel jacket, with vapor barrier tape applied to seams when installed,

(a) lined with two layers of 25 mm (1 in) P3 elastomeric blanket or one layer of 25 mm (1 in) thick P-4 phenolic insulation, with no voids at corners or joints,

.2 at locations requiring access, extend insulation to create collar around bolted connection, and install a compression fit piece of insulation to cover equipment.

.5 Insulate accessories for all other Cold and Dual Temperature Piping systems:

.1 insulate with flexible blanket of same material and thickness of adjacent piping and seal with reinforced vapor barrier sealer.

.2 at locations requiring access including valve handles, valve actuators, drain valves, etc. cut-back insulation and seal exposed edges.

3.7 Drainage Systems - Additional Requirements

.1 Insulate underside of roof drain hoppers with flexible blanket insulation of same type as pipe insulation.

3.8 Cold and Dual Temperature Pipe Insulation Systems - Additional Requirements

.1 Insulate pipe anchor plates and frames with flexible elastomeric closed cell foam insulation blanket of type P-3 insulation and seal with vapour barrier coating.

.2 Extend insulation along anchor steel a minimum distance of 150 mm (6 in) outside the piping insulation thickness.

3.9 Hangers and Supports

.1 Provide insulation protection in accordance with Table 3 at the end of this Section, based on pipe size and service process temperature.

.2 Pipe saddle insulation protection:

.1 insulate the interior void spaces of pipe saddles, of same material as adjacent pipe insulation,

.2 butt insulation up to sides and end of pipe saddle, and leave bottom surface of saddle exposed for direct contact with pipe support.

.3 Pipe shield insulation protection:

.1 install insulation shield between outside of insulation and pipe support; pipe support is sized for outside dimension of insulation.

.2 in accordance with pipe size, provide high density insulation insert of same thickness as adjacent pipeline material, fabricated from:

(a) cold and dual temperature piping: type P-11 (phenolic),
(b) hot piping: type P-11 (phenolic),.
(c) 300 mm (12 in) long for pipe size up to NPS 3, and
(d) 450 mm (18 in) long for pipe sizes NPS 4 and larger.

3.10 Floor and Wall Sleeves

.1 Extend pipe insulation including coatings and finishes through floor and wall sleeves.

.2 For penetrations through fire rated separations, provide finishes in accordance with fire stopping manufacturer's listing requirements.

.3 For outdoor piping passing through exterior walls or roof, terminate mastic lagging at outside face of sleeve and protected by storm flashing, caulked to lagging and to building structure.

3.11 Sealing Insulation

.1 Apply coatings and mastic in accordance with manufacturer requirements.

.1 Hot piping: breather coating/mastic

.2 Cold and Dual Temperature piping: vapor barrier coating/mastic

.2 Only use mastics on outdoor installations.

.3 Apply mastics and coatings when ambient temperature is above 4°C (40°F), unless manufacturer's instructions permit colder ambient installation conditions.

.4 Hot Piping;

.1 seal lap joints with self-adhesive lap joint, reinforced breather coat, or vapour barrier tape,

.2 seal butt joints with matching vapour barrier tape.

.5 Cold and Dual Temperature Piping;

.1 tightly seal insulation with factory applied all-purpose jacket using self-adhering or field applied adhesive on longitudinal laps and butt joint.

(a) where sealing strips are damaged, apply secondary layer of colour matched vapor barrier tape.

.2 seal insulation without factory applied jackets with 100% coverage of vapor barrier coating/mastic as applicable complete with reinforcing membrane.

.3 seal insulation butt ends with vapor barrier coating every four (4) lengths of insulation but not to exceed 2400 mm (8 ft) of pipe length.

.6 Hanger high-density insulation inserts:

.1 seal inserts with reinforced breather or vapour barrier coating as applicable, overlapping adjacent insulation a minimum of 50 mm (2 in).

.7 Elbows, tees, flanges, and fittings;

.1 Apply applicable breather or vapor barrier coating/mastic with reinforcing membrane over fitting insulation and overlap 50 mm (2 in) onto adjacent pipe insulation.

(a) for greater clarity, use of vapor barrier tape to seal insulation is not permitted.

.2 Apply coating/mastic and reinforcing membrane regardless of final finish application.

.8 Maintain integrity of vapor barrier through sleeves, around fittings and at hangers and supports.

3.12 Insulation Finish Coverings

.1 Install protective finish coverings on insulation in accordance with Table 4 at the end of this Section, after breather and vapor barrier sealing is completed.

.2 Cut finish jacket materials used for covering to allow 50 mm to 100 mm (2 in to 4 in) longitudinal overlap and similar circumferential overlap onto adjacent sheets.

.1 On vertical pipes arrange circumferential overlap on adjacent sheets outside of sheet below and under sheet above.

.3 PVC sheeting :

.1 Hot piping:

(a) overlap longitudinal edges and adjacent sheets by minimum of 50 mm (2 in) and staple fasten the sheets.
(b) secure sheeting with colour matched tape around circumference, at least two places per section of sheet, and by stapling longitudinal and circumferential edges.
(c) do not seal edges with vapour barrier tape.
(d) seal PVC fitting covers at throat and heel seams by stapling and secure over insulation by banding or taping ends to adjacent pipe finish covering with colour matched tape.

.2 Cold and Dual Temperature piping:

(a) overlap longitudinal edges and adjacent sheets by minimum of 50 mm (2 in) and seal longitudinal edges with vapor barrier coating adhesive for full depth and 100% coverage of overlap,
(b) seal circumferential edges of PVC fitting covers with reinforced vapour barrier coating adhesive extending over adjacent pipe insulation section with an overlap of at least 50 mm (2 in).
(c) seal PVC fitting covers at throat and heel seams by solvent bonding and secured over insulation with reinforced vapor barrier coating/mastic overlapping adjacent pipe insulation a minimum of 50 mm (2 in).

.4 Metal:

.1 Use lock-on systems or secure sheeting with bands 450 mm (18 in) apart.

.2 Joint sealing:

(a) Hot pipe: do not seal joints.
(b) Cold and dual temperature pipe: seal joints with caulking.

.3 Curved surfaces: custom made swaged ring or lobster back covers.

.4 On outdoor hot and cold/dual temperature piping, caulk overlapping metal joints to permit expansion of metal jacket.

3.13 Mechanical Damage Protection - Indoors

.1 Protect exposed pipe insulation extending up through a floor sleeve at floor line with 1.2 mm (18 ga) stainless steel jacket approximately 100 mm (4 in) high, secured to floor slab. Conceal fastenings by floor plate.

.2 For piping systems using metal finishes, this protection cover replaces a portion of the specified pipe cover.

.3 For piping systems using other finishes, this protection cover is in addition to the specified pipe cover.

3.14 Fire rated pipe Insulation

.1 Provide two (2) hour rating of type P-10 insulation on tube or pipe, where shown.

.2 Install insulation, including pipe hangers, in accordance with fire-rated insulation manufacturer's listing requirements.

3.15 Field Quality Control

.1 The Consultant reserves the right to have protective finish coverings removed on up to 5% of all fittings, flanges, couplings, valves, and pipeline accessories to review the sealing of the insulation, at no change in cost.

.2 If insulation sealing is found to be incorrect at any one location, remove the protective finish on all fittings, flanges, couplings, valves, and pipeline accessories for review.

.3 Repair defective sealing and replace protective coverings at no change in cost.

3.16 Insulating and Finishes Tables

.1 Table 1, 2 and 3 follows.

Table 1 : Hot Piping Systems, Insulation Type and Thickness mm (in)

System	Fluid Nominal Temp. °C (F)	Insulation Type	Nominal Pipe Size (NPS)				
			< 1	1 to 1¼	1½ to 3	4 to <8	≥ 8
			Insulation Thickness, mm (in)				
Steam and Condensate > 860 kPa (125 psi)	≥177 (351)	P-6 P-7	65 (2½)	75 (3)	75 (3)	100 (4)	100 (4)
Steam and Condensate > 100 kPa (15 psi) and ≤ 860 kPa (125 psi)	122 to 176 (251 to 350)	P-1 P-2 P-6 P-7	50 (2)	65 (2½)	75 (3)	90 (3½)	90 (3½)
Steam and Condensate ≤ 100 kPa (15 psi) High temperature hot water heating	94 to 121 (201 to 250)	P-1 P-2 P-7	38 (1½)	38 1(½)	50 (2)	50 (2)	90 (3½)
		P-4	20 (3/4)	20 (3/4)	25 (1)	38 (1½)	38 (1½)
Hot Water Heating Glycol Heating	61 to 93 (141 to 200)	P-1 P-7	38 (1½)	38 (1½)	38 (1½)	38 (1½)	38 (1½)
Pumped Condensate		P-4	20 (3/4)	25 (1)	25 (1)	25 (1)	25 (1)
Low Temperature Hot Water Heating	40 to 60 (105 to 140)	P-1	25 (1)	25 (1)	25 (1)	38 (1½)	38 (1½)
Low Temperature Glycol Heating		P-4	20 (3/4)	20 (3/4)	20 (3/4)	25 (1)	25 (1)

Table 2 : Cold and Dual Temperature Piping Systems, Insulation Type and Thickness mm (in)

System	Fluid Nominal Temp. °C (F)	Insulation Type	Nominal Pipe Size (NPS)				
			< 1	1 to 1¼	1½ to 3	4 to <8	≥ 8
			Insulation Thickness, mm (in)				
Dual Temperature Heating/Cooling	4.4 to 93 (40 to 200)	P-1	38 (1½)	38 (1½)	38 (1½)	38 (1½)	38 (1½)
Domestic Hot Water Domestic Hot Water Recirculation	40.5 to 60 (105 to 140)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	38 (1 ½)
Domestic Cold Water	4.4 to 16 (40 to 60)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	50 (2)
Drainage		P-4	---	---	---	25 (1)	25 (1)
Equipment Drains	4.4 to 16 (40 to 60)	P-3	13 (1/2)	20 (3/4)	25 (1)	---	---
Chilled Water	4.4 to 16 (40 to 60)	P-1	25 (1)	25 (1)	38 (1 ½)	38 (1 ½)	50 (2)
		P-4	25 (1)	25 (1)	25 (1)	25 (1)	25 (1)
Refrigerant Suction	< 4.4 (< 40)	P-3	25 (1)	25 (1)	25 (1)	---	---
		P-4	25 (1)	25 (1)	25 (1)	25 (1)	25 (1)

Table 3 : Insulation Hanger Protection				
Process Temperature °C (F)	Pipe Size NPS	Pipe Saddle	Insulation Shield	High-Density Insert
> 93 (200)	≥ 1-1/2	●	---	---
	≤ 1-1/4		●	---
61 to 93 (141 to 200)	> 6	●	---	---
	≥ 1-1/2 and ≤ 6	---	●	●
	≤ 1-1/4	---	●	---
26 to 60 (80 to 140)	≥ 1-1/2	---	●	●
	≤ 1-1/4	---	●	---
Cold & Dual Temp	≥ 1-1/2	---	●	●
	≤ 1-1/4	---	●	---

Table 4 : Piping Insulation Protective Finishes			
Location	Weather Exposure	Piping System	Finish
Concealed	Indoors	All	None
Exposed	Indoors	All except steam over 860 kPa (125 psig)	PVC
	Indoors	Steam over 860 kPa (125 psig)	Metal
	Indoors - painted pipe	All	Fabric
	Outdoors	All	Metal

END OF SECTION

START-UP AND PERFORMANCE TESTING REPORTING
20 08 01

1 GENERAL

1.1 Scope

.1 Performance testing and balancing of heating, ventilating, air conditioning and liquid systems.

.2 Survey of installed automatic controls and verification of functional performance.

.3 Measuring and reporting space acoustic(noise) levels.

.4 Measuring and reporting vibration isolation equipment.

.5 Rechecking of testing and balancing during the alternate (heating/cooling) season.

1.2 Related work in other sections

.1 Air and water balancing: to section 20 08 05

.2 Acoustic measurement: to section 20 08 06

.3 Vibration measurement to section 20 08 13

.4 Commissioning: to section 20 08 15

.5 Factory testing, and calibrating of equipment or control systems

1.3 Related work in other contracts

.1 Air and water balancing

1.4 Coordination

.1 Coordinate the work of testing companies:

.1 Schedule sufficient time so that testing and balancing can be completed before occupancy begins and coordinate with trades involved.

.2 Keep Testing and Balancing firm informed of any major changes made during construction and furnish same with a set of project drawings and reviewed Shop Drawings.

.3 Furnish balancing devices, test connections access openings, balancing probe inlets and plugs.

.4 Clean and pre-run all equipment, filters, etc. and place all heating, ventilating and air conditioning systems into full operation and continue same during each working day of testing and balancing.

.5 Provide immediate labour from pertinent mechanical trades and tools, equipment and materials to make equipment and system alterations and adjustments, as required including control adjustments.

.6 Building Management System technical representative to operate the BMS during air and water balancing testing.

.7 Refrigeration machine manufacturer service representative conducts performance testing of the refrigeration equipment. Testing and Balancing Firm witnesses and records all test results.

.8 Fuel fired heating equipment manufacturer service representative, or other qualified service company technical representative, conducts performance testing of heating equipment. Testing and Balancing Firm witnesses and records all test results.

.2 Be responsible for systems constructed, installed and adjusted to provide optimum performance as required by design intent. Perform any re-adjusting required as the result of spot checks by the Consultant at no increase in Contract Price.

1.5 Submittals

.1 Submit layout drawings and Report Format a minimum 14 days prior to start of air and water balancing on-site.

.2 Report Format:

.1 submit proposed format of initial report,

.2 include a complete list of instruments and tests for which they are to be used as they relate to this project, including date of last calibration

2 PRODUCTS

2.1 Not applicable.

3 REPORT FORMAT

3.1 General

.1 Include the following information for each test report:

.1 Owner Name

.2 Project Name

.3 Contractor Name

.4 Consultant Name

.5 Name of Test Report

.6 Name and signature of the person submitting the report

.7 Date of report

.2 Submit two (2) copies of test reports in hardcopy form in 3-“D” ring binders, indexed for each type of report, separately bound from the Operations and Maintenance manuals. Provide two (3) copies of the same reports in Adobe Acrobat version 7 PDF forma.

4 START-UP AND PERFORMANCE REPORTS

4.1 Required reports

.1 Provide the following Start-Up and Performance Testing reports:

.1 Equipment start-up report

.2 Authorities report

.3 Air and water balancing report

.4 Acoustic survey report

.5 Vibration survey report

.6 Controls / BMS operation report

.7 Alternate Season test report

4.2 Equipment start-up report

.1 Provide a test report in spreadsheet format which summarizes the following data for each piece of equipment which is powered or has automatic controls:

.1 equipment ID and name,

.2 motor insulation megger test - result and initialed by contractor,

.3 motor rotation (bump test) - result and initialed by contractor,

.4 equipment Start-Up report status - status and initialed by contractor,

.5 M\manufacturer Start-Up report status – status and initialed by contractor,

.6 test completion date.

.2 Provide a test report in spreadsheet format which summarizes the following data for testing of piping systems:

.1 system name

.2 system limits (if system is not tested in its entirety),

.3 type of test (pneumatic, hydrostatic),

.4 pressure at start of test,

.5 pressure at end of test,

.6 duration of test,

.7 contractor dated and initialed,

.8 expansion tank initial pressure,

.9 expansion tank final pressure,

.10 backflow preventers have been tested - status and initialed by contractor,

.11 pressure relief valves installed – record setpoint and initialed by contractor.

.3 Equipment/System Start-Up Test Report

.1 Provide a separate start-up report for each piece of the following equipment. The SMACNA “Systems Ready to Balance Check List”, where applicable, may be used for this report.

(a) HVAC Units
(b) Duct Systems
(c) Refrigeration Equipment

.4 Manufacturer’s Start-Up Test

.1 Provide a separate start-up report for each piece of the following equipment, utilizing the manufacturer’s start-up check list. This report may be prepared by the manufacturer’s service representative:

(a) refrigeration equipment,
(b) packaged AC equipment,
(c) adjustable frequency drives,
(d) Building Automation Systems.

4.3 Authorities review

.1 Submit copies of authorities-having-jurisdiction inspection and test reports, including:

.1 Plumbing and drainage municipal inspector reports

.2 TSSA pressure vessel and piping inspection reports

.3 ESA field certification reports

4.4 Air and water balancing

.1 Provide air and water balancing report : to Section 20 08 05.

4.5 Alternate season testing

.1 Provide alternate season test report: to Section 20 08 05.

4.6 Acoustic survey

.1 Provide acoustic survey test report: to Section 20 08 06.

4.7 Vibration survey

.1 Provide vibration survey test report: to Section 20 08 13.

4.8 Controls / Building Management System

.1 Provide controls test reports: to Section 25 08 00.

5 SPECIFIC EQUIPMENT PERFORMANCE TESTS

5.1 Performance data

.1 In addition to tests specified elsewhere, perform the following equipment performance tests. If contractor's standard forms provide for additional data, also submit such additional data.

.1 Some equipment tests may need to be performed during the alternate season testing.

.2 Include nameplate data and as-tested results.

6 REPORT SUBMISSIONS

6.1 Deficiencies

.1 Immediately report to Consultant, any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.

6.2 Draft report

.1 On completion of the start-up, testing, adjusting and balancing of all systems, submit to the Consultant, two (2) typewritten copies of a full report on all tests, adjustments, and balancing performed.

.2 Attachments including systems schematics with numbered terminals for referring to data above.

6.3 Spot checks

.1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 30% of all measurements in locations as directed by the Consultant, at no cost extra to the contract.

.2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.

6.4 Interim report

.1 After completion of any retesting described above, submit three (3) typewritten copies of the interim report, in a 3-hole “D” style binder, and two (2) CD or DVD electronic copies in Adobe Acrobat ver.7 PDF format.

.2 This report is required to obtain Substantial Performance of the Contract.

6.5 Final report

.1 Submit to Consultant following completion of alternate season testing and balancing

6.6 Acceptance

.1 The Substantial Performance of the Mechanical Work will be considered reached when the interim Start-Up and Performance Testing report is reviewed by the Consultant and in the opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.

.2 The substantial performance is not dependent upon alternate season testing.

.3 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and reviewed by the Consultant.

END OF SECTION

TESTING ADJUSTING AND BALANCING
20 08 05

1 GENERAL

1.1 Scope

.1 Test, adjust, and balance (TAB) air handling systems and hydronic systems installed, modified or extended as part of this work.

.2 Rechecking of testing and balancing during alternate heating/cooling season.

.1 Alternate season testing is for both the re-furbished AHU in Level 3 Mechanical Room and glycol chiller on grade outside.

1.2 Qualifications and performance standards

.1 Balancing to be performed under supervision of recognized expert with an established reputation in this field.

.1 TAB contractor to be a member of AABC or NEBB.

Standard of Acceptance (no alternatives)

° Air & Water and Precision Balancing – Matthew Crittenden matt@awpbgroup.com – 647-896-5353

.2 Perform testing and balancing in accordance with:

.1 SMACNA Testing, Adjusting and Balancing guidelines,

.2 Associated Air Balancing Council standards for Total System Balance..

1.3 Preparatory work

.1 Review design drawings and specifications, shop drawings, interference drawings and other related documentation to become familiar with their intended performance.

.2 Carry out site visits during later stages of construction to ensure that arrangements for TAB are incorporated.

.3 Confirm proper placement of thermometer wells, test ports, pressure gauge cocks, balancing valves, balancing dampers and splitter dampers, and access doors.

.4 Submit TAB schedule, with descriptive data outlining procedures and sample forms showing method of data presentation, three months before start of TAB work on site.

.5 Provide details of specific procedures to be used for determining test parameters from test measurements and criteria proposed to establish compliance with specification requirements.

.6 List instruments to be used, method of instrument application (by sketch) and correction factors.

.7 Calibrate instruments in accordance with recognized standards, and submit calibration curves not more than three months before commencement of TAB.

.8 TAB measurements to commence when building is “closed in” and work is sufficiently advanced to include;

.1 Installation of ceilings, doors and windows.

.2 Application of sealing, caulking, and weather stripping.

.3 Normal operation of mechanical systems.

1.4 Systems, equipment and related controls requiring TAB

.1 Air handling systems.

.2 Hydronic systems including

.1 Heating and cooling equipment and piping systems.

.2 Domestic water equipment and cold, hot and recirculation hot water piping systems.

2 AIR MOVING SYSTEMS

2.1 Parameters

.1 Listed below is an outline of the information to be established in the TAB process:

.1 Air flow related;

(a) Air velocity
(b) Flow cross sectional area.
(c) Static pressure.
(d) Velocity pressure.

.2 Temperature related;

(a) Wet bulb.
(b) Dry bulb.

.3 Equipment related;

(a) rotational speed (rpm)
(b) Electrical power,
(c) Voltage.
(d) Current draw.

.2 Measurement are required at and around equipment to establish air side performance of;

.1 Fans.

.2 Coils.

.3 Filters.

.4 Dampers.(fresh, return and relief)

.5 Humidifiers.

.6 Terminal units

.3 Measurement are required to characterize system performance;

.1 at main ducts.

.2 at branch ducts.

.3 at sub-branch ducts.

.4 at each supply, exhaust and return air inlet and outlet.

.5 in each thermostatically controlled zone.

2.2 General criteria

.1 Balance systems so that fans operate at lowest possible speed and static pressure consistent with delivery of specified air quantity at most remote terminal point.

.2 Set-up supply fans with sufficient speed to deliver required air quantity when filters are loaded to manufacturers recommended maximum pressure drop. Temporarily block filters to achieve maximum pressure drop at design air flow.

.3 Air quantities at each exhaust system inlet and supply system outlet are to be measured and throw and pattern is to be adjusted at each supply outlet.

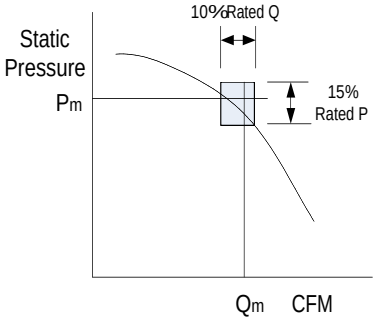
2.3 Fan performance assessment

.1 Measure air quantity by taking anemometer traverses across a coil or at a filter bank or by pitot tube traverse in a straight section of duct at fan suction or discharge.

.2 Measure static pressure difference between fan inlet and discharge, motor amperage and fan speed in rpm. Determine motor input power from a curve showing power output as a function of motor amperage for the particular motor.

.3 Plot results of measurements on fan characteristic curve supplied by fan manufacturer and the air volume, static pressure and fan speed lines should form a triangle enclosed by a rectangle with a dimension of not more than 15% of the rated static pressure by a dimension of not more than 10% of the specified air quantity. Input power taken from the fan characteristic should be within 10% of the power determined from the motor amperage readings.

.4 If required precision is not obtained, readings to be repeated. If subsequent testing shows that the required precision is unobtainable then fan manufacturer is to submit written report explaining actual fan performance and provide new characteristic curve showing actual performance for fan “as installed”.



.5 Measure static pressure loss across cooling coils, heating coils and individual filter banks and tabulate readings with manufacturers published pressure loss figures for the actual measured air volume.

2.4 Variable volume system balancing procedure

.1 Obtain from Consultant the expected diversity value. Open sufficient boxes to 100%, and close a random selection of boxes, equally distributed throughout the system, to obtain the design fan flow rates.

.2 Set system to operate with 100% return air, set room thermostats at design indoor temperature, set fan discharge temperature at design point.

.3 Set thermostat in most remote zone to full cooling and adjust fan inlet guide vane, or AFD speed, static pressure control to supply specified air quantity at most remote zone volume damper, pneumavalve or terminal box.

.4 Reset most remote zone thermostat to design room temperature and set next most remote zone thermostat to full cooling and adjust branch splitter damper ahead of zone volume damper, pneumavalve or terminal box, to provide design air quantity at outlets.

.5 If zone air quantity is less than design, increase fan inlet guide vane, or AFD speed, static pressure control setting to achieve design air quantity and rebalance previously checked zones.

.6 Repeat as required for each zone.

2.5 Mixed constant volume and variable volume balancing procedure

.1 Same procedure as for all VAV system except as follows:

.1 Boxes which are constant volume are to be selected and set for 100% design airflow.

.2 Balance the constant volume boxes first, then the VAV boxes are per the procedure described above.

2.6 Terminal box supply system balancing procedure

.1 Set system to operate with 100% return air, set room thermostats at indoor design temperature and set fan discharge temperature at design value.

.2 Set thermostat in most remote zone to full cooling and adjust fan inlet guide vane static pressure controller to maintain manufacturer's specified minimum static pressure at box inlet.

.3 Check air quantity delivered by box and adjust volume regulators to obtain design value.

.4 Reset room thermostat to full heating and check performance of regulator.

.5 Reset thermostat to design temperature and repeat procedure for remaining terminal boxes.

.6 If inlet static pressure at a subsequent box is less than manufacturer's specified minimum, reset inlet guide vane static pressure controller to suit.

.7 Open balancing dampers and adjust fan inlet static pressure controllers, or fan speed to obtain design air quantity at most remote outlet.

.8 Balance remaining outlets by adjusting dampers.

.9 If air quantity at some outlet other than the most remote outlet is less than design, re-adjust fan and rebalance previously adjusted outlets.

.10 Measure fan performance and adjust fan speeds and inlet guide vane controllers so that return air quantity is equal to supply air quantity less fixed exhaust air quantities, with a 10 percent allowance for pressurization.

2.7 Fresh air adjustment procedure

.1 After adjustment of supply, return and related exhaust fans, adjust minimum fresh air damper position to obtain design fresh air quantity.

.2 Damper position to be determined by measurement of outside return and mixed air temperatures and confirming calculations to be included in balance report.

.3 Where duct space permits, include airflow measurement of supply, and recirculation or outdoor air, to verify results.

2.8 Branch air quantity measurement procedure

.1 Branch air quantities to be determined using pitot tube traverses in accordance with the procedures outlined in "Testing, Balancing and Adjusting of Environmental Systems" by William G. Eads, P.E., issued by SMACNA.

.2 Measurements to be taken at each riser as it is connected to fan discharge or suction header and at each floor where branches are taken from the riser. Measurement to be repeated until sum of branch air quantities is within 10% of fan delivery.

3 HYDRONIC SYSTEMS

3.1 Parameters

.1 Listed below is an outline of the information to be established in the TAB process;

- .1 Flow.
- .2 Pressure.
- .3 Temperature.
- .4 Specific gravity.
- .5 Rotational speed (rpm).
- .6 Electrical
  - (a) power
  - (b) Voltage.
  - (c) Current draw.

.2 Measurement are required at and around equipment to establish fluid side performance of;

- .1 Heat exchangers (primary and secondary sides).
- .2 Coils.
- .3 Boilers.
- .4 Pumps.
- .5 PRVs.
- .6 Makeup (water) systems.
- .7 Domestic hot water heaters.
- .8 Humidifiers.

3.2 General criteria

.1 Use calibrated venturi tubes, orifices or other metered fittings and pressure gauges in conjunction with permanent and portable type flow meters to determine flow rates for system balance.

.2 Effect system balancing with automatic control valves open to heat transfer elements and bypasses closed.

.3 Base flow balance on (in order of preference):

- .1 double regulating valves, or globe valves associated with flow measuring elements (flow meters),
- .2 temporary non-invasive flow meters,
- .3 differential pressure measurement across heat transfer elements, and checked against manufacturer's literature, or

.4 temperature difference across various heat transfer elements in the system where flow metering devices are not installed. This method may only be used at design heat transfer conditions.

.4 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing.

.5 Perform balancing by measurement of temperature differential in conjunction with air balancing.

.6 Adjust water distribution systems by means of double regulating valves, globe valves, balancing cocks, valves and fittings. Do not use shut-off valves for balancing unless indexed.

.1 Butterfly valves on discharge side of pumps may be used if they are one trade size smaller than system pipe size. Include Cv values and flow vs valve position curve with balancing report.

.7 Where available pump capacity is less than total flow requirements of individual system parts, full flow in any part may be simulated by temporary restriction of flow to other parts.

3.3 Multiple pump systems

.1 Balance multiple pump systems, which have two (2) or more pumps operating in parallel (not including stand-by pumps), as follows:

.1 Set load automatic control valves to 100% open.

.2 Start each pump separately, and determine discharge valve maximum-open position to keep pump just at the maximum-flow end of the pump curve.

.3 Start-up all pumps which are required for maximum capacity. Open flow through chillers, cooling towers and boilers as required.

.4 Concurrently adjust discharge valve at each pump to obtain total system design flow rate. Record this value as Maximum Rated Capacity (MRC)

.5 In addition to MRC value, shut-down one pump and associated chiller, cooling tower or boiler, and record part load performance of each pump (N-1 pumps operating).

.6 Repeat above part load performance with increasing number of pumps shut-off (N-2, N-3, etc.) until only one pump is operating.

4 EQUIPMENT TESTING

4.1 Performance data

.1 Submit the following data as a minimum. If contractor's standard forms provide for additional data, also submit such additional data.

.1 Some equipment tests may need to be performed during the alternate season testing.

.2 Include nameplate data and as-tested results.

.2 Motors:

.1 manufacturer,

.2 model or Serial number,

.3 amperage and voltage,

.4 horsepower,

.5 RPM,

.6 corrected full load amperage,

.7 measured amperage and voltage,

.8 calculated BHP (kW).

.3 Fans:

.1 manufacturer,

.2 model or Serial number,

.3 flow rate

.4 RPM,

.5 static pressures (suction and discharge),

.6 pulley size, type and manufacturer,

.7 belt size and quantity.

4.2 ALTERNATE SEASON TESTING

.1 Requirements

.1 Re-check testing and balancing of the heating, ventilating and air conditioning systems and water flow conditions at approximately six months after initial testing and balancing has been performed and accepted, as advised by the Consultant.

.2 Include items which, because of their seasonal character could not be adequately completed during the initial balancing

.3 Include the reading and recording of temperatures and pressures at all gauges, as well as outdoor and indoor conditions.

.4 Measure and record the motor amperages and drive RPM of all fans and pumps during re-checking.

.2 Report

.1 Provide an addendum report to the original balancing report.

5 REPORT PRESENTATION AND VERIFICATION

5.1 Required reports

.1 Provide the following reports:

.1 Air and water balancing report,

.2 Alternate season test report.

5.2 Report format

.1 Reports to incorporate approved standard forms, with values expressed in SI and (Imperial) units.

.2 Include "as-built" system schematics showing flow quantities and measurement points. Use as-built drawings and ventilating line diagrams for references.

.3 Submit four hard copies of TAB reports, with index tabs, in "D" ring binders, for verification.

.4 Submit two soft copies of TAB reports in Adobe Acrobat V7 PDF format.

5.3 Accuracy

.1 Adjust systems until operating values within plus or minus 5% of design values are achieved.

.2 Measurements to be accurate to within plus or minus 2% of actual values.

5.4 Spot checks

.1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 30% of all measurements in locations as directed by the Consultant, at no cost extra to the contract.

.2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re-balance entire affected system(s) at no increase in Contract Price.

5.5 Balance position marking

.1 Mark the balance position of dampers and valves at the completion of the final testing:

.1 Ductwork: indicate with arrow using paint or permanent marker,

.2 Exposed ductwork in public areas: self adhesive label, placed adjacent to balancing damper, neatly filled in with % open or degree open value.

.3 Valves: self-adhesive label, placed on piping (insulated or not) adjacent to valve, neatly filled in with either % valve open, or number of valve turns to open.

.2 Additional requirements for Double Regulating Valves:

.1 Remove valve handle or other protective device, and set memory stop to limit valve open travel. Replace valve handle or protective cover.

5.6 Record keeping

.1 Keep records of trial and final balance and submit preliminary report as each system is completed.

.2 Make spot checks as requested and repeat balancing of system if actual spot check quantities do not agree with preliminary report figures.

5.7 Verification

.1 Reported measurements will be verified.

.2 Provide instrumentation and manpower to verify results of up to 30% of reported measurements.

.3 Number and location of verification measurements to be at discretion of Engineer.

.4 Where discrepancies are encountered repeat TAB, and resubmit reports.

5.8 Completion

.1 Continue TAB until reports are approved.

.2 The Substantial Performance of the Mechanical Work will be considered reached when the initial Start-Up and Performance Testing report is accepted by the Consultant and in the opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.

.3 The substantial performance is not dependent upon alternate season testing.

.4 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and accepted by the Consultant.

END OF SECTION

PROJECT CLOSE-OUT MECHANICAL
20 08 19

1 GENERAL

1.1 Scope

.1 Provide documentation deliverables at completion of the Work.

1.2 Occupancy Permit

.1 Submit the reviewed final Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit.

1.3 Substantial Performance

.1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.

.2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.

.3 Prepare and submit to the Consultant a comprehensive deficiency list of items to be completed or corrected, as part of the application for a review by the Consultant to establish Substantial Performance of the Work, or for each designated portion of the Work in the case of phased Substantial Performance.

.1 Failure to include an item on the list does not alter the Contractor's responsibility to complete the Work.

.4 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

1.4 Total Performance

.1 Submit the following documentation with the application for Total Performance. Application for Total Performance cannot be submitted any earlier than the date of Alternate Season testing.

.1 Where documentation has already been submitted to the Owner, provide a copy of the transmittal.

SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Contractor has compiled and submitted a detailed deficiency list, identifying work still to be completed, incomplete, or requires correction.
- ☐ Equipment start-up reports (Interim).
- ☐ Building department inspection reports.
- ☐ TSSA pressure piping inspection reports (if applicable)
- ☐ TSSA fuel system field inspection reports (if applicable)
- ☐ ESA field inspection reports.
- ☐ Sprinkler installation certification report to NFPA 13.
- ☐ Standpipe installation certification report to NFPA 14..
- ☐ Medical gas field inspection report and certificate.
- ☐ Air and Water Balancing reports (Interim).
- ☐ Acoustic survey report.
- ☐ Vibration survey report (if specified).
- ☐ Controls / BMS operation report.
- ☐ Equipment, pipeline, and valve identification completed
- ☐ Clean-up completed.
- ☐ Spare parts and replacement parts turned over to Owner; transmittal attached.
- ☐ Warranty certificates
- ☐ Operating and Maintenance Manuals, draft, submitted.
- ☐ As-built drawings submitted
- ☐ Training completed and attendance logs submitted.
- ☐ Commissioning reports submitted and reviewed by Consultant

Consultant Review		
Status:	☐ Reviewed	☐ Incomplete or deficient - resubmit
Signed:		
Date:		

TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- ☐ Air and water balancing - final versions including alternate season testing completed and submitted.
- ☐ Final commissioning reports submitted and accepted by Owner.
- ☐ Operating and Maintenance manuals - finalized and submitted (if final version was issued at time of Substantial Performance indicate here)
- ☐ As-built drawings final version submitted (if final version was issued at time of Substantial Performance indicate here)

Consultant Review	
Status:	□ Reviewed □ Incomplete or deficient - resubmit
Signed:	
Date:	

End of Section

FIRE PROTECTION - GENERAL
21 05 01

1.1 GENERAL

1.2 Scope

.1 Fire protection work includes;

.1 Commissioning of fire protection systems,

.2 Standpipe & Hose Systems

.3 Fire Extinguishers

.4 Wet Pipe Sprinkler System

.5 Pre-action Sprinkler System

1.3 Applicable Codes and Standards

.1 Legislation:

.1 Fire Protection Work to conform to Standards of National Fire Prevention Association (NFPA) and relevant sections of the Ontario Building Code.

1.4 Qualified Tradesmen

.1 Work to be performed by qualified and recognized firm with an established reputation in this field, using tradesmen holding certificates of competency.

1.5 Water supply test results

.1 Provide water flow test on municipal water service in proximity to building connection, in accordance with NFPA 14 and NFPA 291. Flow test must be conducted within one (1) year prior to system design. Submit record of test including static pressure, and residual pressure and flow.

.1 Obtain municipal approval and pay fees associated with testing.

2 PRODUCTS

2.1 Pipe, hangers and gaskets

.1 Pipe:

.1 ASTM A53 Grade B, Schedule 40 continuous weld steel to up to NPS 2, grooved or screwed.

(a) Galvanized where specified.

.2 ASTM A53-63R Grade B, Schedule 40 electric resistance weld steel for NPS 2½ to NPS 10, welded.

.3 NPS 2½ and over ASTM A53-72A Schedule 10 thin wall, rolled grooved.

.2 Pipe hangers:

.1 UL/ULC listed for fire protection, and

.2 swivel ring hanger type or

.3 as specified in Section 20 05 29 Hangers and Supports.

.3 Gaskets for flanged joints:

.1 Red rubber sheet 1.6 mm (1/16 in) thick.

Standard of Acceptance

- Chesterton 100
- Beldam Red Rubber

2.2 Fittings, and valves up to 1200 kpa (175 psi) working pressure

.1 Fittings:

.1 1035 kPa (150 #) black malleable iron screwed up to NPS 2.

.2 Forged steel, butt welding Schedule 40 for NPS 2½ and over.

.2 Unions:

.1 1035 kPa (150 #) black malleable ground joint union, bronze to iron seat up to NPS 2.

.3 Flanges:

.1 1035 kPa (150 #) forged steel, slip-on or weld neck, raised face style.

.4 Valves:

.1 ULC and FM listed for fire protection service.

.2 as specified in Section 20 10 00 Valves.

2.3 Fittings for grooved pipe to 1200 kpa (175 psi)

.1 Couplings:

.1 Malleable or ductile iron NPS 2½ and over.

.2 Fittings:

.1 Malleable iron or ductile iron to NPS 2½ to NPS 12.

.3 Flanges:

.1 Cast iron, raised face flange with coupling groove NPS 2½ and over.

.4 Gaskets for grooved couplings:

.1 EPDM Grade "E", dry lubricated.

3 EXECUTION

3.1 Piping Installation

.1 General layout of mains, risers, run-outs and connection details of piping systems are shown.

.2 Provide bends, expansion loops, hoses or joints to compensate for pipe seismic movement.

.3 Anchor, guide and laterally support vertical and horizontal piping to support filled weight and absorb thrust under operating conditions.

.4 Erect piping so that gravity forces and thrust from changes in direction do not stress connections to apparatus.

.5 Separate copper pipe and fitting materials from contact with ferrous material with di-electric couplings.

.6 Install drain valves at low points in water piping systems and in valved run-outs from risers so that system or isolated parts of system can be drained.

END OF SECTION

FIRE EXTINGUISHERS
21 12 29

1 GENERAL

1.1 Scope

.1 Provide extinguishers as shown.

1.2 Applicable standards

.1 National Fire Protection Association (NFPA) 10 Standard for Portable Fire Extinguishers.

2 PRODUCTS

2.1 Multipurpose dry chemical extinguishers

.1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for A, B and C class protection, red enamel finish.

.2 Provide 2.25 kg (5 lb) extinguisher.

Standard of Acceptance
- National Fire Equipment Limited - ABC
- Flag Fire Equipment Limited - ABC

2.2 Extinguisher brackets

.1 Supplied by extinguisher manufacturer.

2.3 Extinguisher cabinets

.1 Recessed, surface mounted or semi-recessed type as indicated.

.2 Constructed of 1.6 mm (16 ga) steel.

.3 180° opening door of 2.5 mm (12 ga) steel with latching devices and 5 mm (3/16 in) full glass panel.

2.4 Identification of extinguishers

.1 Include bilingual tag or label attached to extinguishers, in accordance with recommendations of NFPA 10, indicating month and year of installation, with space for service dates.

3 EXECUTION

.1 Mount cabinets and brackets.

.2 Install extinguishers at project completion. Confirm location with local building or fire department prior to installation.

END OF SECTION

WET PIPE SPRINKLER SYSTEM
21 13 13

1 GENERAL

1.1 Scope

.1 Provide wet pipe automatic sprinkler systems.

.2 Provide installation drawings and hydraulic calculations, designed and sealed by a professional engineer licensed in the province of Ontario.

1.2 Qualified Subcontractors

.1 Sprinkler work to be undertaken by specialist automatic sprinkler installation firm with an established reputation in this field.

1.3 Applicable codes and standards

.1 National Fire Protection Association (NFPA) 13 - Standard for the Installation of Sprinkler Systems

.2 NFPA 25 - Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

.3 Risk Management Services (RMS)

.4 Ontario Building Code

.5 Ontario Fire Code

.6 ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless

.7 CSA B64 - Backflow Preventers and Vacuum Breakers

1.4 Shop drawings and product data

.1 Prepare shop drawings and forward three copies with hydraulic calculations to Owners Insurers for review and acceptance.

.2 After shop drawings are accepted by reviewing Authority submit copies of these stamped shop drawings and product data sheets for review in accordance with Division 1 procedures.

1.5 Samples

.1 Submit samples of;

.1 sprinkler heads,

.2 signs.

1.6 Design criteria

.1 System is designed to NFPA 13 using pipe schedule sizing method for hazard classification shown with design densities and design areas for each zone as detailed

.2 Changes to pipe sizes or head layouts accompanied with modified hydraulic calculations, may be submitted for approval.

1.7 Maintenance materials

.1 Provide cabinet, containing special sprinkler wrench, and spare stock of sprinklers. Include at least one head of each type and temperature rating installed in system.

2 PRODUCTS

2.1 Pipe, hangers and gaskets

.1 To section 21 05 01.

2.2 Sprinkler heads

.1 Ratings:

.1 ULC and FM listed for fire service.

.2 standard temperature rating 57°C to 74°C (135°F to 165°F) with intermediate or high temperature rating to suit local conditions.

.3 thermal sensitivity:

(a) Quick Response type for Light and Ordinary hazard applications
(b) Standard response type for Extra hazard applications.

.2 Selection:

.1 indicated by type in accordance with following:

(a) TYPE U-1 upright bronze body with 12 mm (½ in) diameter orifice or 13 mm (17/32 in) diameter orifice as shown.
(b) TYPE P-2 pendent, flush, concealed with fusible chrome or white cover plate, glass bulb type.

Standard of Acceptance

- Viking
- Tyco
- Reliable
- Victaulic

2.3 Signs

.1 Type:

.1 fitted on control valves, shut-off valves, drain valves and test valves,

.2 150 mm x 150 mm (6 in x 6 in) for automatic control valves and alarm valves,

.3 50 mm x 150 mm (2 in x 6 in) for other valves, and

.4 made of enameled steel with fire department red enamel background, white letters, inscription in accordance with NFPA Standards.

3 EXECUTION

3.1 General

.1 Provide headers, alarm check valve assemblies, valves, and fire department connections.

.2 Provide supervisory switches on valves.

.3 Provide water flow alarm switches, and two low water pressure monitoring switches.

- .1 one low water pressure switch to operate excess pressure pump
- .2 one low water pressure switch to annunciate trouble condition to fire alarm system, set at 70 kPa (10 psig) below excess pressure pump start setpoint - field verified.

.4 Provide signs at each valve identifying portion of system controlled. Fasten signs to pipe in immediate vicinity of valve.

.5 Install excess pressure pump across alarm valve.

.6 Extend piping through zone sprinkler control cabinets and connect to sprinklers.

.7 Provide drain valves at trapped low points in piping system.

.8 Provide small hose assemblies connected where shown.

.9 Provide additional sprinkler heads with associated piping for sprinkler protection under ducts, under obstructions, and in blind spaces. Identify additional sprinkler heads on shop drawings with capital letter "A" and resubmit drawings to permit inclusion of these sprinkler heads in hydraulic calculations.

.10 Combination drains or hub drains will be provided at headers and control cabinets under Division 22.

.11 Run NPS 2 drain through wall to outside for Inspectors water flow testing in locations shown.

.12 Personnel involved in installation of grooved joint piping and fittings to be conversant with;

- .1 pipe end preparation and special tools,
  - (a) pipe ends to be clean and free from indentations, projections and roll marks in area from pipe end to groove.
  - (b) dimensions to be according to standard cut groove or roll groove Specification (Victaulic TS-215/78).
- .2 coupling and fitting selection.
- .3 joint assembly to accommodate expansion, contraction, and flexibility,
- .4 specifications and/or recommendations with respect to support, anchorage and guiding of pipe systems.

3.2 Sprinkler selection

.1 Use pendant sprinklers where suspended ceilings occur. Locate sprinklers in symmetrical pattern to suit reflected ceiling plans and to avoid speakers, fire alarm components, lighting fixtures, ductwork and diffusers. In general, centre heads in ceiling tiles.

3.3 Testing and approvals

.1 Test sprinkler systems in accordance with requirements of [NFPA][Factory Mutual Engineering Data Sheets.

.2 Schedule testing to give at least two weeks' notice to following authorities:

- .1 Local Building/Plumbing Inspector,
- .2 Local Fire Department Representative,
- .3 Insurer's Representative,
- .4 Owner, and
- .5 Consultant.

.3 Prior to testing, ensure that valves, flow switches, pressure switches, supervisory switches and other devices are functioning.

.4 Provide Contractor's Material and Test Certificate for above ground piping.

.5 Distribute copies of Certificates as per shop drawing requirements.

.6 On completion of project obtain Certificate of Approval showing that work is in accordance with rules and regulations of Factory Mutual.

END OF SECTION

PRE-ACTION SPRINKLER SYSTEM
21 13 19

1 GENERAL

1.1 Scope

.1 Provide dry pipe pre-action sprinkler systems as shown.

.2 Provide installation drawings and hydraulic calculations, designed and sealed by a professional engineer licensed in the province of Ontario.

1.2 Qualified Subcontractors

.1 Work to be undertaken by same specialist automatic sprinkler installation firm providing wet pipe sprinkler systems for this project.

1.3 Applicable codes and standards

.1 National Fire Protection Association (NFPA) 13 - Standard for the Installation of Sprinkler Systems

.2 NFPA 25 - Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

.3 Ontario Building Code

.4 Ontario Fire Code

1.4 Shop drawings and product data

.1 Prepare shop drawings and forward three copies with hydraulic calculations to Owners Insurers for review and acceptance.

.2 After shop drawings are accepted by reviewing Authority submit copies of these stamped shop drawings and product data sheets for review in conformity with Division 1 procedures.

1.5 Samples

.1 Submit samples of;

- .1 sprinkler heads,
- .2 signs,
- .3 heat detectors.

1.6 Design criteria

.1 System is designed to NFPA 13 using hydraulic method for hazard classification shown with design densities and design areas for each zone as detailed.

.2 Hydraulic calculations are based on water supply test results, down-rated in accordance with requirements of Authorities having jurisdiction as shown. Hydraulic calculations establishing pipe sizing as shown on drawings are available.

.3 Changes to pipe sizes or head layouts accompanied with modified hydraulic calculations, may be submitted for approval.

1.7 Maintenance materials

.1 Provide cabinet, containing special sprinkler wrench, and spare stock of sprinklers. Include at least one head of each type and temperature rating installed in system.

2 PRODUCTS

2.1 Pipe, hangers, gaskets, valves and fittings:

.1 To section 21 05 01

2.2 Sprinkler heads

.1 Sprinkler heads to be listed Dry-pendant heads.

Standard of Acceptance
- Viking
- Tyco
- Reliable

2.3 Pre-action system type

.1 Double-interlocked, cross-zoned

3 EXECUTION

3.1 Sprinkler installation

.1 Provide headers, alarm valve assemblies, valves, and fire department connections.

.2 Valves to be fitted with supervisory switches as shown. Wiring from supervised valves and provision of supervisory annunciator will be done under Electrical Division 26.

.3 Provide signs at each valve identifying portion of system controlled. Fasten signs to pipe in immediate vicinity of valve.

.4 Wiring of trouble and flow alarms will be done under Electrical Division 26.

.5 Provide double-valved auxiliary drains at trapped low points in piping system.

.6 Locate sprinklers in symmetrical pattern to suit reflected ceiling plans and to avoid speakers, fire alarm components, lighting fixtures, ductwork and diffusers. In general, centre heads in ceiling tiles.

.7 Provide additional sprinkler heads with associated piping for sprinkler protection under ducts, under obstructions, and in blind spaces. Identify additional sprinkler heads on shop drawings with capital letter "A" and resubmit drawings to permit Inclusion of these sprinkler heads in hydraulic calculations.]

.8 Isolate automatic sprinkler system from potable water supply to comply with The Ontario Building Code, Part 7, Potable Water Systems, Protection from Contamination, Back Siphonage.

.9 Combination drains or hub drains will be provided at headers and control cabinets under Plumbing.

3.2 Testing and approvals

.1 Test sprinkler systems in accordance with requirements of NFPA.

.2 Schedule testing to give at least two weeks' notice to following authorities

.1 Local Fire Department.

.2 Insurer's Representative.

.3 Owner.

.4 Consultant.

.3 Prior to testing, ensure that flow switches, pressure switches, supervisory switches and other devices are functioning.

.4 Obtain Contractor's Material and Test Certificate for above ground piping.

.5 Copies of Certificates to be distributed as per shop drawing requirements.

.6 On completion of project obtain Certificate of Approval showing that work is in accordance with rules and regulations of National Fire Protection Association.

END OF SECTION

PLUMBING PIPING SYSTEMS – GENERAL REQUIREMENTS
22 05 01

1 GENERAL

1.1 Scope

.1 Provide piping systems for plumbing, drain and vent systems for:

.1 Potable (domestic) water systems.

.2 Non-potable water piping systems including:

(a) sanitary drainage and vent systems,
(b) storm water drainage systems,

1.2 Applicable Codes and Standards

.1 Legislation:

.1 Ontario Building Code

.2 Municipal bylaws regarding potable water and sewage systems.

.2 Installation standards and codes:

.1 AWWA C651 Disinfecting Water Mains.

.3 Product standards:

.1 CSA B272 Pre-Fabricated Self Sealing Roof Vent Flashings

1.3 Qualified Tradesmen

.1 Work to be performed by qualified and recognized firm with an established reputation in this field, using tradesmen holding certificates of competency.

1.4 Design Criteria – Pressure Piping Systems

.1 The following design conditions apply unless otherwise shown on drawings.

.2 System design criteria:

.1 Domestic Cold Water Service (to building):

(a) Design pressure: 900 kPa (130 psig)
(b) Design temperature: 25°C (77°F)

.2 Potable water:

(a) Design pressure: 900 kPa (130 psig)
(b) Design temperature: 107°C (225°F)

.3 Non-potable water:

(a) Design pressure: 900 kPa (130 psig)
(b) Design temperature: 107°C (225°F)

.4 Pumped sanitary and storm:

(a) Design pressure: 700 kPa (100 psig)
(b) Design temperature: 65°C (150°F)

2 PRODUCTS

2.1 Flashings

.1 Through-roof penetration flashing, and other waterproofed areas:

.1 manufactured from composite material in accordance with CSA B272,

.2 minimum dimensions of 500 mm x 500 mm (20 in x 20 in),

.3 with sleeve extending at least 150 mm (6 in) above roof.

2.2 Dielectric Unions

.1 Construction:

.1 Bronze or brass body with non-metallic fitting or coating the FNPT tailpiece.

.2 FNPT x Copper sweat connection.

.3 Pressure rating; ASME Class 3000 at 121°C (250°F)

Standard of Acceptance

° Hart Industrial Unions - fig. D-3136 or Polymer Compsit Coating

2.3 Dielectric Flanges

.1 Construction:

.1 ASME Class 150 or 300 carbon steel flange, Van-stone style with copper tube adapter tailpiece.

.2 Flange provided with a powder coated finish, and an EPDM insulator to isolate the copper tailpiece form contact with the flange.

.3 Minimum MCPR:

(a) Class 150: 1400 kPa (200 psi) at 121°C (250°F)

(b) Class 300: 2800 kPa (400 psi) at 121°C (250°F)

Standard of Acceptance

° CTS Flange Canada - fig. BF / WBG

3 INSTALLATION

3.1 Piping

.1 Piping system routing is shown diagrammatically. Locate mains, risers and runouts concealed behind furrings or above ceilings except in mechanical equipment rooms and access spaces where piping is to be exposed.

.2 Determine areas without ceilings from Architectural Drawings and Room Finish Schedules, and in these areas keep piping as high as possible.

.3 Anchor, guide and support vertical and horizontal runs of piping to resist dead load and absorb thrust.

3.2 Domestic Cold Water System Distribution

.1 Extend existing domestic cold water system with

.1 distribution pipe and fittings,

.2 valves,

.3 premises backflow isolation,

.4 zone or equipment backflow protection.

.2 Minimum water pressure at street level: approximately 500 kPa (70 psi).

.3 Provide valved connections from supply system, to fixtures and other equipment requiring cold water.

3.3 Domestic Hot Water System Distribution

.1 Extend existing domestic hot water system with

.1 distribution pipe and fittings

.2 valves

.3 zone or equipment backflow protection.

.2 Provide cold water connections to hot water tank, with shut-off and check valve on supply and valved drain at bottom of tank. Drill check valve disc with 1.6 mm (1/16 in) hole in its centre.

.3 Provide valved connections from hot water supply system to fixtures and other equipment requiring hot water.

3.4 Domestic Hot Water Recirculation System

.1 Extend existing domestic hot water recirculation system with

.1 distribution pipe and fittings

.2 valves

.3 pumps

.2 Connect ends of hot water risers to recirculation mains and extend to recirculation pump.

.3 Install recirculation piping as shown.

3.5 Dissimilar Metals Galvanic Isolation

.1 Provide dielectric unions or flanges to separate copper and copper alloy tube and fitting materials from contact with carbon (plain and galvanized) steel material.

.1 For clarity, dielectric unions or flanges are not required when connecting copper to T304 or T316 stainless steel pipe or tubing.

.2 Refer to specification section 23 05 01 for exemptions when connecting domestic water copper piping or stainless steel piping to HVAC piping systems.

3.6 Drainage

.1 Provide roof drains and storm drainage piping system.

.2 Provide waste and vent connections to plumbing fixtures and equipment.

.3 Fittings;

.1 Do not use double hubs, straight crosses, double T's, or double TY's in soil or waste pipe below any fixture.

.2 Do not use branch fittings other than full "Y" or "Y" and an eighth bend, on soil or waste pipe running in horizontal direction.

.3 Do not use quarter bend placed on its side.

.4 Do not use inverted joints below fixtures.

.5 Do not install cleanouts above food preparation or patient treatment areas. In these areas carry rodding connection up to floor cleanout fitted with adjustable gasketted access cover and plug, with cleanout body cast in floor slab above.

.6 Drainage fittings to match connected piping for quality and wall thickness.

3.7 Special Water and Waste Connections

.1 Provide hot and cold water, waste and vent connections to equipment.

.2 Provide vacuum breakers and backflow preventers on equipment connections, and hose bibbs, and on fixture connections without adequate air gaps.

.3 Where hot and cold water supply pipes connect to combination supply fitting with shut-off valve on discharge, or where combination supply fitting is equipped with manual or thermostatic mixing valve, equip each hot and cold water supply pipe with composition disc swing check fitting.

.4 Provide shut-off valve on each service line close to apparatus and brass trap complete with cleanout on waste connection unless waste discharges directly into floor drain or funnel drain.

.5 Where specific sizes are not shown, valves, and final connections to equipment to be one pipe size larger than equipment tapping size, and trap and drain size to be one pipe size larger than waste connection on apparatus.

.6 Provide similarly sized connections for items marked N.I.M.C. (Not in Mechanical Contract) and S.B.O. (Supplied by Owner).

.7 For these items:

.1 N.I.M.C. Do not make final connections but provide services.

.2 S.B.O. Make final connections including traps, screwdriver stops and accessories.

3.8 Flashings

.1 Provide flashing for piping penetrations through roofs and other waterproofed areas. Leave flashing ready for Roofing or Waterproofing Trades to make watertight connections.

3.9 Pressure Testing – Water Pressure Piping Systems

.1 Pressure test piping before insulation is applied.

.2 Initial pneumatic leak test:

.1 Conduct an initial pneumatic pressure test at a maximum pressure of 70 kPa (10 psig) prior to hydrostatic pressure test, to check for large leaks or incomplete joints.

.2 Remove compressed air source and maintain this pressure for the time necessary to inspect for major leaks, but not less than 2 hours. Repair major leaks.

.3 Final hydrostatic pressure test:

.1 Use the system design pressure for the entire installation, unless different design pressures are indicated for each floor.

.2 Fill the system with water and conduct a pressure test at 150% of the design pressure for 10 minutes, then reduce pressure to design pressure.

(a) maintain pressure and examine each joint with commercial leak detector solution.

Standard of Acceptance

- Snoop
- Leak-tec

(b) repair leaks and retest using leak detector solution with piping under pressure specified.

.3 As an alternative to leak testing of each joint, conduct a 24 hour standing pressure test:

(a) raise the water pressure to 150% of the design pressure for 10 minutes, then reduce pressure to design pressure,

(b) record the test pressure one (1) hour after establishing the system hydrostatic test pressure Record ambient air temperature at the same time,

(c) maximum pressure loss over 24 hours: not more than 1% of test pressure, corrected for ambient temperature.

.4 Repair leaks and retest until satisfactory.

(a) For soldered or brazed joints, one attempt at repairing the joint is permitted. If joint continues to fail, cut-out and replace the fitting.

.5 Maintain a log of all pressure tests, including locating of where leaks have been repaired. Submit the log to the Consultant for review when requesting prior to substantial completion of the Work. Where a piping system is subject to AHJ inspection, provide evidence of such inspection by means of an AHJ inspection report or name of the AHJ inspector and the date they witnessed the pressure test.

3.10 Flushing and Cleaning - Building Water Distribution Piping

.1 Conduct first fill and pressure testing of building distribution piping only after completion of flushing and disinfection of water service pipe.

.2 Complete piping pressure tests prior to flushing and cleaning operations.

.3 Flush water distribution piping through available outlets with sufficient flow to produce velocity of 1.5 m/s, within pipe for 10 minutes, or until foreign materials have been removed and flushed water is clear.

.4 Minimum flushing flowrates:

Pipe size	Minimum Flow	
NPS	L/s	usgpm
2	3.3	52
2 1/2	4.7	75
3	7.3	115
4	12.6	200

.5 Open and close valves, hydrants and service connections to ensure thorough flushing.

.6 When flushing has been completed to satisfaction of Consultant, introduce strong solution of chlorine into watermain and ensure that it is distributed throughout entire system:

.1 Drain down system to remove flushing water,

.2 Introduce Chlorine close to point of re-filling of system, and evenly add to water as system is refilling, to provide an initial concentration of 50 mg/L

.3 Operate valves, hydrants, and appurtenances while main contains chlorine solution.

.4 Flush line to remove chlorine solution after 24 hours contact time.

.5 Arrange and pay for laboratory testing of water samples taken from newly disinfected main.

.6 Where samples do not meet laboratory test standard for potable water, disinfection procedure and testing is to be repeated until satisfactory results are achieved.

3.11 Testing and Balancing – Water Pressure Piping Systems

.1 Balance domestic water piping systems where double regulating valves are installed, including hot water recirculation piping and as otherwise shown.

END OF SECTION

GENERAL-DUTY VALVES FOR PLUMBING PIPING

22 05 23.13

1 GENERAL

1.1 Scope

.1 Provide valves for general duty service in plumbing piping systems, including shut-off valves, check valves, manual balancing valves, and automatic flow balancing valves.

.2 Valves under this specification section are provided for:

.1 Domestic (potable) water systems using copper tubing, stainless steel pipe or tube, ductile iron water piping, and galvanized steel piping.

.2 Non-potable water piping systems including:

(a) Process water systems,

(b) Irrigation systems,

(c) Grey water systems,

(d) Pumped sewage systems.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section integrates with or refers to the following specification sections:

.1 20 05 23 General Requirements for Valves

.2 22 05 01 Plumbing - General

1.3 Definitions

.1 The following definitions apply to this section.

.1 ***Contaminant-free:*** means the material is free of contaminants and impurities to the prescribed limits of NSF/ANSI 61 – section 8 (NSF/ANSI 61/8), but excludes evaluation for lead.

.2 ***Lead-free***: means the weighted average lead content does not exceed 0.25% when evaluated in accordance with the test methods in NSF/ANSI 61-Annes G or NSF/ANSI 372.

1.4 Submittals

.1 Refer to section 20 05 23.

1.5 Applicable Codes and Standards

.1 Refer to section 20 05 23 and as specified herein.

.2 Product standards:

.1 CSA B125.3 Plumbing Fittings

.2 NSF/ANSI 61 Drinking Water System Components – Health Effects

.3 NSF/ANSI 372 Drinking Water System Components – Lead Content (formerly NSF/ANSI 61, Annex G).

2 PRODUCTS

2.1 General

.1 Where products are specified as being lead-free, they shall be listed to either:

.1 CSA B125.3;

.2 NSF/ANSI 61-G; or

.3 NSF/ANSI 372.

.2 Where products are specified as being contaminant-free, they shall be listed to either:

.1 CSA B125.3;

.2 NSF/ANSI 61-G; or

.3 NSF/ANSI 61/8

2.2 Ball Valves, brass body (type BV-1)

.1 NPS 3 and under, copper alloy body:

.1 To MSS SP-110, 600 CWP, two-piece bronze or DZF brass body, full port, stainless steel or chrome plated bronze ball, PTFE seat rings, solder or NPT threaded ends.

.2 Handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

.3 Required MCPR: 2500 kPa (363 psig) at 93°C (200°F).

.4 Certified for lead-free and contaminant-free service.

.5 Soldered ends: NPS 2 and under [1].

Standard of Acceptance

- Kitz - fig. 859
- Apollo - fig. 77FLF-20x
- Nibco - fig. S-685-66-LF
- Watts - fig. LFB6081

.6 Threaded ends: NPS 4 and under [2], [3].

Standard of Acceptance

- Kitz - fig. 858
- Apollo - fig. 77FLF-10x
- Nibco - fig. T-685-66-LF
- Watts - fig. LFB6080

2.3 Ball Valves, stainless steel body (type BV-2)

.1 NPS 3 and under, threaded ends:

.1 To MSS SP-110, 600CWP, two piece T316 stainless steel body, full port, stainless steel or chrome plated bronze ball, PTFE seat rings, NPT threaded ends.

.2 Handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

.3 Required MCPR: 2500 kPa (363 psig) at 93°C (200°F).

.4 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Apollo - fig. 76F-10x series (NPS 2 and under)
- Watts - fig. S-FBV-1 series

.2 NPS 1- ½ to NPS 12, flanged ends:

.1 To MSS SP-72, two piece CF8M stainless steel body, full port, stainless steel ball, PTFE seat rings, flanged ends.

.2 Locking handles up to NPS 4, and gear operators for NPS 6 and over.

.3 Certified for lead-free and contaminant-free service.

.4 ASME Class 150:

(a) Required MCPR: 1600 kPa (232 psig) at 93°C (200°F).

Standard of Acceptance

- Apollo - fig. 87A-200 series

.5 ASME Class 300:

(a) Required MCPR: 4000 kPa (580 psig) at 93°C (200°F).

Standard of Acceptance

- Apollo - fig. 87A-900 series

2.4 Globe Valves (type GLV-1)

.1 NPS 2 and under:

.1 To MSS SP-80, Class 125 bronze body valves, brass or bronze disc, threaded bonnet, threaded or soldered ends.

.2 Required MCPR: 1200 kPa (174 psi) at 93°C (200°F).

.3 Certified for lead-free and contaminant-free service.

.4 Soldered ends:

Standard of Acceptance

- Kitz - fig. 812
- Apollo - fig. 121S-LF

.5 Threaded ends:

Standard of Acceptance

- Kitz - fig. 811
- Apollo - fig. 121T-LF

2.5 Gate Valves (type GTV-1)

.1 NPS 2 and under (type GTV-1):

.1 To: MSS SP-80, Class 125; or MSS SP-139, 300 CWP. Bonze body, solid wedge bronze disc, non-rising stem, screw in or union bonnet, soldered ends.

.2 Required MCPR: 1200 kPa (174 psi) at 93°C (200°F).

.3 Certified for lead-free and contaminant-free service.

.4 Soldered ends:

Standard of Acceptance

- Kitz - fig. 808
- Apollo - fig. 102SLF
- Crane (GGC) - fig. LF1320
- Nibco - fig. S-111-LF

.5 Threaded ends:

Standard of Acceptance

- Kitz - fig. 807
- Apollo - fig. 102TLF
- Crane (GGC) fig. LF438
- Nibco - fig. T-113-LF

2.6 Gate Valves, Non-Potable Applications (type GTVNP-1)

.1 For non-potable water systems only. Do not use on potable water systems.

.2 NPS 2½ to NPS 12, cast iron:

.1 To MSS SP-70, Class 125, cast iron body with flat faced flange, bronze or bronze faced solid wedge disc with bronze seat rings, OS & Y, bolted bonnet, flanged ends.

(a) Required MCPR: 1200 kPa (174 psi) at 93°C (200°F).

Standard of Acceptance

- Kitz - fig. 72
- Crane - fig. 465 ½
- Jenkins - fig. 454J
- Nibco - fig. F-617-O

.3 NPS 2½ to NPS 24, stainless steel:

.1 To ASME B16.34, Class 150, ASTM A216 grade WCB cast steel body with raised faced flange, flexible Type 416 stainless steel disc and hard faced seat rings, rising stem, OS & Y, bolted bonnet, flanged ends.

.2 ASME Class 150:

(a) Required MCPR: 1700 kPa (246 psi) at 93°C (200°F).

Standard of Acceptance

- Kitz - fig. 150 SCLS
- Crane - fig. 47 XU-F
- Jenkins - fig. J1009B8F
- Powell - fig.1503-FC8G

.3 ASME Class 300:

(a) Required MCPR: 4000 kPa (580 psi) at 93°C (200°F).

Standard of Acceptance

- Kitz - fig. 300 SCLS
- Crane - fig. 33 XU-F
- Powell - fig. 3003-FC8G

2.7 Butterfly Valves - Flanged

.1 NPS 2 to NPS 12, ductile iron (type BFV-1):

.1 To MSS-SP-67, ductile iron lug body style, with flange bolt holes drilled and tapped for ANSI 150 flange pattern.

.2 Required MCPR: 1200 kPa (174 psi) at 93°C (200°F).

.3 Stainless steel shaft, aluminum bronze or 316 stainless steel or ductile iron/nickel plated disc, and replaceable EPDM resilient seat to provide bubble tight shut-off under system pressure from either side with flange removed from un-pressurized side.

.4 ISO 5211 mounting pad.

.5 Locking handles up to NPS 4, and gear operators for NPS 6 and over.

.6 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Nibco - fig. LD-2000
- Apollo - fig. LD 141, LD 145
- Kitz - fig. 6122EL
- MA Stewart - fig. L-D-4-A-E-LH
- Watts - fig. DBF-03
- Milwaukee - fig. ML233E, ML333E
- Crane Center Line fig. 200

.2 NPS 2 to NPS 12, stainless steel (Type BFV-2):

.1 To MSS-SP-68, Class 300, CF8M stainless steel lug body style, with flange bolt holes drilled and tapped for ANSI 300 flange pattern.

.2 Required MCPR: 4000 kPa (580 psi) at 93°C (200°F).

.3 T316 or 17-4 stainless steel disc and shaft, TFM-PTFE seat complete with titanium or 316 stainless steel spiral wound back-up ring to provide bubble tight shut-off under system pressure from either side, when installed with single flange.

.4 ISO 5211 mounting pad.

.5 Locking handles up to NPS 4, and gear operators for NPS 6 and over.

.6 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Apollo - fig. 230
- Keystone - fig. K-Lok 37

2.8 Butterfly Valves – Groove Ends

.1 NPS 2 to NPS 12, ductile iron (type BFV-3).

.1 To MSS SP-67, ductile iron body with coated flow passage, and grooved ends to CSA B242.

.2 Required MCPR: 2000 kPa (290 psi) at 93°C (200°F).

.3 Stainless steel shaft, aluminum bronze or 316 stainless steel or ductile iron/nickel plated disc, and replaceable EPDM resilient seat to provide bubble tight shut-off under system pressure from either side with flange removed from un-pressurized side.

.4 ISO 5211 mounting pad.

.5 Locking handles up to NPS 3, and gear operators for NPS 4 and over.

.6 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Victaulic - fig. Vic 300 MasterSeal series 761
- Gruvlok - fig. AN7700 series
- MAS - fig. W50-A-ED-66-S-LL

.2 NPS 2 to NPS 12, stainless steel (type BFV-4).

.1 To MSS SP-67, CF8M stainless steel body, and grooved ends to CSA B242.

.2 Required MCPR: 2000 kPa (290 psi) at 93°C (200°F).

.3 Stainless steel shaft, CF8M stainless steel disc, and replaceable EPDM resilient seat to provide bubble tight shut-off under system pressure from either side with flange removed from un-pressurized side.

.4 ISO 5211 mounting pad.

.5 Locking handles up to NPS 3, and gear operators for NPS 4 and over.

.6 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Victaulic - fig. Vic 300 MasterSeal series 461

.3 NPS 2-1/2 to NPS 6, grooved ends for copper tubing (type BFV-5).

.1 To MSS SP-67, brass or bronze body, grooved ends for copper tubing.

.2 Required MCPR: 2000 kPa (290 psi) at 93°C (200°F).

.3 Stainless steel shaft, aluminum bronze disc with fluorelastomer seat or ductile iron with EPDM encased disc/seal combination.

.4 ISO 5211 mounting pad.

.5 Locking handles up to NPS 6.

.6 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Victaulic - fig. Vic 608N
- Gruvlok - fig. AN6721

2.9 Inline Silent Check Valves

.1 NPS 2 and under:

.1 To MSS SP-80, Class 125, bronze or stainless steel body, inline spring-actuated disc or ball type, and PTFE or EPDM seat.

.2 Required MCPR: 1200 kPa (174 psi) at 93°C (200°F).

.3 Certified for lead-free and contaminant-free service.

.4 Soldered ends:

Standard of Acceptance

- Nibco – fig. S-480-Y-LF
- Apollo – fig. CVB-LF (61LF-600)
- Kitz – fig. 826

.5 Threaded ends:

Standard of Acceptance

- Nibco - fig. T-480-Y-LF
- Apollo - fig. CVB-LF (61LF-500)
- Kitz - fig. 836

.2 NPS 2 to NPS 12:

.1 To MSS SP-125, cast iron body with flat faced flange or wafer body, inline spring-actuated silent type, replaceable PTFE or BUNA-N seats, bronze faced iron or bronze disc.

.2 Required MCPR: 13200 kPa (188 psi) at 65°C (150°F).

.3 Certified for lead-free and contaminant-free service.

.4 Class 125:

(a) Required MCPR: 1380 kPa (200 psi) at 65°C (150°F).

Standard of Acceptance

- Nibco - fig. F-910-W-LF, W-910-LF
- Valmatic - fig. VM-8802-S

.5 Class 250:

(a) Required MCPR: 2700 kPa (392 psi) at 65°C (150°F).

Standard of Acceptance

- Nibco - fig. F-960-W-LF, W-910-LF
- Valmatic - fig. VM-8802-S

.3 NPS 2 and over, grooved ends:

.1 Ductile iron body with spring-assisted twin stainless steel discs, and EPDM disc coating and O-rings.

.2 Required MCPR: 2000 kPa (290 psi) at 93°C (200°F).

.3 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Victaulic - fig, 716, 716H.

2.10 Swing Check Valves – Non-slam

.1 For building sump pumps service only.

.2 NPS 2 and larger, flanged:

.1 To MSS SP-71, Class 125, swing check type with external lever weight and/or spring closure, cast iron body, renewable bronze seat rings, bronze faced iron or bronze disc, bolted cap, flanged ends.

.2 Required MCPR: 1200 kPa (174 psi) at 93°C (200°F).

Standard of Acceptance

- Val-Matic - fig. 7800LW / 7800LS
- DeZurik - fig. APCP swing check

2.11 Double Regulating Valves (DRVLF)

.1 NPS 3 and under, threaded or soldered:

.1 Brass body, plug type stem with flow measurement ports and tamper-proof setting.

.2 NPT threaded or soldered ends.

.3 Required MCPR:

(a) Soldered: 2000 kPa (300 psig) at 93°C (200°F).

(b) Threaded: 2750 kPa (400 psi) at 93°C (200°F).

.4 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Bell and Gossett - fig. CB-*-LF, RF-*-LF
- Nexus - fig. Ultra MBNL

.2 Flow meter for DRVs:

.1 Differential pressure gauge with calibration charts or digital flow meter type.

.2 Hoses and fittings to suit manual double regulating valves.

Standard of Acceptance

- Bell and Gossett - Readout Kit
- Nexus - Meter Kit, MKM series

2.12 Automatic Flow Balancing Valve

.1 NPS ½ to NPS ¾, threaded:

.1 Automatic flow balancing valve providing constant flow rate over a wide differential pressure control range.

.2 Stainless steel or brass body, with stainless steel cartridge and EPDM seals.

.3 Performance:

(a) +/- 5% flow rate over 95% of control range.

(b) Differential pressure control range: minimum of 14 to 220 kPa (2 to 32 psi) operating range.

.4 NPT threaded ends.

.5 Minimum MCPR: 2750 kPa (400 psi) at 93°C (200°F).

.6 Certified for lead-free and contaminant-free service.

Standard of Acceptance

- Victaulic/Tour and Anderson - fig. 76X
- Griswald Controls - fig. K Valve

3 EXECUTION

3.1 Installation

.1 Refer to section 20 05 23 and as required herein.

.2 Use certified lead-free and contaminant-free valves on potable cold, hot and recirculating water systems. Valves not certified as lead-free may only be used on non-potable water systems, pumped drainage systems and other similar systems.

3.2 Valve Selection Based on Pressure Rating

.1 Unless otherwise specified herein or shown, select valves that have a Minimum Component Pressure Rating (MCPR) which exceed the applicable piping system Design Pressure and Design Temperature specified in section 22 05 01.

.2 Where drawings indicate either: (a) a pressure rating; or (b) a pressure rating and Class rating, by floor level then select valves as follows:

.1 For all valves, select a valve with a MCPR rating equal to or greater than the pressure rating indicated on the drawings for each floor level.

.2 For clarity, even if a valve has an ASME Class rating, do not select a valve based on its Class to match any Class rating shown on the drawings.

3.3 Manual Valve Selection Based on Service and Pipe Material

.1 Select manual valve types based on the requirements of Table 1.

Table 1: Manual Valve Selection

Piping System	Pipe and Tube Material	Manual Valve Type
Domestic Cold Water Domestic Hot Water Domestic Recirculating Water Domestic Tempered Water	Copper	BV-1 GLV-1 GTV-1 BFV-1, BFV-2, BFV-5
	Stainless Steel	BV-2 BFV-2, BFV-4
	Ductile Iron	BFV-1, BFV-2
Domestic Cold Water (Industrial Occupancies only)	Galvanized steel	BV-1 GTV-2 BFV-1, BFV-3
Non-potable water	Copper	BV-1 GLV-1 GTV-1 BFV-1, BFV-2, BFV-5
	Stainless Steel	BV-2 BFV-2, BFV-4
	Galvanized Steel	BV-1, BV-2 GLV-1 GTV-1, GTVNP-1 BFV-1, BFV-2, BFV-3, BFV-4

Table 1: Manual Valve Selection		
Piping System	Pipe and Tube Material	Manual Valve Type
Pumped Sanitary Drainage Pumped Storm Drainage	Copper	BV-1, BV-2
	Galvanized Steel	BV-1, BV-2

3.4 Check Valves

.1 Select check valves based on the requirements of Table 2.

Table 2: Check Valve Type Selection	
General use	Inline silent check
Domestic water heaters	Inline silent check
Temperature mixing valves	Inline silent check
Elevator sump pump discharge Clear waste sump pump discharge	Inline silent check or non-slam swing check
Sanitary sump pump discharge Storm sump pump discharge	Non-slam swing check valve

3.5 Automatic Flow Balancing Valves

.1 Select automatic flow balancing valves to suit the flow rates as shown at a pressure differential of 35 kPa (5 psig). Where the indicated flow rate falls between two catalogued values, select the lower flow rated valve.

End of Section

DOMESTIC WATER PIPING - COPPER
22 11 16.13

1 GENERAL

1.1 Scope

.1 Provide copper tube and fittings for potable domestic water piping systems for aboveground installations.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 20 05 24 Welding and Brazing

.2 22 05 01 Plumbing Piping Systems – General Requirements

.3 22 05 23.13 General-duty Valves for Pluming Piping.

1.3 Definitions

.1 The following definitions apply to this specification section:

.1 ***Exposed areas***: include inside service rooms and above lay-in tile ceilings, but excludes: vertical and horizontal service shafts; above any other ceiling construction; and inside walls and partitions.

1.4 Applicable Codes and Standards

.1 Installation standards:

.1 Copper Development Association (CDA) Copper Tube Handbook

.2 Product standards:

.1	ASTM B88	Standard Specification for Seamless Copper Water Tube
.2	ASME B16.15	Cast Bronze Threaded Fittings, Classes 125 and 250
.3	ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
.4	ASME B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
.5	ASME B16.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings; Class 150, 300, 400, 600, 900, 1500, & 2500.
.6	ASME B16.50	Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
.7	ASTM B828	Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
.8	ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature
.9	ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
.10	ASTM B-32	Specification for Solder Metal
.11	AWS A5.8	Brazing Filler Metal.
.12	CSA B242	Groove and Shouldered Type Mechanical Couplings

.13 MSS SP-106 Cast Copper Alloy Flanges and Flanged Fittings, Class 125, 150 and 300

2 PRODUCTS

2.1 Copper Tube

.1 Hard drawn, type L.

.2 Listed to ASTM B88 and to have certification markings made by testing agency accredited by Standards Council of Canada.

2.2 Fittings

.1 Brass or bronze flanges and flanged fittings: to ASME B16.24.

.2 Brass or bronze threaded fittings: to ASME B16.15.

.3 Solder/brazed fittings: cast bronze to ASME B16.18, or wrought copper and bronze to ASME B16.22.

.4 Threaded fittings including unions to ASME B16.15, Class 250.

.5 Roll groove full flow standard radius cast bronze fittings for sizes NPS 2 1/2 and larger: to CSA B242

2.3 Joints

.1 Solder: 95:5 tin-antimony solder to ASTM B-32.

.2 Silver brazing alloy to AWS A5.8 classification BCUP-5.

Standard of Acceptance

- Handy Harman "SIL-FOS"
- All-State Welding Alloys "SILFLO 15"

.3 Flanges:

.1 Threaded end connection: flat face, cast copper alloy to ASME B16.24, class 150 and 300, NPT threaded,

.2 Brazed end connection: flat face, cast copper alloy to MSS SP-106, class 150 or 300.

.3 Dielectric flanges: to specification section 22 05 01.

.4 Studs and bolts: stainless steel to ASTM A193.

.5 Nuts: stainless steel type 316, to ASTM A194.

.4 Flange gaskets:

.1 Full flat-faced style to ANSI B16.21.

.2 Suitable for use in potable water service and listed to NSF/ANSI 61.

.3 Ethylene propylene diene monomer (EPDM);

(a) required working pressure: 1700 kPa (250 psi) at up to 95°C (203°F)

.4 Compressed mineral fibers bonded with nitrile (NBR);

(a) required working pressure: 2750 kPa (400 psi) at up to 95°C (203°F)

Standard of Acceptance

- American-Biltrite (EPDM) – fig. AB-576
- Durlon (NBR) – fig. 7910

.5 Roll grooved piping:

.1 Roll groove positive clamp gasketted couplings or roll groove flange adapters for copper piping to CSA B242.

Standard of Acceptance

- Victaulic
- Gruvlock
- Couplox
- Shurjoint

3 EXECUTION

3.1 Installation

.1 Refer to section 22 05 01 for piping design criteria and general requirements for piping installation.

.2 Install tubing close to building structure to minimize furring and conserve headroom. Group tubing and run parallel to walls and ceilings.

.3 Cut tube square, ream tube ends and clean tubing and tube ends before joint assembly.

.4 Before making solder or brazed joints, remove working parts of valves, clean inside of solder fittings and outside of mating pipe with emery paper and coat with applicable flux.

3.2 Class Rated Fittings

.1 Select ASME Class rated fittings and flanges in accordance with the following table for design pressure limits at coincident design temperature limits unless otherwise shown on drawings.

Class	Maximum Design Pressure	Maximum Coincident Design Temperature
150	1720 (250 psi)	≤ 38°C (100°F)
150	1400 kPa (200 psi)	≤ 121°C (250°F)
300	3700 kPa (535 psi)	≤ 38°C (100°F)
300	3100 kPa (450 psi)	≤ 121°C (250°F)

3.3 Joints and Fittings

.1 Joints in tubing:

.1 NPS ½ to NPS 2:

(a) soldered.

.2 NPS 3 and larger:

(a) brazed, flanged or roll-grooved joints.

.2 Make solder joints in accordance with the recommendations of the CDA handbook.

.3 Make braze joints in accordance with specification section 20 05 24.

.4 Use manufactured fittings. Use of fabricated pulled-tee's is subject to approval by the local municipal authority for plumbing, and only brazed butt weld joints shall be used.

.5 For flange joints, select gasket materials in accordance with the following table so that gasket pressure and temperature both exceed the piping system design pressure and design temperature.

Gasket Temperature Limit	Gasket Pressure Limit	Gasket Material	Gasket Thickness	Figure
95°C (203°F)	1720 kPa (250 psig)	EPDM	1.5 m (1/6 in)	A-B AB-576
	2750 kPa (400 psig)	NBR	1.5 m (1/6 in)	Durlon 7910

3.4 Groove Joint Piping

.1 Make pipe ends clean and free of indentations, projections and roll marks, between the end of the pipe and the groove.

.2 Verify gasket style and material grade with supplier for use with intended service.

.3 Provide for manufacturers' service representative to conduct on-site training prior to piping rough-in and installation.

3.5 Equipment Connections

.1 Make pipe connections to equipment as follows.

.1 NPS 2 and smaller: threaded fittings.

.2 NPS 2 ½ and larger:

(a) flanged connections, or
(b) grooved end where equipment has compatible factory-prepared grooved ends.

.2 Where connection is made to equipment with a threaded fitting, provide a union between the isolation valve and the equipment connection.

.3 For threaded flanges, provide a sweat x NPT adaptor; do not thread tubing directly.

.4 Provide a dielectric union or dielectric flange in accordance with specification section 22 05 01 when connecting potable water piping to equipment with carbon steel connections. Dielectric fittings are not required when connecting to equipment with stainless steel connections.

3.6 Valves

.1 Provide valves in accordance with specification section 22 05 23.13.

.1 Isolate equipment, fixtures and branches with gate, ball or butterfly valves.

.2 Use globe, DRVs, ball or butterfly valves for throttling service.

3.7 Pressure Testing, Flushing and Balancing

.1 Pressure test, flush and balance water systems to specification section 22 05 01.

END OF SECTION

DOMESTIC WATER PIPING SPECIALTIES
22 11 19

1 GENERAL

1.1 Scope

.1 Provide domestic water piping specialties and accessories.

1.2 Applicable Codes and Standards

.1 Product standards:

.1	ANSI/ASSE 1010	Water Hammer Arrestors
.2	CSA-B125	Plumbing Fittings.
.3	CSA B.64.1.1	Atmospheric Vacuum Breakers (AVB)
.4	CSA B.64.1.2	Pressure Vacuum Breakers (PVB)
.5	CSA B64.2.1	Hose Connection Vacuum Breaker (HCVB) with Manual Drain Feature
.6	CSA B.64.4	Backflow Preventers, Reduced Pressure Principle (RP)
.7	CSA B64.10	Manual for the Selection and Installation of Backflow Prevention Devices/Manual for the Maintenance and Field Testing of Backflow Prevention Devices
.8	CSA B137.6	Chlorinated Polyvinylchloride (CPVC) Pipe, Tubing, and Fittings for Hot- and Cold-Water Distribution Systems
.9	CSA C22.2 No. 14	Industrial Control Equipment
.10	CSA C22.2 No. 94.1	Enclosures for Electrical Equipment, Non-Environmental Considerations
.11	NSF/ANSI 61	Drinking Water System Components – Health Effects
.12	NSF/ANSI 372	Drinking Water System Components – Lead Content
.13	PDI-WH201	(Plumbing and Drainage Institute) Standard Water Hammer Arresters

1.3 Submittals

.1 Submit product data sheets for materials specified herein.

2 PRODUCTS

2.1 Trap Seal Primers

.1 Electrically operated manifold units – Type A:

.1 factory assembled in 1.5 mm (16 ga) recessed metal cabinet with hinged stainless steel lockable access door,

.2 atmospheric vacuum breaker,

.3 24 hr controller with manual over ride switch,

.4 120 Volt solenoid valve,

.5 NPS ¾ or NPS ½ valved inlet water connection,

.6 calibrated water distribution manifold,

.7 NPS ½ outlet compression fittings,

.8 power supply: 120 VAC.

Standard of Acceptance

- Precision Plumbing Products - fig PT-3 thru PT-30
- Mifab - fig.MI-100

.2 Electrically operated manifold units – Type B:

.1 Same as Type A electronic trap seal primer, except distribution manifold is shipped loose for field installation external to the trap primer cabinet.

2.2 Strainers

.1 NPS ½ to NPS 3:

.1 wye pattern, bronze body, solid retainer cap with gasket, and NPT threaded or soldered end,

.2 type 304 stainless steel baskets: 1.2 mm (3/64 in) diameter perforations,

.3 required MCPR: 2750 kPa (400 psi) at 93°C (200°F)

.4 lead free and listed to NSF/ANSI 61/G or 372.

Standard of Acceptance

- Watts - fig. LF777, LFS777
- Zurn - fig. YBXL
- Cash Acme

.2 NPS 4 to NPS 10:

.1 simplex basket strainer, cast iron body, bolted screen retainer cover, plugged drain/blowdown NPT connection, ASME Class 125 flat faced flange ends,

.2 type 304 stainless steel baskets: 3.2 mm (⅛ in) diameter perforations,

.3 required MCPR:1370 kPa (200 psi) at 66°C (150°F),

.4 lead free and listed to NSF/ANSI 61/G or 372.

Standard of Acceptance

- Watts - fig. LF98FB-CIB

3 EXECUTION

3.1 Trap Seal Primers

.1 Electronic manifolds:

.1 Install trap seal primer panels in the locations as shown on drawings to serve individual or groups of floor drains and/or hub drains.

.2 120V/1ph/60 Hz power supply will be brought to electric manifolded units under Division 26 and connected under Division 22.

.3 For Type B trap primer unit, pipe the outlet of the primer unit in type L hard-drawn copper down through the floor slab and connect to the trap primer distribution manifold located in ceiling space below.

.2 Trap primer tubing:

.1 Use soft annealed copper tube to connect trap primer distribution manifold to floor drains and/or funnel drains.

3.2 Strainers

.1 Install with sufficient space to remove baskets.

.2 Provide a valved blow-down drain line on NPS 4 to NPS 10 basket strainers, and pipe blow-down line in hard Tyle L copper tube and terminate over floor drain, hub drain or trench drain.

END OF SECTION

SANITARY WASTE AND VENT PIPING – CAST IRON AND COPPER
22 13 16.13

1 GENERAL

1.1 Scope

.1 Provide cast iron pipe and fittings and/or copper tube and fittings for sanitary soil and waste drain and vent piping.

.2 Provide PVC-DWV tubing for urinal fixture drains and a portion of the fixture vent piping.

.1 For aboveground services.

1.2 Applicable Codes and Standards

.1 Legislation:

.1 Ontario Building Code

.2 Installation standards and codes:

.1 Cast Iron Soil Pipe Institute (CISPI) Technical Manual

.3 Product standards:

.1	ASME B16.23	Cast Copper Alloy Solder Joint Drainage Fittings: DWV
.2	ASME B16.29	Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings-DWV
.3	ASTM B32	Standard Specification for Solder Metal
.4	ASTM B306	Standard Specification for Copper Drainage Tube (DWV)
.5	ASTM C564	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
.6	ASTM C1540	Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
.7	ASTM B828	Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
.8	CSA B70	Cast Iron Soil Pipe, Fittings, and Means of Joining
.9	CSA-B125	Plumbing Fittings.
.10	CSA B158.1	Cast Brass Solder Joint Drainage, Waste, and Vent Fittings
.11	CSA B602	Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe.

2 PRODUCTS

2.1 Copper DWV Pipe and Fittings

.1 Application: inside of buildings only. Do not use for buried drain or vent.

.2 Pipe:

.1 copper DWV tube to ASTM B306

.2 certification markings made by testing agency accredited by Standards Council of Canada.

.3 Fittings:

.1 copper or copper alloy to ASME B16.23, or ASME B16.29.

.4 Solder

.1 tin-antimony 95/5 to ASTM B32 alloy Sb5.

2.2 Cast Iron DWV Pipe and Fittings

.1 Application: inside of buildings and buried drain and vent.

.2 Pipe and fittings:

.1 cast to CSA B70,

.2 with heavy bituminous coating for buried service.

.3 Joints below grade:

.1 Plain end made up using mechanical sleeve joints to CSA B602 and ASTM C1540 with neoprene or butyl rubber compression gaskets to ASTM C564, with stainless steel sleeve and not less than four stainless steel drive clamps with stainless steel worm gears

.4 Joints above ground:

.1 Plain end made up using mechanical sleeve joints to CSA B602 and ASTM C1540 with neoprene or butyl rubber compression gaskets to ASTM C564, with stainless steel sleeve and not less than four stainless steel drive clamps with stainless steel worms.

.2 Hub and spigot made up neoprene gasket to ASTM C564 and lubricating compound.

.5 Tie-rods:

.1 fabricated by double bolted riser clamps and 10mm (3/8 in) carbon steel rods, with riser clamp placed on each side of joint.

2.3 PVC DWV Pipe and Fittings

.1 Application:

.1 Restricted to fixture drain piping and partial vent pipe for urinals.

.2 Pipe and fittings:

.1 PVC pipe and fittings to CSA-B181.2,

.2 flame spread rating (“FSR”) of not more than 25 when tested to ULC-S102.2,

.3 smoke developed rating (“SDR”) of not more than 50 when tested to ULC-S102.2.

.4 materials marked for CSA B181.2 and ULC-S102.2.

Standard of Acceptance

- IPEX -“System XFR 15-50”

.3 Joint cement:

.1 one-step CSA listed cement for pipe sizes NPS 1½ to NPS 6.

.2 IPS primer Type P-70 and Heavy Bodied IPS Cement Type 711 for pipe sizes larger than NPS 6.

.3 Volatile Organic Content: maximum 510 g/L.

3 EXECUTION

3.1 Installation General

.1 Install soil, waste and vent piping in accordance with the requirements of the plumbing code applicable at the project location. Except as otherwise shown, venting of fixtures may use any method permitted in the plumbing code.

.2 Install suspended piping to grade, parallel and close to walls and ceilings to conserve headroom and space.

.3 Install piping close to building structure to minimize furring. Group piping and run parallel to walls and ceilings.

3.2 Cast Iron Piping

.1 Install cast iron drainage piping in accordance with Cast Iron Soil Pipe and Fittings (CISPF) Technical Manual.

.2 Lay buried piping in bedding prepared in accordance with specification section 20 05 25. Support piping on 150 mm (6 in.) thick bed of clean sand, shaped to accommodate hubs and fittings, to line and grade as shown. Backfill with clean sand to 300 mm above top of pipe or to underside of floor slab whichever is less.

.3 For suspended piping, provide hangers within 450 mm (18 in.) of each joint, at each change of direction, and within 450 mm (18 in.) of the terminal end of each pipe run.

.4 Assemble and tighten mechanical sleeve joints to coupling manufacturers recommended torque value with torque wrench.

.5 Provide braces or tie-rods on horizontal piping NPS 5 and larger:

.1 at each branch opening or change of direction,

.2 at each pipe run coupling.

.6 Provide sway bracing on all horizontal piping where the hanger length is greater than 450 mm (18 in.) from the top of the pipe to the connecting point on the structure. For projects requiring seismic restraint, coordinate these sway bars with the seismic restraint supports.

.7 Install cast iron hub-and-spigot joints with neoprene compression gasket and lubrication in accordance with manufacturer requirements.

3.3 Copper Tubing

.1 Cut copper tube square, ream tube ends and clean tubing and tube ends before joint assembly.

.2 Before assembling solder joints, clean inside of solder fittings and outside of mating pipe with emery paper and coat with flux.

.3 Solder joints in copper pipe with blow torch or oxy-acetylene flame.

3.4 Testing

.1 Test drainage piping in accordance with the requirements of the plumbing code applicable at the project location.

.2 Test before piping is concealed.

.3 Cut-out and replace leaking soldered fittings, remake joints in cast iron piping, and retest.

END OF SECTION

SANITARY DRAINS
22 13 19.13

1 GENERAL

1.1 Scope

.1 Provide sanitary waste piping accessories including floor drains, area drains and cleanouts.

1.2 Definitions

.1 The following definitions apply to this specification section.

.1 ***Grate:*** the finished exposed element of the floor or area drain which is suitable for heavy loads including vehicle loads.

.2 ***Sheet waterproof flooring:*** includes vinyl sheet or tiles, linoleum sheet or tiles, and rubber sheet or tiles, which have an installed thickness of 6 mm (1/4 in.) or less.

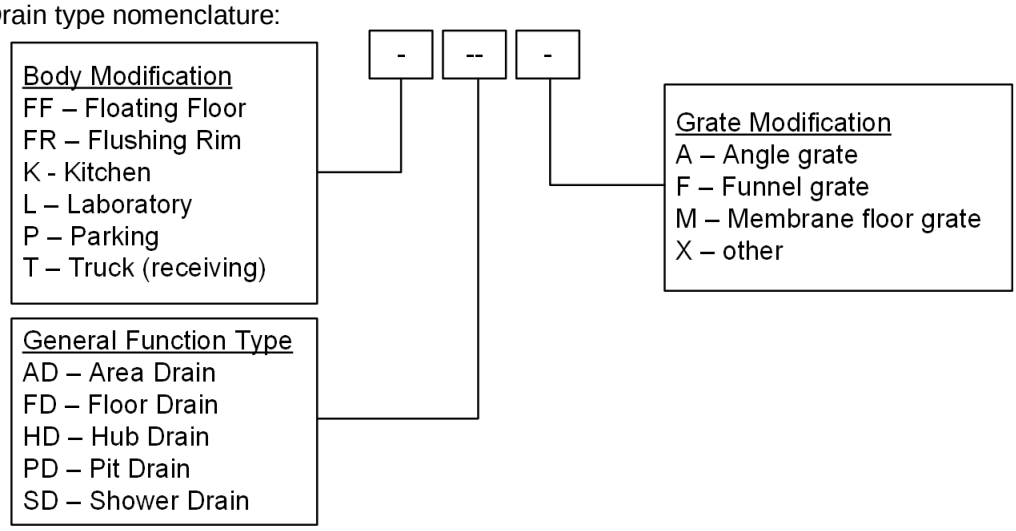
.3 ***Strainer:*** the finished exposed element of the floor or area drain which is suitable for foot traffic only.

.4 ***Strainer shank:*** the strainer supporting element which connects to the drain body. Grate shank has the same meaning.

.5 ***Tile (floors):*** includes ceramic or porcelain tiles and similar materials that are thicker than 6 mm (1/4 in.) including mortar/adhesive bed.

.2 Load ratings of Light Duty, Medium Duty, Heavy Duty, Extra Heavy Duty and Special Duty: in accordance with CSA B72 / ASME A112.3.1 / ASME A112.6.3.

.3 Drain type nomenclature:



1.3 Applicable Codes and Standards

.1 Product standards:

.1	ASME A112.3.1	Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above-ground and Below Ground
.2	ASME A112.6.3	Floor and Trench Drains
.3	ASME A112.36.2M	Cleanouts

.4 CSA B79 Commercial and Residential Drains and Cleanouts

1.4 Submittals

.1 Submit product data sheets for materials specified herein.

2 PRODUCTS

2.1 Floor Drains (type "FD")

.1 Floor drains to be listed to CSA B79 and marked in accordance with ASME A112.3.1 (stainless steel floor drains), or ASME A112.6.3 (non-stainless steel floor drains).

.2 The following requirements apply to all floor drains, combination drains, and hub drains except as otherwise specified.

.3 Construction:

.1 application: general purpose floor drains, for floors with or without a sub-floor membrane.

.2 loading: Light Duty to CSA B79, for foot traffic,

.3 body:

(a) coated cast iron with minimum Ø200 mm (8 in.) diameter anchor flange with primary and secondary drainage (seepage) openings,
(b) sub-floor membrane clamp,
(c) bottom hub outlet pipe connection.
(d) NPS ½ NPT trap seal primer connection.
(e) No-hub outlet.

.4 strainer:

(a) adjustable height, nickel bronze or stainless steel strainer secured with stainless steel tamper resistant (Allen key) screws,
(b) openings not exceeding 8 mm (5/16 in.) in any direction,
(c) round shape for poured monolithic floor finishes,
(d) square shape for tiled or similar floor finishes,
(e) minimum size: based on location in accordance with the following table.

Drain Pipe Size, NPS	Strainer/Grate Size mm (in.) diameter or square		
	General Purpose, Kitchens	Service Rooms, Wash Down Rooms, Emergency Fixtures	Parking, Loading Docks
2	125 (5)	125 (5)	---
3	175 (7)	200 (8)	---
4	200 (8)	250 (10)	250 (10)
6	250 (10)	250 (10)	250 (10)

.5 Drain body pipe size as shown on drawings.

Standard of Acceptance

- Watts - fig. FD-100-C-A
- Zurn - fig. Z415 series
- Mifab - fig. F1100-C series
- Jay R. Smith - fig. 2005-C series

2.2 Funnel Floor Drain (type "FDF-") – General Purpose

.1 Application: floors in general purpose spaces and service rooms.

.2 Type FD floor drains and/except as follows:

.1 floor drains other than in service rooms: one piece integral funnel and open-throat strainer, Ø100mm (4 in. dia.) round funnel,

.2 floor drains in service rooms: one piece integral funnel and open-throat strainer, 100 mm x 225 mm (4 in. x 9 in.) elliptical funnel.

2.3 Cleanouts

.1 Listed to CSA B79 and marked in accordance with ASME A112.36.2M.

.2 In floors:

.1 line size for NPS 2, NPS 3 and NPS 4, and NPS 4 in larger lines.

.2 body: cast iron body with sub-floor membrane clamp, and with gas-tight plug.

.3 head - unfinished floor areas including service rooms:

(a) coated cast iron frame heavy duty scoriated cast iron round.

.4 head - finished floor areas:

(a) round, coated cast iron frame and polished nickel bronze adjustable head cover[.][,

3 EXECUTION

3.1 Installation - General

.1 Install sanitary drainage specialties in accordance with the applicable provincial plumbing code, and the requirements of the local authority having jurisdiction.

.2 Install sanitary drainage specialties in accordance with the manufacturers installation instructions and as described herein.

3.2 Floor Drains and Area Drains

.1 For floors constructed with a sub-floor membrane;

.1 install bodies flush to top of structural slab, and provide temporary coverings to protect top surface of anchor flange, receiver threads and body openings during concrete pour,

.2 after the sub-floor membrane is installed, install the membrane clamp and strainer and set the strainer top to be at the finished floor level or slightly lower,

.2 For floors constructed as a single concrete pour without a sub-floor membrane, set the body and the strainer to suit the final floor elevation prior to concrete pour. Provide temporary covering of the strainer top surface.

.3 For all types of floors, place clear pea gravel around the top of the anchor flange to protect the primary and secondary weeping drainage openings from being plugged with concrete or other flooring material.

.4 Where shown on drawings for a combination floor drain, install a hub of specified type by attaching to the floor drain strainer.

3.3 Cleanouts

.1 Install cleanouts at the base of soil and waste stacks, at changes in direction of sanitary drainage piping, at intermediate locations on long runs of piping, and as shown.

.2 Extend cleanouts flush to wall or up to finished floor above except as follows:

.1 clean-outs may be terminated in accessible ceiling spaces except where drawings indicate the clean-out is to be extended up through the floor.

.3 Install cleanouts located in floors clear of obstructions.

END OF SECTION

PLUMBING FIXTURES & TRIM
22 42 13

1 GENERAL

1.1 Scope

.1 Provide plumbing fixtures and trim.

1.2 Applicable Codes and Standards

.1 Installation codes and standards:

.1 CSA Z317.1 Special Requirements for Plumbing Installations in Health Care Facilities.

.2 CSA Z318.3 Commissioning of Plumbing Systems in Health Care Facilities

.2 Product standards:

.1 CSA-B45 Series Plumbing Fixtures.

.2 CSA-B125 Plumbing Fittings.

.3 UL 1951 Electrical Plumbing Accessories

.4 ASME A112.6.1 Supports for Off-the-Floor Plumbing Fixtures for Public Use

1.3 Design Criteria

.1 Fixture count and location:

.1 Determine the number and location of plumbing fixtures from Architectural drawings in the first instance, followed by the mechanical drawings.

.2 In the event of a conflict as to location of plumbing fixtures between the architectural drawings and the mechanical drawings, the location as shown on the architectural drawings govern.

2 PRODUCTS

2.1 General Requirements - Fixture Quality

.1 Fixtures and trim of the same type to be the product of one manufacturer.

.2 Finished surfaces to be clear, smooth and bright, and guaranteed not to craze, discolour or scale.

.3 Visible parts of faucets, escutcheons, wastes, strainers, traps, shower heads, supplies and stops to be chrome plated.

.4 Do not include aerators in water supply faucets in healthcare facilities

.5 Floor mounted water closets fitted with china bolt caps; plastic bolt caps are not acceptable.

.6 Where fixtures and trim are identified by manufacturers' catalogue designation these references are to establish quality standards not otherwise specified. For the purposes of this section of the specification, fixtures or trim from manufacturers listed below are equally acceptable when conforming to the same level of quality.

Standard of Acceptance

° Eljer

- American Standard
- Crane
- Kohler
- Symmons Valve
- Waltec
- Delta Commercial
- Emco
- Beneke
- Centoco
- Kindred
- Waltec
- Architectural Metals

2.2 Sink Type "S-1"

.1 Single station scrub sink with laminar flow spray head (2.2 gpm/8.3 Lpm max.)

Single station stainless steel scrub sink with sensor activated, 24 VAC, chrome plated brass hand washing faucet with the following features:

- Sink constructed from 14 gauge, Type 304 stainless steel with bead blast finish on sink bowl interior for superior wash-down characteristics
- Cabinet constructed from 14 gauge, Type 304 stainless steel with satin finish
- 18 gauge “lift-out” style front access panel for easy maintenance access
- 1 ½” stainless steel dome strainer with integral tailpiece and P-trap
- “Z-clip” wall hangers for mounting (fasteners by others)
- Unit supplied with 20” flexible supply hoses

Sloan Optima faucets feature:

- Sloan OPTIMA EL-1500-LL-S self-adaptive sensor with 2 second on-delay, sensor mounted in the front edge of sink for hands-free operation
- Splash-proof control modules with troubleshooting LED indicator lights
- Filtered solenoid valve with serviceable “Y” strainer filter
- Chrome plated, brass, deck mounted gooseneck spout with surgical bend
- 2.2 gpm (8.3Lpm) maximum pressure compensating laminar spray head (“C” variation)
- 120 VAC/24 VAC plug-in transformer

Sink to be complete with below deck thermostatic mixing valve – MIX-70-A

Standard of Acceptance
- Sloan ESS-2100-C-BDT

2.3 Sealant Between Fixture and Wall Finish:

.1 One-part acetoxy silicone sealant

.2 White or clear colour.

.3 Formulated with fungicide

Standard of Acceptance
- Tremco Tremsil 200
- Dow Corning
- GE

3 EXECUTION

3.1 Fixture Installation - General

.1 Support fixtures level and square and connect with supplies, drains, traps and vents.

.2 Where a faucet has separate hot and cold water handles, position the hot water handle on the left side of the faucet.

.3 Where fixtures on located on exterior walls, run the water supplies up through the floor. For other fixture locations, run water supplies in the wall cavity.

.4 Provide resilient, watertight and gas-tight seals for every joint in a floor flange or between a floor-outlet fixture and the drain.

3.2 Fixture Supports

.1 Provide plates, brackets, wall carriers, cleats, and supports to secure fixtures in place.

.2 Fasten wall brackets with bolts attached to double steel supporting plates.

.3 Bolt fixture to wall through cored holes under lavatory wall flange, using chrome plated carriage bolts with integral washers, and expansion shields.

.4 Install extra-heavy-duty chair carriers for fixtures not directly supported from floor.

.5 Conceal vertical supports and baseplates in wall construction.

.6 Apply sealant bead between wall mounted fixture and finished wall and finish with a smooth concave profile.

.7 Set floor mounted water closet bowls in mastic, and seal the floor flange with a resilient, watertight and gas-tight flange seal.

3.3 Plumbing Fixture Installation Heights and Clearances

.1 Install plumbing fixtures at heights as shown on architectural drawings and specifications. Where such information is not provided therein, install fixtures at heights as described in the following table.

.1 Mounting heights are in reference to the top of the finished floor level unless otherwise stated.

Fixture Type	Mounting Height Reference (above finished floor)	Mounting Height Mm (inch)	
		Barrier-Free	All Other
Water Closet	Top of seat	≥ 430 and ≤ 460 (≥ 17 and ≤ 18)	≥ 430 and ≤ 460 (≥ 17 and ≤ 18)

Fixture Type	Mounting Height Reference (above finished floor)	Mounting Height Mm (inch)	
		Barrier-Free	All Other
Urinal	Front rim	400 to ≤ 430 (16 to ≤ 16.5) [Note 1]	575 to ≤ 600 (22.5 to ≤ 23.5)
Lavatory	Rim	850 to ≤ 865 (33.5 to ≤ 34)	850 to ≤ 865 (33.5 to ≤ 34)
Shower	Valve control handle	1150 to ≤ 1200 (45 to ≤ 47)	1150 to ≤ 1200 (45 to ≤ 47)
	Hand-held shower head: Two positions	1200 and 2300 (45 and 90) [Note 2]	1200 and 2300 (45 and 90) [Note 2, 3]
Bathtub	Faucet centerline (above tub rim)	425 to ≤ 450 (16.5 to ≤ 17.5)	425 to ≤ 450 (16.5 to ≤ 17.5)
	Hand-held shower head; Two positions	1200 and 2300 (45 and 90) [Note 2]	1200 and 2300 (45 and 90) [Note 2, 3]

Notes:
[1] Where there are two or more urinals in a washroom, one urinal is to be mounted at this height.
[2] An adjustable hand-held shower head mounted on a vertical shower bar, that can be set at these positions.
[3] If specified.

.2 Mount manually-operated flushing control for water closets;

.1 between 500 and 900 mm above the finished floor, and

.2 for barrier-free water closets, located on the transfer side of the water closet.

.3 Mount manually-operated flushing control for urinals;

.1 between 900 and 1100 mm above the finished floor level for barrier-free urinals, and

.2 at a height to suit the urinal fixture and flush-control valve for all other urinals.

.4 For barrier-free lavatories not equipped with a fixture-skirt barrier, arrange piping beneath the lavatory so that the hatched area shown in figure 1 is clear of any obstruction.

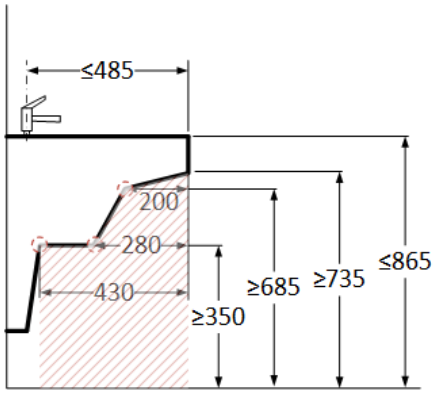


Figure 1: Barrier-Free Lavatory Clearances

3.4 TMV Installation

.1 Provide field installed in-line brass bodied swing check valves on the hot and cold water supplies to each TMV unit. For greater certainty, if the TMV unit is supplied with integral check valves they are deemed not to meet this requirement.

3.5 Protection

.1 Cover plumbing fixtures and trim with plywood, cardboard or heavy paper and kept protected before, during and after installation and until work is completed and accepted.

.2 Clean fixtures, and trim immediately prior to building completion.

3.6 Hot Water Temperature Limits

.1 Test, adjust and set high temperature limit stops on shower fixtures to supply a maximum water temperature of 49°C (120°F).

.2 Test, adjust and set temperature control on thermostatic mixing valves to supply a maximum water temperature of:

.1 49°C (120°F) for group showers, and

.2 29°C (85°F) for emergency showers.

.3 Provide a report of this testing and include:

.1 fixture reference,

.2 measured maximum temperature,

.3 date of test(s),

.4 signature of person(s) conducting test.

.4 The above tests are subject to a demonstration test audit of up to 10% of the total fixture count to verify compliance. If audit tests are not satisfactory to the Consultant, additional testing and verification will be conducted by the Contractor until such time as a demonstration audit provides satisfactory results to the Consultant.

END OF SECTION

MEDICAL GAS PIPING
22 60 13.70

1 GENERAL

1.1 Scope

.1 Provide medical gas piping distribution systems including:

.1 piping, fittings, and valves,

.2 medical gas control panels,

.3 line pressure regulators and safety valves,

.4 terminal units, including terminal units to be installed in Medical Supply Units, headwall units and ceiling mounted service columns.

.5 pipe hangers and accessories,

.2 Applicable systems:

.1 Medical pressure gases intended for patient care:

(a) oxygen USP,
(b) medical air USP,
(c) nitrous oxide USP,
(d) carbon dioxide USP,
(e) oxygen 93 USP,
(f) helium USP,
(g) oxygen USP/nitrous oxide USP mixtures,
(h) helium USP/oxygen USP mixtures.

.2 Medical pressure gases for powering devices unrelated to human respiration:

(a) nitrogen NF.

.3 Medical vacuum and AGSS.

.3 Refer to specification section 22 63 26 for zone valve stations and combination zone valve/ zone alarm panels.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	20 01 02	Qualifications and Authorities
.2	20 05 24	Welding and Brazing
.3	20 05 25	Excavation and Backfilling
.4	20 05 29	Hangers and Supports
.5	22 63 26	Medical Gas Alarm Equipment

1.3 Definitions

.1 The following definitions apply to this section and referenced sections:

.1 ***Anaesthetic gas scavenging system (AGSS):*** a complete system that is connected to the exhaust port(s) of a breathing system or other equipment for the purpose of conveying expired or excess anaesthetic gases to an appropriate place of discharge.

.2 ***Anaesthetizing location****: a*ny room in a health care facility in which:

(a) the induction and maintenance of general anaesthesia are routinely carried out in the course of the examination or treatment of patients; or
(b) both nitrous oxide and oxygen are supplied by pipeline.

.3 ***Certification Agency:*** a testing organization of medical gas systems accredited to the requirements of ISO/IEC 17025 by Standard Council of Canada (has the same meaning as "testing body" as used in CSA Z7396.1.

.4 ***Diameter index safety system (DISS):*** threaded connections that comply with the requirements of CGA V-5.

.5 ***Instrument air****:* the compressed air intended for powering of medical devices unrelated to human respiration (e.g., surgical tools, ceiling arms).

.6 ***Master alarm:*** has the same meaning as "supply system alarm" in CSA Z7396.1.

.7 ***Medical gas:*** means all services within the scope of CAN/CSA-Z7396.1.

.8 ***Medical pressure gas:*** means only those medical gases which operated under positive pressure.

.9 ***Medical supply units***: means those medical devices which supply medical gases within the scope of CSA Z305.8.

.10 ***Pipe (piping)***: has the meaning as defined in ASME B31.3, and is used interchangeable with "tube" or "tubing", except where the context indicates otherwise.

.11 ***Qualified installer***: a competent person or company responsible for the installation of medical gas pipeline systems or components within a medical gas system.

.12 ***Service units***: includes headwall units, ceiling-mounted service columns, ceiling-mounted articulating arms, patient service strips and medical supply units.

.13 ***Terminal unit****:* an outlet assembly for medical gases in a medical gas pipeline system at which the operator makes connections and disconnections.

.14 ***USP***: United States Pharmacopeia.

.15 ***USP-NF***: USP National Formulary

.16 ***Zone, zone alarm, and zone valve:*** have the same meaning as defined in CSA Z7396.1.

1.4 Applicable Codes and Standards

.1 Legislation:

.1 Ontario Regulation 220/01 Boiler and Pressure Piping Regulation,

.2 Ontario Regulation 213/07 Fire Code

.2 Installation codes and standards:

.1	ASME B31.3	Process Piping
.2	CSA B51	Boiler, Pressure Vessels and Pressure Piping Code.
.3	CSA Z7396.1-17	Medical Gas Pipeline Systems - Part 1: Pipelines for Medical Gases and Vacuum
.4	CAN/CSA Z15001	Anaesthetic and Respiratory Equipment - Compatibility with Oxygen
.5	CGA G-4.1	Cleaning Equipment for Oxygen Service.

.3 Product standards:

.1	ASME B1.20.1	Pipe Threads, General Purpose, Inch
.2	ASME B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.3	ASME B16.50	Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
.4	ASTM B819	Standard Specification for Seamless Copper Tube for Medical Gas Systems.
.5	AWS A5.8	Brazing Filler Metal.
.6	CGA V-5	Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)
.7	CSA Z305.8	Medical Supply Units
.8	CAN/CSA-Z5359	Anaesthetic and respiratory equipment — Low-pressure hose assemblies for use with medical gases, medical vacuum, medical support gases, and anaesthetic gas scavenging systems
.9	CSA-Z9170-1	Terminal units for medical gas pipeline systems - Part 1: Terminal units for use with compressed medical gases, vacuum, and anaesthetic gas scavenging systems
.10	CAN/CSA-Z10524-2	Pressure Regulators for Use with Medical Gases - Part 2: Manifold and Line Pressure Regulators

1.5 Qualified Tradesperson

.1 Work to be performed by qualified, licensed and recognized firm with an established reputation in this field, using tradespersons holding applicable certificates of competency for pressure piping and brazing work.

.2 In addition, medical gas systems shall be installed by a specialist firm that: has experienced in this type of work; is knowledgeable of the applicable regulations, installation codes and standards; has registered procedures for silver brazing; and regularly employs tradespersons qualified in pressure piping installation. Before commencing work on site, supply copies of tradespersons certificates of competency for brazing to the Owner for their records.

.3 In addition, tradespersons performing work on medical gas systems shall be certified in accordance with CSA *Medical Gas Piping & Systems Installation Personnel Certification Program.* Prior to commencing work on site, supply copies of certification record to the Owner for each qualified tradesperson working performing work on the medical gas system.

1.6 Registration and Inspection

.1 Pressure piping:

.1 Before commencing work, make arrangements and pay for registration and inspection of pressure vessels and pressure piping by the AHJ responsible for Pressure Piping safety, unless otherwise exempt by regulation.

.2 All materials which operate with an internal gas pressure greater than 100 kPa (15 psi) above atmospheric pressure shall have a CRN in accordance with CSA B51.

.3 Collect and record CRNs for components and fittings, and obtain and coordinate equipment CRNs or field registration of composite equipment.

.4 At the start of the Work, obtain existing pressure piping system registration numbers, if available, from the Owner and/or the AHJ.

.2 Fire safety:

.1 Before commencing work, make arrangements and pay for permits and inspection of medical gas piping systems by the AHJ responsible for fire safety.

1.7 Design Criteria – Medical Gas and Vacuum Piping

.1 Piping design and installation code:

.1 to ASME B31.3.

.2 System design criteria:

System	Design Temp. °C (°F)	Maximum Operating Pressure kPa (psig)	Design Pressure kPa (psig)
Oxygen	38 (100)	415 (60)	700 (100)
Medical Air	38 (100)	415 (60)	700 (100)
Nitrous Oxide	38 (100)	415 (60)	700 (100)
Nitrogen	38 (100)	1240 (180)	1550 (225)
Instrument Air	38 (100)	1240 (180)	1550 (225)
Carbon Dioxide	38 (100)	550 (80)	850 (125)
Medical Vacuum	38 (100)	-70 (-20 in.Hg.)	-100 (-30 in.Hg.)
AGSS	38 (100)	-55 (-16 in.Hg.)	-100 (-30 in.Hg.)

1.8 Submittals

.1 Submit manufacturer catalogue cut-sheets for the following materials;

.1 tubing,

.2 valves,

.3 terminal units,

.4 line pressure regulators, safety valves and assemblies,

.5 emergency gas inlet connections.

1.9 Quality Control

.1 Site Acceptance Testing;

.1 Manufacturer to provide services of manufacturer's authorized service personnel to provide field services in accordance with the requirements of Part 3 of this specification.

.2 Brazing Quality Control;

.1 Maintain records of in-process examination of not less than 5% of production brazed joints in accordance with ASME B31.3. Submit copies of examination records of selected joints (or nearest examined joint) when requested by the Certification Agency or the Consultant.

.2 Include a copy of in-process examination records in the maintenance and operations manual.

.3 Commissioning and Certification;

.1 The medical gas installation contractor shall be responsible to commission the medical gas systems in accordance with the requirements of CSA Z7396.1 and as specified herein.

.2 The medical gas systems will be certified by an independent Certification Agency, hired directly by the Owner, to verify that the installation is in accordance with CSA-Z7396.1. The medical gas installation contractor shall include labour, superintendence and all other costs associated with co-ordination, attendance and participation during certification testing of the medical gas systems.

1.10 Material Shipping, Handling and Storage

.1 Where specified as to be cleaned for oxygen service, material shall be cleaned in accordance with CGA G-4.1 or CAN/CSA Z15001, sealed in a plastic bag, labelled to state that the product has been so cleaned, and shipped to the project site in packaging to prevent contamination by dirt, grease, or other foreign matter.

.2 Where such material protection is damaged prior to installation, including damage to the packaging, the material shall not be installed and shall be removed from the site.

.3 Store materials in clean and dry conditions.

1.11 Operating and Maintenance Data

.1 In addition to the requirements of Division 01, submit operating and maintenance data including:

.1 equipment list identifying components used in each system,

.2 equipment manufacturer's names and addresses,

.3 wiring diagrams of alarms and electrical components,

.4 detailed drawings of equipment and components,

.5 manufacturers service manuals, including recommended maintenance tasks and frequency, and recommended spare parts,

.6 manufacturers' warranties,

.7 valve schedule listing valves in system with location.

.8 Canadian Registration Numbers (CRN) for components and fittings.

.9 manufacturer instructions for the non-destructive and non-invasive procedures for testing of alarms,

2 PRODUCTS

2.1 Copper Tube

.1 Hard drawn copper to ASTM B819;

.1 type "L" except as follows:

(a) type "K" for tube size NPS 3 and larger with design pressures in excess of 1275 kPa (185 psi),
(b) type "K" for buried (underground) services.

.2 factory cleaned and marked with classification symbols for medical gas use,

.3 cleaned for oxygen service,

.4 shipped with pipe end sealed.

2.2 Fittings

.1 Wrought copper or copper alloy to ASME B16.22 or ASEM B16.50, and

.2 For pipe sizes NPS 1/2 or less, fittings that are not made especially for soldered or brazed connections may be used, provided that the fitting as installed is visible in the room or is readily accessible for maintenance.

.3 Dielectric fittings may be used where required by the manufacturer of special medical equipment to electrically isolate the equipment from the pipeline distribution system.

.4 Axially swaged, elastic strain preload fittings providing metal-to-metal seal may be used provided that the fittings have pressure and temperature ratings not less than that of a brazed joint and, when complete, are permanent and non-separable.

.5 All fittings to be cleaned for oxygen service.

Standard of Acceptance

° LOKRING Technology

2.3 Flanges and Gaskets

.1 Flange:

.1 ASME Class 150 or 300 carbon steel flange, Van-stone style with copper tube adapter tailpiece, suitable for brazed connection to copper tubing. Flange designed to prevent contact of carbon steel material and the medical gasses.

.2 flange provided with a powder coated finish, and an EPDM insulator to isolate the copper tailpiece form contact with the flange.

.3 minimum MCPR:

(a) Class 150: 1400 kPa (250 psi) at 38°C (100°F)

(b) Class 300: 2800 kPa (400 psi) at 38°C (100°F)

Standard of Acceptance

° CTS Flange Canada - fig. BF / WBG

.2 Flange gaskets:

.1 full flat-faced style to ANSI B16.21.

.2 material: PTFE with silica, suitable for use in oxygen service and nitrous oxide.

(a) thickness: 1.6 mm (1/16 in.).
(b) required working pressure: 7000 kPa (1000 psi), from -268°C (-450°F) to +260°C (500°F)

Standard of Acceptance

° Garlock - fig. Gylon 3502

2.4 Joints

.1 Brazed joints:

.1 for copper-to-copper joints: silver brazing alloy to AWS A5.8 classification BCuP-3 or BCuP-5, and no flux.

.2 for brazing dissimilar metals: silver brazing alloy to AWS A5.8 classification BCUP-5 with brazing flux No. 3A.

Standard of Acceptance

° Handy Harmon "SIL-FOS"
° All-State Welding Alloys "SILFLO 15"

.2 Threaded joints:

.1 for connections to valves and other equipment: NPT to ASME B1.20.1.

.2 thread sealant: oxygen compatible Teflon tape.

Standard of Acceptance

° Masters - Oxygen compatible T-Tape

2.5 Pipe Hangers and Supports

.1 Refer to section 20 05 29 except as specified herein.

.2 Trapeze Hangers:

.1 12 ga galvanized steel channel frames, solid backs.

Standard of Acceptance

° Taylor Figure TS
° Unistrut

.3 Pipe/Tubing Clamps:

.1 two piece, epoxy coated clamp, with thermoplastic liner to separate piping from clamp.

Standard of Acceptance

° Taylor Figure 8500 Strut-Clamp
° Unistrut

.4 Spacers:

.1 U-shape splice plates used as spacer control between adjacent piping clips.

Standard of Acceptance

° Taylor UF series
° Unistrut

2.6 Ball Valves

.1 NPS 4 and under – general requirements:

.1 for medical gases, medical vacuum and AGSS.

.2 to MSS SP-110, 600 CWP, three-piece forged brass or bronze body, full port, stainless steel ball or chrome plated bronze ball, PTFE seat rings, and blow-out resistant with Viton seals, solder ends.

.3 required MCPR: 4100 kPa (600 psig) at 38°C (100°F).

.4 lever handle with locking device.

.5 factory assembled with type K" copper tube extensions to ASTM B819, complete with 1/8" FNPT inlet purge port, and an outlet purge/gauge ports.

.6 cleaned for oxygen service and with tube ends capped.

Standard of Acceptance

° Amico - fig. VV-ISO-G2L series
° Class I - fig. 7300 series
° BeaconMadaes - fig. 21160 series

.2 Additional requirements for Zone Valves, up to NPS 3:

.1 application: ball valves installed inside of zone valve boxes/stations.

.2 ball valves as specified above. and as follows:

(a) copper tube extensions to a minimum of 100 mm (4 in) beyond sides or back of zone valve box,
(b) an additional 1/8" FNPT port on the discharge end for connection of pressure transducers,
(c) identification bracket bolted over valve body for application of medical gas identification label,
(d) fitted with line pressure gauges suitable for each gas or vacuum service,

2.7 Butterfly Valves

.1 NPS 2-1/2 and over:

.1 for medical vacuum and AGSS services only.

.2 to MSS-SP-67, ductile iron lug body style, with flange bolt holes drilled and tapped for ANSI 150 flange pattern.

.3 stainless steel shaft, aluminum bronze or 316 stainless steel or ductile iron/nickel plated disc, and replaceable EPDM or BUNA-N resilient seat to provide bubble tight shut-off under system pressure from either side with flange removed from un-pressurized side.

.4 required MCPR:1200 kPa (174 psi) at 93°C (200°F).

.5 ISO 5211 mounting pad.

.6 locking handles up to NPS 4, and gear operators for NPS 6 and over.

.7 cleaned for oxygen service.

Standard of Acceptance

- Class 1 - fig. BFC-Lug
- Nibco - fig. LD-2000
- Apollo - fig. LD 141, LD 145
- Kitz - fig. 6122EL

2.8 Check Valves

.1 In-line Silent Check, NPS 4 and under:

.1 three-piece bronze body with swing out core, spring-loaded duo-disc, EPDM seat, socket ends.

.2 factory assembled with type K" copper tube extensions to ASTM B819, complete with 1/8" FNPT inlet purge port, and an outlet purge/gauge ports.

.3 cracking pressure less than 3.5 kPa (1/2 psi).

.4 required MCPR: 2000 kPa (300 psi) at 93°C (200°F).

.5 cleaned for oxygen service and with tube ends capped.

Standard of Acceptance

- Amico - fig. Medical Check Valve with Extensions
- Class 1 - fig. CVE series
- US Valve - fig. Medical Check Valve with Extensions

.2 In-line Silent Check Valves, NPS 2 and over:

.1 to ASME B16.34, Class 150, ASTM A351 grade CF8M stainless steel wafer body, stainless steel trim and spring-controlled dual-disc check, EPDM or PTFE seat.

.2 required MCPR:1800 kPa (260 psig) at 38°C (100°F).

.1 cleaned for oxygen service.

Standard of Acceptance
- Dezurik - fig. APCO CDD-9000T
- Crane - fig. Duo-Chek
- Mueller - fig. Sure Check 72D

2.9 Line Pressure Gauges

.1 For source and distribution piping, not including zone valves.

.2 To ASME B40.100 Grade 2A, direct pressure measurement, Ø115 mm (4½ in) dial type, silicone-free dampening, bronze tube, black solid front case, blow-out back, 0.5% full scale accuracy, adjustable pointer.

.3 Measurement units and ranges:

.1 Gases: dual units kPa/psi;

(a) 0 to 700 kPa / 0 to 100 psig for all gases except Nitrogen, and Instrument Air,
(b) 0 to 2000 kPa / 0 to 300 psi for Nitrogen and Instrument Air,

.2 Vacuum: dual units kPa/in.Hg;

(a) -100 to 0 kPa / 30 in.Hg. to 0 for Medical Vacuum and AGSS.

.4 Cleaned for oxygen service.

Standard of Acceptance
- Trerice - 450B

.5 Accessories:

.1 pressure snubbers:

(a) brass construction, NPT threaded ends.
(b) cleaned for oxygen service.

Standard of Acceptance
- Trerice – 872-1

.2 needle valves:

(a) rising stem, brass or T316 stainless steel construction, NPT threaded ends.
(b) cleaned for oxygen service.

Standard of Acceptance
- Trerice - 735 / 740

2.10 Medical Gas Control Panels

.1 Recessed, wall mounted in 1.3 mm (18 ga) painted steel back box with supports to secure unit within wall or partition and anodized aluminum fascia,

.2 Anodized aluminum front cover, with panel covered gas pressure regulation controls:

.1 inlet pressure gauge: 0-2000 kPa (0-300 psig) mounted ahead of shut-off valve,

.2 shut-off valve: integral 2000 kPa (300 psi) quarter-turn valve valve,

.3 pressure regulator: self-actuated, adjustable from 0 to 1700 kPa (o to 250 psi)

.4 outlet pressure gauge: 0-2000 kPa (0-300 psig) mounted ahead of shut-off valve,

.5 DISS check body, of type to suit medical gas service.

.3 Internal tubing: NPS 3/8 type K copper to ASTM B819, with inlet and outlet extension risers.

.4 Maimum pressure rating: 1700 kPa (250 psi).

.5 Cleaned for oxygen service and with tube ends capped.

Standard of Acceptance

- Amico - fig. Alert-1 Gas Control Panel
- Class 1 - fig. NCP/IP/CCP

2.11 Line Pressure Regulator Valves

.1 Forged brass body and housing cap, large diaphragm for high flow applications, and adjustable loading handle.

.2 Internal materials suitable for each applicable medical gas and conforming to CAN/CSA Z10524-2.

.3 Pressure ratings:

.1 valve maximum inlet gas pressure rating: 2400 kPa (250 psi).

.2 operating nominal inlet (intermediate) pressures:

(a) Oxygen, Medical Air, and Nitrous Oxide: 700 kPa (100 psi)
(b) Nitrogen and Instrument Air: 2000 kPa (300 psi)
(c) Carbon Dioxide: 850 kPa (120 psi)

.4 Cleaned for oxygen service.

.5 Accessories:

.1 Ø65 mm (2-1/2 in.dia.) pressure gauge measuring outlet pressure.

Standard of Acceptance

- Amico
- Class 1
- BeaconMadaes

2.12 Pressure Safety Valves

.1 Bronze body, re-seatable, spring loaded type, with brass or bronze trim, with NPT connections.

.2 Relief flow rating: full flow of all connected upstream sources.

.3 Relieving setpoint:

(a) Oxygen, Medical Air, and Nitrous Oxide: 514 kPa (75 psi)
(b) Nitrogen and Instrument Air: 1380 kPa (200 psi)
(c) Carbon Dioxide: 720 kPa (105 psi)

.4 ASME Section VIII, UV code stamped.

.5 Cleaned for oxygen service.

Standard of Acceptance

- Amico
- Class 1
- BeaconMadaes

2.13 Dual Line Pressure Regulator Station

.1 Factory assembled line pressure regulation station with dual line pressure regulators, dual pressure relief valves, one (1) inlet pressure gauge and two (2) outlet pressure gauges, downstream test ports, and ball valves to isolate each regulator/relief valve assembly.

.2 Silver brazed joints except at equipment connections.

.3 Line pressure regulator valves:

.1 construction: as specified herein,

.2 number of valves: two, and each sized for full design flow.

.3 outlet pressure at a flow rate of 57 SCMH (2000 SCFH):

(a) in accordance with CSA Z7396.1.
(b) with pressure variation less than 15 kPa (2 psi) from full flow at required outlet pressure.

.4 Safety valves:

.1 construction: as specified herein,

.2 number of valves: two, and each sized for full design flow.

.3 each safety valve installed to protect its associated line pressure regulating valve and with no intervening valve between them.

.5 Isolation valves: two piece union-style bronze body, quarter turn, NPT threaded ends.

.6 CRN to CSA B51 as an assembly or as individual components.

.7 Cleaned for oxygen service.

Standard of Acceptance

- Amico - fig. M-DLRS-CSA-05 / -05HP
- Class 1 - fig. DSA-500 series
- BeaconMadaes - fig. DLRA500, with second relief valve.

2.14 Medical Gas Terminal Units

.1 Connector type: Diameter Index Safety System (DISS) to CGA V-5.

.2 Main body:

.1 rough-in mounting box or plate,

.2 one-piece brass body:

(a) with secondary check valve rated for 1380 kPa (200 psig) for positive pressure gasses,
(b) designed to swivel 360° for multi-direction connection,
(c) O-ring seal or seats.

.3 type K copper tube to ASTM B819 inlet connection stubs;

(a) NPS 1/2 for pressure gasses,
(b) NPS 3/4 for medical vacuum and AGSS.
(c) gas service identified on tube stub.

.4 provided with dust-cover to protect body during construction after rough-in installation.

.3 Primary valve body style:

.1 gas specific latch type with serviceable primary check valve.

(a) do not mix latch and cartridge styles on the same project.

.4 Outlet cover:

.1 gas specific 1.5 mm (16 ga) mounting plates, and modular design to allow on-site ganing of multiple outlets, with a minimum center-to-center spacing of 127 mm (5 in.),

.2 colour coded front plate with English language printed service identification, and indexing pins for safety keying gas specific cover plate to appropriate steel rough-in mounting plate.

.3 chrome plated, satin finish, or epoxy powder-coated fascia plate,

.4 outlet to be adjustable for variable wall thickness at least between 12 mm (1/2 in.) and 25 mm (1 in.) wall thickness,

.5 pressure test plug for medical vacuum and AGSS outlets, rated for 1000 kPa (150 psi).

.5 Model variants:

.1 medical gas terminal units designed for various installation locations including:

(a) recess wall mount for concealed piping,
(b) surface wall mount for exposed piping,
(c) recess mount for consoles,
(d) recess mount for ceilings,
(e) recess mount for suspended service columns,
(f) recess mount for installation in medical supply units,
(g) non-ferrous material compatible for installation in MRI Rooms.

.2 Listed to CAN/CSA-Z9170-1.

.3 Each unit tested for pressure-leak tested and flow tested.

.6 Cleaned for oxygen service and tube ends capped.

Standard of Acceptance

° Amico - fig. O-DIS series
° Class 1 - fig. M series
° BeaconMadaes - fig. B series

2.15 Medical Gas Valve Identification

.1 Valve tags:

.1 plastic valve tags, nominally 115 mm x 80 mm (4-5/8 x 3-1/8 in.), rounded corners with pre-punched fastening holes, orange colour, suitable for application of a printed adhesive label.

Standard of Acceptance

° Brady - fig. 87695

.2 Valve tag label marking system:

.1 labels: 50 mm (2 in.) high, low-shrinkage vinyl labels for indoor and outdoor use, high tack permenant adhesive, black lettering on white background.

.2 printer: portable printer with LCD display and full QWERTY keyboard, capable of multiline printing on 50 mm (2 in.) wide labels.

Standard of Acceptance

° Brady - fig. BMP71

3 EXECUTION

3.1 Field Cleaning

.1 Field cleaning of copper tubing, valves, pressure regulators, safety valves and terminal units is not permitted. If factory shipping packaging is damaged or tube ends are missing prior to installation, these materials shall not be used and shall be removed from site.

.2 Where fittings other than valves, pressure regulators, safety valves or terminal units are not supplied to site as “cleaned for oxygen service”, they shall be cleaned on site in accordance with CGA G-4.1 as follows:

.1 Prepare a written site cleaning report, which describes:

(a) the cleaning method,
(b) the fittings and equipment which are subject to the field cleaning,
(c) the name and signature of the person supervising the field cleaning.

.2 Wash the part before installation with hot solution of trisodium phosphate in water 500 g in 12.5 litres (1 lb in 2.5 gal),

.3 Scrub inside of parts, and fittings with cleaning solution and agitate parts and fittings in bath of cleaning solution.

.4 Thoroughly rinse in fresh clean water and blow dry with nitrogen.

.5 Inspection: use the white light and UV light test method described in CGA-4.1 on a 5% random sampling basis where the number of fittings of one type exceeds 20 units, and inspect all units of a fitting type which numbers less than 20.

.3 Keep cutting and reaming tools scrupulously clean and free from oil or grease.

.4 Do not use organic solvents such as carbon tetrachloride under any circumstances.

3.2 Piping Fabrication and Support

.1 Install piping in accordance with CSA Z7396-1.

.2 Make pipeline joints by brazing or mechanical swage coupling except as follows:

.1 butterfly valves and pressure relief valves: threaded or flanged,

.2 connections to source equipment: threaded or flanged,

.3 pressure sensors and switches: DISS connector,

.4 pipeline DISS check bodies for pressure sensors and switches: threaded,

.5 pressure gauges and other instruments including instrument isolation valve: threaded.

.3 For threaded joints;

.1 use Sweat x NPT adapters for connection to equipment with threaded joints.

.2 make-up threaded joints with Teflon tape.

.4 Use ells, tees, caps and couplings to make offsets and changes in direction and to route piping between connections. Do not bend hard drawn tubing except for long sweep cold bending with minimum bending radius of 20 x OD, without deformation or reduction in pipe diameter.

.5 Cap off open ends of piping at the end of each work shift, using shipping dust caps overlayed with plastic and held in place with tape.

.6 Piping supports:

.1 multi-service support: provide tubing clips on trapeze channels to secure piping to channel. Install U-plates on each side of pipe clamp to prevent horizontal movement,

.2 individually with adjustable wrought clevis hangers, rods and anchors as specified,

.3 vertically with riser clamps, and with support lugs brazed to tubing,

.4 support spacing in accordance with the following table:

Pipe/Tube Size NPS	Support Horizontal Spacing m (ft)	Support Vertical Spacing m (ft)
1/2	1.8 (6)	1.8 (6)
3/4	2.4 (8)	1.8 (6)
1	2.4 (8)	2.4 (8)
1-1/4	3.0 (10)	2.4 (8)
1-1/2	3.0 (10)	2.4 (8)
2 and larger	3.0 (10)	3.0 (10)

.7 Do not support medical gas piping from other building services. Do not support other building services from medical gas piping.

3.3 Brazed Joints

.1 Make brazed joints in accordance with specification section 20 05 24 and as specified herein.

.2 Make up joints between copper and copper materials without the use of flux. Joints between dissimilar metals may use flux as follows:

.1 brush flux over end of fitting and keep inside of pipe and fittings free from flux,

.2 after brazing dissimilar metals, wash with hot water to remove residual flux,

.3 wire brush joints after brazing.

.3 For new installations where there are no connections to existing medical gas systems, provide continuous nitrogen purging of the inside of the tube during brazing to obtain less than 1% oxygen by volume during brazing.

3.4 Valves

.1 Provide valves as shown.

.2 Provide zone valves and/or combination zone valves/zone alarm panels in accordance with specification section 22 63 26. Install zone valves or combination zone valve/zone alarm panels so that the height of the center-most valve is approximately 1500 mm (5 ft.) above floor level.

.3 For pipeline distribution service valves other than those located in zone valve boxes, provide common-keyed padlocks on each service valve, not including zone valves. Leave valves padlocked in the open position, and turn five (5) copies of the common-key over to the owner. Padlocks are not required on valves located in a locked service room containing the medical gas source equipment.

3.5 Line Pressure Regulator Stations

.1 Provide line pressure regulator stations where not otherwise provided as part of packaged source equipment or manifold control stations.

.2 Install line pressure regulator stations at a nominal height of 1500 mm (5 ft) above the floor, arranged so that the pressure gauges and regulator adjustment handles are readily visible and accessible.

.3 Set the line pressure regulator setpoints as follows:

Regulator	**Line Pressure Regulator Setpoints**		
	kPa (psi) gauge		
	Oxygen, Medical Air, Nitrous Oxide,	Nitrogen, Instrument Air	Carbon Dioxide
Primary regulator	360 (52)	1170 (170)	500 (70)
Secondary regulator	260 (38)	895 (130)	345 (50)

3.6 Safety Valves

.1 Install safety valve vent piping in copper tube with brazed joints.

.2 Pipe safety valves discharge piping for all medical pressure gases to outside of the building as follows:

.1 locate a minimum of 3 m (10 ft) from any door, operable window, or ventilation intake,

.2 termininate at a height of at least 1 m (3 ft) above roof or adjacent grade level,

.3 terminate relief pipe with a down-turn facing outlet, and increase relief pipe size at termination point by one NPS trade size and terminate with screened outlet fitted with T304 stainless steel plain weave 2x2 mesh, 9.3 mm (0.365 in.) opening size

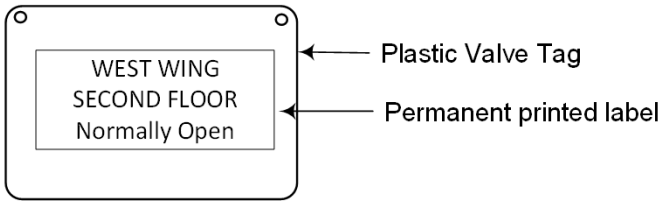
3.7 Identification

.1 Label medical gas systems in accordance with CSA Z7396-1.

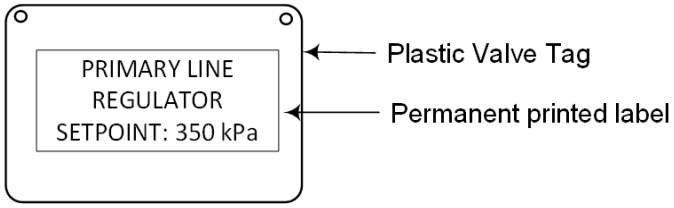
.2 Label piping progressively on a daily basis as piping is installed.

.3 For service valves and line pressure regulators, provide a gas specific pipeline marker identifying the gas immediately adjacent to the inlet or outlet side of the valve or regulator with no visible obstruction between the valve/regulator and the marker. For zone valves, provide the pipe marker inside the zone valve cabinet.

.4 For service valves, provide a valve tag with a machine printed label identifying the area or zone served, and “Normally Open” or “Normally Closed” as applicable to the valve. Secure the valve tag to the valve with stainless steel tie-wire to the valve body, not the valve handle.



.1 For line pressure regulators, provide a valve tag with a machine printed label identifying whether the regulator is the Primary or Secondary regulator, and the regulator setpoint valve in kPa units.



3.8 Terminal Units

.1 Install terminal units in accordance with manufacturer's instructions. Protect backbody openings during rough-in stage to prevent contamination of main body.

.2 Refer to architectural drawings for set-out heights of wall mounted individual or ganged terminal units. In the absence of such information, set wall mounted terminal outlets at a height of 1500 mm (5 ft) above the floor as measured to the center of the DISS outlet.

3.9 Terminal Units for Installation in Service Units

.1 Service units are provided under Division 11 and/or Division 26 and include:

.1 internal medical gas piping using copper tubing or flexible hose as applicable to the equipment,

.2 installation of terminal units.

.2 Supply medical gas terminal units to the vendor supplying the service units for factory installation in the service units.

.3 Coordinate with the Division providing the service units including:

.1 scheduling delivery of medical gas terminal units to the service units vendor(s) manufacturing facility.

.4 Make connections of medical gas piping to headwall units and / or patient service strips to the capped tube connections provided with the Service Units.

.5 Make connections of medical gas piping to ceiling service columns, ceiling articulating arms and / or medical supply units as follows:

.1 provide a service ball valve in the ceiling immediately adjacent to the Service Unit for each medical gas,

.2 provide a DISS body without check valve and mount it on the Service Unit mounting plate unless it has been confirmed by the Contractor that the DISS body without check valve has been provided as part of the supply unit.

.6 Witness the final testing of the installed service units and assist the certification agency as necessary. The responsibility for medical gas piping inside the service unit including pressure testing remains with the service unit vendor.

.7 Refer to architectural and/or electrical design documents for locations of service units and quantity of terminal units required.

3.10 Commissioning

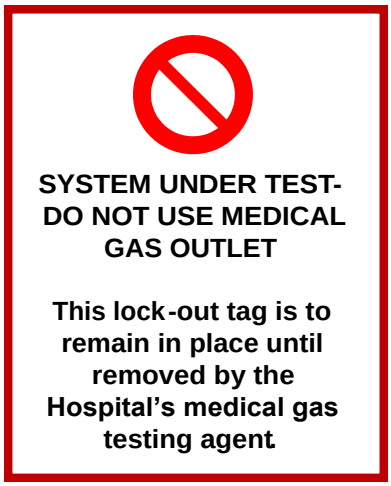
.1 Conduct commissioning on piping systems in accordance with CSA Z7396-1 as summarized herein, prior to 3rd party certification testing by the independent certifier retained by the Owner,

.2 Prepare a written commissioning test plan which verifies and documents the completed commissioning work. Provide a copy of the completed test plan/report to the Owner upon completion.

.3 Conduct commissioning after the terminal units are installed, but before medical gas piping is concealed in walls, above ceilings or in vertical service spaces.

.4 Tag-out / Lock-out requirements:

.1 Tag-out each terminal unit outlet prior to testing of associated piping system with a tag as shown or similar:



.5 Brazing quality test:

.1 When requested by the hospitals inspection body (agent), cut-out a brazed joint as selected by the inspection body who will review the inside of the joint for soundness and evidence of oxidation.

.2 If samples show improper brazing or oxidation, cut-out the joints immediately upstream and downstream of the first joint, plus three other joints randomly selected by the inspection body. If any of these joints fail the inspection, the Contractor shall then remove additional joints as directed by the Owner until the inspection body is satisfied with the quality of the brazing work. Make good all joints which were removed.

.6 Pressure testing and cross connection testing:

.1 Pressure testing and cross connection testing of medical gas piping shall conform to CSA Z7396.1, as summarized and as amended in the following articles. Perform this testing in the following order:

(a) disconnect flexible hoses inside of Service Units (as applicable) and install test caps on medical vacuum and AGSS DISS outlets,
(b) perform the "Initial pressure test",
(c) perform the "Final pressure test".
(d) perform the "Purge test",
(e) perform the "Cross connection test",
(f) perform the "Combined Supply Units test".

.2 Test gas for all tests: oilk-free dry air or oil-free dry nitrogen.

.7 Initial pressure test:

.1 Conduct a standing 24 hour initial pressure test as follows:

(a) perform the test before terminal unit outlet covers are installed, and disconnect the pressure transducers and switches from their DISS bodies,
(b) disconnect flexible hoses inside of Service Units (as applicable) and install test caps on medical vacuum and AGSS DISS outlets,
(c) do not manifold piping systems together - test each system independently,
(d) charge each piping system with the test gas to the required test pressure, and then isolate the test gas source,

(e) test pressure for medical pressure gases: 150% of design pressure or 1035 kPa (150 psi) whichever is greater,
(f) test pressure for medical vacuum and AGSS: minimum 415 kPa (60 psig),

.2 Acceptance criteria: no change in pressure during the test period except due to change in ambient temperature around the piping.

.3 If leaks exist, identify and repair any detected leaks and retest pipe system. Use an oxygen compatible leak detector at each joint,

Standard of Acceptance

- Swagelock Snoop
- American Gas & Chemical Co. Ltd Leak-tec

.4 An acceptable initial test shall be completed before final acceptance pressure testing can occur.

.8 Acceptance pressure test:

.1 Conduct the final standing 24 hour acceptance pressure test as follows:

(a) install terminal unit outlet covers, and reconnect pressure transducers and switches,
(b) keep flexible hoses inside of Service Units (as applicable) disconnected and keep test caps on medical vacuum and AGSS DISS outlets,
(c) do not manifold piping systems together - test each system independently,
(d) charge each piping system with the test gas to the required test pressure, and then isolate the test gas source,
(e) test pressure for medical pressure gases: at system design pressure.
(f) test pressure for medical vacuum and AGSS: at system design vacuum. Medical vacuum pumps and AGSS source equipment may be used to create the vacuum conditions, and then source equipment to be isolated during the 24 hour test period.

.2 Acceptance criteria: no change in pressure during the test period except due to change in ambient temperature around the piping.

.3 Submit a report to the Owner documenting the test methodology and test results.

.9 Purging test:

.1 After acceptance of pressure testing, reconnect the hoses inside of Supply Units (if applicable) and purge the medical gas piping systems. Purge terminal units until test gas is clear of particulate matter and visible moisture as droplets or mist.

.10 Particulate filter test:

.1 At completion of purging, test medical pressure gases for particulate matter:

(a) fabricate the test-flow apparatus in accordance with Annex D of CSA Z7396.1, including a 0.3 µm particulate filter connected to the outlet of the apparatus,
(b) apply the test to at least one terminal unit for each medical pressure gas in each zone,
(c) adjust the test apparatus to provide a flow rate of 120 l/min (4 SCFM) for 15 seconds per test, and then remove the filter.

.2 Acceptance criteria: when examined under good light, the filter shall be free of visible particulate matter.

.3 Maintain a test record of each outlet tested (the room and a description to identify the terminal unit), the date of the test and the name of the person who performed the test.

.11 Cross-connection tests:

.1 Conduct cross-connection tests in accordance with Cross-connection Test - Method 2 of CSA Z7386.1, as summarized herein and as otherwise specified herein.

(a) Test special gas mixtures individually in accordance with Cross-connection Method 1 of CSA Z7396.1, with all other piping systems depressurized.

.2 Disconnect flexible hoses inside of Service Units (as applicable) and install test caps on medical vacuum and AGSS DISS outlets.

.3 Isolate vacuum transducers and vacuum switches from the test gas pressure.

.4 Use a set of pressure gauges with each gauge equipped with a DISS nut and nipple specific for each medical gas.

(a) Label each gauge with the applicable medical gas name, and provide a colour coded tape around the body perimeter in accordance with the following table.
(b) Mark each gauge to indicate the expected test pressure for each specific medical gas terminal unit.

.5 Apply the test gas to all systems at the same time, to pressurize each system in accordance with the following table. Use the medical vacuum pumps for medical vacuum.

Piping System	Test Pressure kPa (psi)	Gauge Marking Tape Colour
Medical vacuum	-35 (10 in.Hg.)	Yellow
AGSS	0 (0)	Red or Orange
Helium	70 (10)	Brown
Carbon Dioxide	140 (20)	Grey
Nitrogen	205 (30)	Black
Nitrous Oxide	275 (40)	Blue
Oxygen	345 (50)	Green
Medical Air	415 (60)	Half Black, Half White
Instrument Air	550 (80)	4 stripes Black, 4 stripes White

.6 Connect the applicable pressure gauges to each terminal outlet in each room based on DISS connector at each unit, Confirm that each terminal unit is correct for DISS connector, test gas pressure, terminal unit name and colour code.

.7 Periodically check the distribution system test pressure. If the test pressure drops by more than 14 kPa (2 psi) in any system due to loss of test gas during application of pressure gauges, re-establish required test pressure before continuing with the test.

.8 If the testing indicates the presence of cross-connected terminal units or piping distribution, correct the cross-connection and re-test the system. Continue re-testing until it is demonstrated there are no cross-connections.

.9 Maintain a record log of each room, listing each outlet and the test confirmation results and provide a copy to the inspection body, the Owner and the Consultant (see Exhibit B).

.12 Combined test for Supply Units:

.1 After completion and acceptance of the main cross-contamination test (including correction of any cross-connection defects), reconnect the internal hoses in the Supply Units (as applicable) and perform a final pressure test and cross-contamination test of the Supply Units.

.2 Charge each piping system with the test gas to the required test pressure described above under “Acceptance pressure test” and then close the zone valves serving each applicable Service Unit. Perform a six (6) hour standing pressure test and confirm there is no loss in test pressure at the

end of the test, using the zone valve pressure gauge. If a pressure loss occurs, notify the General Contractor/Construction Manager of the defective Supply Unit.

.3 After completion of the Supply Unit pressure test, individually test each medical gas service to the Service Units, with only the one medical gas pipeline being pressurized for each test. This can be performed with the applicable zone valves in the closed position.

.4 Confirm that each terminal unit is correct for DISS connector, test gas pressure, terminal unit name and colour code, and record the results in the cross-connection test record.

3.11 Contractor Responsibilities During Certification Testing

.1 Medical gas certification testing will be performed by an independent accredited medical gas testing and certification company (“inspection body”) directly retained by the healthcare facility. The certification shall be in accordance with CAN/CSA Z7396.1, including Annex C for source equipment, and Annex D for pipeline distribution. As a summary, certification testing of the medical gas pipeline distribution system includes:

.1 Source equipment tests.

.2 Master alarm system tests.

.3 Inspection of pipelines, valves and terminal units.

.4 Inspections and testing of zone alarms.

.5 Qualitative particulate contamination testing.

.6 Terminal unit gas identity/cross-contamination test.

.7 Terminal unit performance tests including gas quality, quantitative particulate matter and flow rates.

.2 Medical gas installation contractor shall provide qualified representative who are knowledgeable in medical gas installations in general and the Work specifically, to witness certification testing and to assist the Certification Agency in locating pipe runs, valves, alarm sensors, alarm wiring and other components of medical gas system and repair defects in equipment, workmanship or materials discovered during certification testing.

.3 Provide a copy of the completed commissioning test reports and as-built drawings to the independent certifier prior to certification testing.

.4 Arrange and pay for representatives of medical gas equipment vendor to provide technical support and operating instructions during the certification process.

.5 After completion of the contractor’s commissioning tests described above and while the inspection body is present, purge the distribution piping with applicable medical gases sufficiently to remove the test gases. Purge airflow through each terminal unit.

.6 Assist the inspection body in any subsequent retesting.

3.12 Authourity Inspections

.1 Arrange and pay for AHJ inspections for pressure piping and fire safety. Provide a copy of the AHJ inspection report to the Owner and Consultant; if the AHJ does not issue a report, provide a written record of the AHJ inspection recording the AHJ name, AHJ personnel, contractor personal, date of inspections, a description of what was inspected, and any comments provided by the AHJ.

3.13 Training and Instruction

.1 Comply with the training requirements of specification section 20 01 01.

.2 Arrange for manufacturers’ representatives to provide instructions of Owners staff in use and maintenance of medical gas equipment.

3.14 Records and Reports

.1 At completion of commissioning, provide the healthcare facility with the following documents:

.1 As-built drawings,

.2 completed CSA Z7396.1 form L.1 *Pipeline installation test report*, (sample form follows).

.3 copies of each brazer's certificate of competency (license) who performed all or part of the work,

.4 copies of each tradesperson's certificate issued under the CSA *Medical Gas Piping & Sysems Installation Personnel Certification Program*,

.5 quality assurance program for pressure piping certificate number, or contractor pressure piping licence number (as applicable to the requirements of the provincial AHJ for boilers and pressure vessels),

.6 in-process examination records of brazed joints,

.7 pressure test reports,

.8 particulate matter test report,

.9 cross-contamination test records,

.10 operating and maintenance manuals which

.11 filled out, signed and dated commissioning test plant reports,

.12 AHJ inspections reports.

.2 The submittal and acceptance by the Owner of the records and reports described herein is a condition precedent for obtaining substantial completion of the project.

Exhibit A – Pipeline Installation Test Report

The following is a sample report for installation contractor installation test report (CSA Z7396.1)

Annex L (informative)
Pipeline installation test report

Note: *This Annex is not a mandatory part of this Standard.*

Figure L.1
Pipeline installation test report
(See Clause 11.4.1.4.)

Health care facility:	**Area/floor:**	
Medical gas installation report		
Task	**Action required**	**Complete**
24-hour standing pressure test as per Clause B.2.2	Provide test report	
Perform final leak test as per Clause B.2.3	Verify performed	
Purge terminal units as per Clause B.2.4	Verify performed	
Perform cross connection test as per Clause B.3	Verify performed	
Perform particulate filter test as per Clause D.4	Verify performed	
CSA medical gas piping & installation personnel certification number (Each installers individual number to be submitted) As per Clause 11.4.1.2	1. 2. 3. 4. 5.	
Brazing qualification licence number (Each installers individual licence to be submitted) As per Clause 11.4.1.3	1. 2. 3. 4. 5.	
Quality assurance program certification number as per Clause 11.4.1.6		
Installer: Witnessed by:	Date:	
Notes:		

Note: *As per Clause 12.3, all of the above tests must be performed and a copy of this form is to be submitted to the health care facility before the inspection body commences commissioning.*

Exhibit B – Cross-connection Test Report

The following is a sample report for cross-connection testing.

Medical Gas Cross-contamination Test Record

Project Name: _____
Date of Test: _____
Contractor Name: _____
Test performed by: _____

Wing	Floor	Room	Number of Outlets Verified (No. outlets in rooms / No. outlets correct)								Remarks
			Ox	MA	MV	NOx	N2	CO2	IA	AGSS	
			/	/	/	/	/	/	/	/	
			/	/	/	/	/	/	/	/	
			/	/	/	/	/	/	/	/	
List of cross-connections discovered and corrected											
(Installation contractor) Results verified by:											

END OF SECTION

MEDICAL GAS ALARM EQUIPMENT
22 63 26

1 GENERAL

1.1 Scope

.1 Provide medical gas system controls including:

.1 zone alarm panels,

.2 zone valve stations,

.3 instrumentation and accessories.

.2 Applicable systems: refer to specification section 23 63 13.70

.3 Comply with the requirements of Part 1-General of specification section 22 60 13.70 except/and as required herein.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	20 05 13	Motor Starters and Wiring
.2	20 05 49	Seismic Restraint
.3	22 60 13.70	Medical Gas Piping

1.3 Applicable Codes and Standards

.1 Product standards:

.1	CSA C22.2 No. 92.1	Enclosures for Electrical Equipment, Non-Environmental Considerations
.2	CSA C22.2 No. 205	Signaling Equipment
.3	CAN/CSA C22.2 No. 60601.1	Medical Electrical Equipment – Part 1: General Requirements for Basic Safety and Essential Performance

1.4 Submittals

.1 Submit manufacturer catalogue cut-sheets for the materials specified herein.

.2 Submit shop drawings for;

.1 alarm wiring which are project specific.

2 PRODUCTS

2.1 General Requirements for Medical Gas Alarm Panels

.1 General:

.1 Common requirements for supply system alarm panels and zone alarm panels.

.2 Listed to CSA C22.2 No. 205.

.3 Conforms to CSA Z7396.1

.2 Cabinet:

.1 Tamper-proof, painted, steel back box, for [recessed][surface] mounting with a maximum wall cavity depth of 105 mm (4 in.) from wall finish surface, and removable openings for gas piping and electrical connection.

.2 Tamper-proof, painted, hinged front panel, with front mounted display of gas information.

.3 Internal power transformers with overcurrent protection.

.4 Power supply: 120 VAC, 60 Hz.

.3 Alarm display unit:

.1 Microprocessor based controller:

(a) Either:
- one (1) 250 mm (10 in.) colour TFT LCD display for graphical and text display for all gases/vacuum, or
- multiple TFT colour LCD touchscreen displays for individual gases;

(b) virtual graphical display indicating gas pressure status, with continuous green-normal and continuous red-alarm display,
(c) LED indicators and controls for alarm silence,
(d) built-in web server for remote access to view alarm web page and data,
(e) web-page configurable to allow linking to other zone alarm web pages,
(f) alarm notification via email or text message through any SMTP gateway,
(g) graphical display of alarm panel to mobile devices via WiFi or cellular network].
(h) gas specific colour identification in accordance with CSA Z7396.1

.2 Programmable and operating functions:

(a) high and low gas pressure alarms for medical gases,
(b) low pressure alarm for medical vacuum and AGSS,
(c) configurable repeat alarm horn time delay,
(d) alarm history recall,
(e) transient signal detection and display,
(f) alarm history recall,
(g) self-test diagnostic function to test status indicators and alarm horn,

.3 System initiates an alarm if there is an open or shorted sensor circuit, or a sensor input is not connected.

.4 Alarm horn sound level: 70 dBA at 2 m (6.5 ft.).

2.2 Local Zone Alarm Panels

.1 General:

.1 Complies with the general requirements for alarm panels specified above.

.2 Local alarm panels to monitor zone pipeline pressures for applicable medical gases.

.3 Graphic interface to display zone or room identification, and which cannot be altered except by authorized personnel

.4 Display measured gas pressure/vacuum values, with selectable pressure units – kPa, psi, or in.Hg.

.5 [Custom alarm response instructions for each gas.

.6 Capable of monitoring a minimum of eight (8) of the following gases or vacuum. Actual number and type of monitored gases or vacuum as shown on drawings:

(a) Oxygen,
(b) Nitrous Oxide,
(c) Nitrogen
(d) Instrument air
(e) Medical air
(f) Medical vacuum,
(g) Carbon dioxide, and
(h) Helium
(i) Anaesthetic Gas Scavenging System (AGSS)

Standard of Acceptance

- Amico - Alert-4 series
- BeaconMedaes - TotalAlert Infinity

.2 Interface for remote alarm annunciation:

.1 SPDT Form C dry relay contacts for:

(a) pressure fault conditions for each gas,
(b) control panel general fault.

.2 Wired Ethernet to remotely display panel status and alarm conditions using any standard web browser.

.3 Modbus, or BACNet /IP with PICS statement, gateway.

.3 Pressure transducers:

.1 Pressure transducers as specified below.

.2 Panel mounted with gas specific pressure transducer with DISS nut and nipple, or provided with zone valve stations.

.3 Minimum NPS 3/8 type K copper tube riser for each gas transducer, with matching gas specific DISS check body,

.4 Cleaned for oxygen service.

2.3 Zone Valves

.1 Cabinet:

.1 Conform to CSA Z7396.1.

.2 Tamper-proof, painted steel back box, for recessed mounting with a maximum wall cavity depth measured from the finished wall opening surface of:

(a) 105 mm (4 in.) for valves NPS 2 and smaller,
(b) 170 mm (6.75 in.) for valves NPS 2-1/2 to NPS 3.

.3 Sliding, opaque door with pull-ring, and clear gauge window. Door designed so that in an emergency the door is pulled outwards and free of the cabinet to access the valves.

.4 Gas/vacuum services capacity: up to 7 separate gas valves.

.5 Pressure indicating gauge:

(a) dial indicating gauge, reading kPa and psi units, with normal opeating pressure in the middle third of the gauge scale,
(b) mounted on the downstream side of zone valve.

.6 Labeling:

(a) gas/vacuum flow direction marked on piping inside of cabinet,
(b) provide labelling on panel cover in accordance with CSA Z7396.1 in both English and French.

.2 Valves:

.1 To specification section 22 60 13.70.

.2 Arranged to prevent closing of the valve box cover/door when the valve is in the closed position.

.3 Pressure transducers:

.1 Pressure transducers as specified herein.

.2 Factory installed, and located on downstream side of zone valve.

.3 Pre-wired to terminal strip(s) where field wiring to a remote zone alarm panel is required.

Standard of Acceptance

- Amico
- Class 1
- BeaconMedaes

2.4 Combination Zone Valves with Zone Alarm Panel

.1 Combination zone valves and alarm panels may be used where they comply with the following:

.1 Conforms to CSA Z7396.1.

.2 Zone valve box as specified herein, including both pressure gauge and digital zone alarm pressure display unit.

.3 Zone alarm functions as specified above except use microprocessor based, modular LED numeric pressure display with LED indicator lights for pressure normal and alarm status.

.4 Gas/vacuum services capacity: up to 7 separate gas valves.

.5 Internally mounted pressure transducer with DISS nut and nipple connection downstream of each zone valve.

Standard of Acceptance

- Amico - Combo Unit series
- Class 1 - CZVA series

2.5 Gas Pressure and Vacuum Transducers

.1 Construction:

.1 stainless steel wetted parts and pressure housing,

.2 automatic gas-specific detection feature,

.3 4-20 mA, 2 wire loop powered,

.4 gas/vacuum specific pressure sensors with DISS nut and nipple,

.5 integral interference barrier for increased RFI/EMI protection,

.6 CRN to CSA B51.

.7 CSA listed and suitable for remote installation or installation inside of alarm panels.

.8 cleaned for oxygen service,

.9 operating pressure range:

(a) Low pressure: 0 to 680 kPa (0-100 psig) for oxygen, medical air, nitrous oxide, carbon dioxide.
(b) Medium pressure: 0 to 1700 kPa (0-250 psi) for instrument air and nitrogen.
(c) Vacuum: 0 to 98 kPa (0-29 in.Hg) for medical vacuum and AGSS.

2.6 Gas Pressure and Vacuum Switches

.1 Functions:

.1 Dual setting High and Low pressure switches with pressure gauge, for low pressure service for oxygen, medical air and nitrous oxide only.

.2 Single setting High or Low pressure switch without gauge, for medium pressure service for any medical gas.

.3 Single setting Low pressure switch without gauge, for high pressure manifold for “reserve in use” alarm.

.4 Single setting Low vacuum switch with vacuum gauge, for medical vacuum and AGSS.

.2 Construction:

.1 switch type: SPDT (Form C) dry contact, 5 A at 120 VAC.

.2 listed to CSA C22.2 No. 14 for non-hazardous environments.

.3 CRN to CSA B51.

.4 enclosure: CSA C22.2 No. 92.1, Type 4.

(a) enclosure provides wiring termination access, or unit is provided with 20 mm (3/4 in.) NPT conduit connection for mounting on standard electrical junction box.

.5 switch suitable for remote installation or installation inside of alarm panels.

.6 Low Pressure gases:

(a) pressure rating: 860 kPa (120 psi),
(b) adjustment range: 3.5 to 550 kPa (0.5 to 80 psig)
(c) low alarm setpoint: 275 kPa (40 psig) factory set
(d) high alarm setpoint: 410 kPa (60 psig) fatory set

.7 Medium Pressure gases:

(a) pressure rating: 1720 kPa (250 psi),
(b) adjustment range: 70 to 1720 kPa (10 to 250 psig)
(c) low alarm setpoint: field adjusted to suit specific medical gas
(d) high alarm setpoint: field adjusted to suit specific medical gas

.8 High Pressure gas manifold:

(a) pressure rating: 22 MPa (3200 psi)
(b) adjustment range: 1.1 to 22 MPa (160 to 3200 psig)
(c) low pressure setpoint: field adjusted to suit medical gas

.9 Vacuum:

(a) vacuum rating: 101 kPa (30 in.Hg.),
(b) adjustment range: -2.7 to -98 kPa (0.8 to 29 in.Hg.)
(c) low alarm setpoint: -50 kPa (-15 in.Hg. psig), factory set for medical vacuum
(d) low alarm setpoint: -34 kPa (-10 in.Hg. psig), factory set for AGSS

.10 cleaned for oxygen service.

.3 Accessories:

.1 Ø50 mm (2 in. dia.) dial pressure gauge for Low Pressure gas and vacuum switches.

.2 gas specific DISS nut and nipple.

2.7 Instrument Wiring

.1 To be as recommended by instrument manufacturer, but not less than #20 gauge stranded shielded twisted pair, run in EMT conduit.

3 EXECUTION

3.1 Alarm Panels Installation

.1 Provide supply system alarm panels, zone alarm panels and combination zone/valve alarm panels configured to suit the applicable medical gas and vacuum services as shown on drawings.

.2 Install alarm panels in accordance with manufacturer instructions.

.3 Set alarm panels with top of panel at a height of 1500 mm (5 ft.) above finished floor, unless otherwise shown on drawings.

3.2 Pressure Transducers and Sensing Tubing Installation

.1 Connect pressure transduces to gas pipeline system only after the gas piping has been pressure tested.

.2 Pressure transducers for zone alarm panels shall only be installed in either the zone alarm panel, or in a zone valve box.

.3 Where pressure transducers are installed in the zone alarm panel;

.1 make tubing connections to gas main immediately downstream of zone control valve and before any connections to a terminal outlet.

.2 run NPS 3/8 type K copper medical gas tubing from the pipe main and connect to the copper sensing lines provided on the alarm panel.

.4 Manual valves shall <u>not</u> be installed between the gas main and the pressure transducer.

.5 Run control wiring in conduit from the transducer to the alarm panel in accordance with specification section 20 05 13.

3.3 Pressure and Vacuum Switches

.1 Install pressure and vacuum switches on source equipment and mains piping as shown, unless such instrumentation is already factory installed on packaged source equipment.

.2 Adjust and set high and low pressure and low vacuum setpoints in accordance with manufacturer instructions.

3.4 Pressure Switch Setpoints for Zone Alarm Panels

.1 Adjust and set pressure/vacuum switches for zone alarm panels in accordance with the following table 2:

Alarm	**Table 2: Zone Alarm Panel Pressure Setpoints**				
	kPa (psi) gauge			kPa (in.Hg.)	
	Oxygen, Medical Air, Nitrous Oxide,	Nitrogen, Instrument Air	Carbon Dioxide	Medical Vacuum	AGSS
Low gas pressure Alarm setpoint	276 (40)	965 (140)	400 (56)	-40 (-12)	-27 (-8)
Nominal gas pressure	345 (50)	1100 (160)	500 (70)	-68 (-20)	-40 (-12)
High gas pressure Alarm setpoint	413 (60)	1310 (190)	600 (84)	N/A	N/A

3.5 Electrical supply and wiring

.1 Dedicated emergency power circuits for alarm panels will be provided under Electrical Division 26 at 120 volt 60 Hz single phase and will terminate at the device power terminal strip in each alarm panel.

.2 Provide wiring and conduit from these junction boxes to connect control devices being electrically powered in accordance with specification section 20 05 13.

.3 Wiring between control and alarm panels and between panels and remote sensors to be provided in accordance with specification section 20 05 13,

.4 Provide terminal junction boxes wherever signal and control wiring interfaces with alarm wiring.

.5 Alarm wiring from main panel to terminal junction boxes to be Belden multi-pair colour coded 18 gauge wire with chrome PVC jacket run in EMT conduit.

.6 Alarms to be wired to same terminal number in each terminal junction box and alarm panel.

.7 Provide legend showing terminal number, colour code of wire and identifying common wire used for each alarm and each spare circuit.

.8 25% of wire pairs and terminals to be provided as spare circuits in cable and spare terminals in terminal junction boxes and alarm panels.

.9 Wire alarm panels in accordance with manufacturers wiring diagrams.

3.6 As-built Information

.1 For remote mounted pressure transducers, mark-up the as-built drawings with dimensioned location of the pressure transducer.

.2 In addition for supply system alarm panels, provide a diagram indicating the location of remotely mounted pressure transducers, directly printed on foam-core and permanently mounted in a frame (with Lexan cover), and installed adjacent to the applicable source equipment.

.3 In addition for zone alarm panels, provide a diagram indicating the location of remotely mounted pressure transducers and place it inside the zone alarm panel.

3.7 Medical Gas System Commissioning and Certification

.1 Refer to specification section 22 60 13.70.

3.8 Training and instruction

.1 Arrange for manufacturers' representatives to provide instructions of Owners staff in use and maintenance of equipment associated with medical gas systems.

END OF SECTION

HVAC PIPING SYSTEMS GENERAL REQUIREMENTS
23 05 01

1 GENERAL

1.1 Scope

.1 Provide heating and cooling piping systems in accordance with the referenced piping materials, standards, specifications and piping codes described herein.

.2 This specification applies to;

.1 water based piping systems, including glycol/water mixtures, for building hydronic heating and cooling systems,

.2 steam and condensate systems,

.3 non-potable water systems for HVAC services, and

.4 process heating or cooling systems.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 20 05 24 Welding and Brazing.

1.3 Applicable Codes and Standards

.1 Legislation:

.1 Ontario Regulation 220/01 Boiler and Pressure Piping Regulation

.2 Installation standards and codes (as adopted and amended by the AHJ for pressure vessels):

.1 CSA B51 Boiler, pressure vessels, and pressure piping code

.2 ASME B31.1 Power Piping

.3 ASME B31.3 Process Piping

.4 ASME B31.9 Building Services Piping

1.4 Qualified Tradesmen

.1 Work to be performed by qualified, licensed and recognized firm with an established reputation in this field, using tradesmen holding applicable certificates of competency as applicable to the work.

1.5 Registration and Inspection

.1 Before commencing work, make arrangements and pay for registration and inspection by the AHJ responsible for boiler and pressure vessel safety for the following pressure piping systems:

.1 Steam, including condensate piping, at pressures greater than 100 kPa (15 psig).

.2 Service water piping for heating a building, at design temperatures greater than 121°C (250°F) or at design pressures greater than 1100 kPa (160 psig),

.3 HVAC water systems (other than building heating water systems), including chilled water and condenser water systems, at design temperatures greater than 65°C (150°F) or design pressures greater than 1717 kPa (250psig).

.2 At the start of the Work, obtain existing pressure piping system registration numbers, if available, from the Owner and/or the AHJ.

1.6 Design Criteria – General

.1 Pressure piping design conditions and applicable codes are specified herein. Where different operating and design pressures are shown on drawings, the drawings govern.

.2 Where a "Class" is indicated on drawings, this refers to Class as defined in the applicable ASME B16 series of product standards. Notwithstanding the maximum allowable pressure-temperature ratings defined for each ASME Class designation, the applicable Class designation by floor level shown on the drawings may identify lower maximum design pressures.

.3 Where a "Class" is indicated on drawings, this Class designation is applicable to Class rated components other than valves. Refer to valve specification sections for the Minimum Component Pressure Rating for each valve type and selection criteria based on system design pressure.]

1.7 Design Criteria – Steam, Condensate and Feedwater Systems

.1 Piping design and installation code:

.1 To ASME B31.1 for steam design pressure greater than 100 kPa (15 psig)

.2 To ASME B31.9 for steam design pressure 100 kPa (15 psig) or less.

.3 Piping code for condensate systems: same as the connected steam system.

.2 Piping system(s) includes but is not limited to;

.1 steam metering,

.2 trap assemblies,

.3 controls,

.3 System design criteria:

.1 Steam and associated gravity condensate systems:

(a) for the purpose of this article, "gravity condensate" means condensate which is not transmitted by a condensate pump.

System	Saturated Steam		Gravity Condensate
	Operating Pressure	Design Pressure	Design Pressure
Low Pressure	Up to 85 kPa (12 psig)	103 kPa (15 psig)	700 kPa at 121°C (100 psi at 250°F)
Intermediate Pressure	>103 kPa (15 psig) and up to 345 kPa (50 psig)	700 kPa (60 psig)	1000 kPa at 160°C (150 psi at 320°F)
Medium Pressure	>350 kPa (50 psig) and up to 900 kPa (130 psig)	1030 kPa (150 psig)	1030 kPa at 190°C (150 psi at 374°F)
High Pressure	> 900 kPa (130 psig) and up to 1400 kPa (200 psig)	1720 kPa (250 psig)	1720 kPa at 210°C (250 psig at 410°F)

1.8 Design Criteria - Hot Water Heating Systems

.1 Piping design and installation code:

.1 To ASME B31.9 for piping system not subject to boiler and pressure vessel regulations.

.2 To ASME B31.1 for piping systems which are subject to boiler and pressure vessel regulations.

.2 System includes but is not limited to;

.1 Boilers,

.2 Heat exchangers,

.3 Pumps,

.4 Expansion tanks,

.5 Convectors,

.6 Radiators,

.7 Radiant panels,

.8 Finned radiation,

.9 Unit heaters,

.10 Heating coils,

.11 Controls,

.12 Water treatment.

.3 System design criteria:

.1 Design temperatures and pressures:

System Type	Supply Temp. °C (°F)	Return Temp. °C (°F)	Design Temp. °C (°F)	Maximum Operating Pressure kPa (psig)	Design Pressure kPa (psig)
Terminal Reheat System	82.2 (180)	74 (165)	77 (170)	900 (125)	1030 (150)

1.9 Design Criteria - Cooling Water Systems

.1 Piping design and installation code:

.1 To ASME B31.9 for piping system not subject to boiler and pressure vessel regulations.

.2 To ASME B31.1 for piping systems which are subject to boiler and pressure vessel regulations.

.2 System includes but is not limited to;

.1 Cooling coils,

.2 Controls,

.3 System design criteria:

.1 Design temperatures and pressures:

System Type	Supply Temp. °C (°F)	Return Temp. °C (°F)	Design Temp. °C (°F)	Maximum Operating Pressure kPa (psig)	Design Pressure kPa (psig)
Chilled water	8.9 (48)	15.5 (60.1)	38 (100)	900 (125)	1030 (150)

1.10 Design Criteria - Glycol system

.1 Piping design and installation code:

.1 To ASME B31.9 for piping system not subject to boiler and pressure vessel regulations.

.2 To ASME B31.1 for piping systems which are subject to boiler and pressure vessel regulations.

.2 System includes but is not limited to;

.1 Coils,

.2 Controls

.3 System design criteria:

.1 Design temperatures and pressures:

System Type	Glycol Type	Glycol / Water %	Supply Temp. °C (°F)	Return Temp. °C (°F)	Design Temp. °C (°F)	Maximum Operating Pressure kPa (psig)	Design Pressure kPa (psig)
Glycol Heating – Air Handling Unit Coils	Propylene	50	82 (180)	71 (160)	93 (200)	900 (125)	1030 (150)

2 PRODUCTS

2.1 Dielectric Unions

.1 Construction:

.1 Bronze or brass body with non-metallic fitting or coating the FNPT tailpiece.

.2 FNPT x Copper sweat connection.

.3 Pressure rating; ASME Class 3000 at 121°C (250°F)

Standard of Acceptance

° Hart Industrial Unions - fig. D-3136 or Polymer Compsit Coating

2.2 Dielectric Flanges

.1 Construction:

.1 ASME Class 150 or 300 carbon steel flange, Van-stone style with copper tube adapter tailpiece.

.2 Flange provided with a powder coated finish, and an EPDM insulator to isolate the copper tailpiece form contact with the flange.

.3 Minimum MCPR:

(a) Class 150: 1400 kPa (200 psi) at 121°C (250°F)

(b) Class 300: 28oo kPa (400 psi) at 121°C (250°F)

Standard of Acceptance

° CTS Flange Canada - fig. BF / WBG

2.3 Cam and Groove Fittings

.1 NPS 2 size:

.1 Brass body cam and groove fittings, male groove end x female NPT end, with camlock femanle dust cap.

3 EXECUTION

3.1 Pipe Installation General Requirements

.1 General layout of mains, risers, run-outs and connection details of piping systems are shown.

.2 Install concealed pipes close to building structure to keep furring spaces to minimum and minimize obstruction to other services in ceiling spaces.

.3 Run exposed piping parallel to walls and conserve headroom and space. Group piping wherever practical.

.4 Ream pipe after cutting to length and clean off scale and dirt inside and outside of pipe before threading, grooving or welding.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and special fittings such as expansion joints.

.6 Cap ends during construction to prevent entry of foreign matter.

.7 Provide bends, expansion loops, hoses or joints to compensate for pipe expansion and contraction.

.8 Anchor, guide and laterally support vertical and horizontal piping to support filled weight and absorb thrust under operating conditions.

.1 For steam, gas and vapour piping, provide temporary intermediate supports when hydrostatically piping so that pipe support spans are not greater than that required for liquid piping service.

.9 Erect piping so that expansion forces, gravity forces and thrust from changes in direction do not stress connections to apparatus.

.10 Do not use galvanized materials in contact with glycols.

.11 Refer to piping system specifications for additional requirements.

3.2 Drainage Piping, Drain Valves and Air Vents

.1 Provide drain valves at low points in water piping systems and in valved run-outs from risers so that system or isolated parts of system can be drained. Locate piping system drain valves as close to the system pipe as possible.

.2 Provide an additional drain valve at the drain termination point where;

.1 the drain valve is not accessible from a floor with or without the use of a 2.4 m (8 ft) high ladder, or from an elevated work platform,

.2 and as otherwise specified herein.

.3 Provide drain valves on equipment drains, including but not limited to refrigeration equipment, boilers, heat exchangers and water treatment and filtration equipment.

.4 For copper tube drains, connect coper drain tubing to the outlet side of equipment drain valves or piping system drain valves; do not make connections of copper drain tubes directly to carbon or stainless steel HVAC liquid piping.

.5 Drain sizes:

.1 NPS 2 for large water-filled equipment including refrigeration equipment, boilers, and heat exchangers.

.2 NPS ¾ for other equipment drains, including integral or field installed condensate and drip pans.

.3 NPS 2 for piping system drains, unless otherwise shown.

.6 Run large equipment drains to floor trenches unless otherwise shown to terminate in a specific location.

.7 Run other equipment drains to nearest floor drain unless otherwise shown to terminate in a specific location. Where NPS ¾ drains terminate at a floor drain, provide a funnel of at least 200 mm x 100 mm (8 in x 4 in) on the floor drain cover.

.8 Install piping system drains as follows;

.1 In mechanical service rooms and permanently accessible service spaces, extend drains down along a wall or column and terminate approximately 1000 mm (40 in) above the floor level in the service room, or above the lowest accessible level in a vertical service space.

.2 In other service rooms including non-accessible service spaces, electrical rooms, telecom rooms or data rooms, extend drains to a location outside of these service room to a location agreed with by the Engineer unless otherwise shown and provide a drain valve at the termination point.

.3 Where piping system drains are located in finished areas above accessible ceilings that are not more than 3 m (10 ft) high, terminate the drains approximately 200 mm (8 in) above the top of the ceiling and provide a drain valve at this termination point.

.4 Where piping system drains are located above non-accessible ceilings, or where an accessible ceiling is more than 3 m (10 ft) high, extend the drain tubing to a location agreed with by the Engineer unless otherwise shown and provide a drain valve at this termination point.

.9 Terminate drain ends with a 45° elbow and a brass body, male-end, cam-and-groove (Camlock) coupling fitting with dust cap. Supply the matching hose-end female connector and turn over to the owner.

.10 Provide air vents with isolation ball valves at high points to allow effective drainage of the system and to facilitate removal of air from the system.

3.3 Dissimilar Metals Galvanic Isolation

.1 Provide dielectric unions or flanges to separate copper and copper alloy tube and fitting materials from contact with carbon steel material. This includes equipment such as coils with copper header connections.

.2 Dielectric unions or flanges are not required when all of the following conditions are met:

.1 the hydronic water treatment program (existing or new) includes a cathodic and/or anodic filming chemistry for mixed metals,

.2 copper tubing is not used in the piping system, except for the final 1 m (40 in) length connection to terminal equipment and in which the tubing is isolated from the carbon steel piping by a bronze body or carbon steel body valve (no brass) , and

.3 terminal equipment which contains copper or copper alloy tubing is connected to carbon steel piping with a flexible connector having an internal non-metallic hose.

.3 For clarity, where copper tubing is installed in a part of a carbon steel piping system, dielectric unions or flanges are required.

3.4 Pressure and Leak Testing - Liquid Service Piping

.1 This test procedure applies to piping normally containing water, including HVAC water piping and condensate piping.

.2 Pressure test liquid HVAV piping systems unless otherwise specified in other sections of Division 23.

.3 Initial pneumatic leak test:

.1 Conduct an initial pneumatic leak test to locate and repair major leaks.

(a) ASME B31.1 systems: 175 kPa (25 psig)

(b) ASME B31.9 systems: 70 kPa (10 psig)

.2 Remove compressed air source and maintain this pressure for the time necessary to inspect for major leaks, but not less than 2 hours. Repair major leaks.

.3 During pneumatic pressure tests, comply with the site safety requirements for notification and guarding during testing with compressed gasses.

.4 Final hydrostatic pressure test:

.1 Use the system design pressure for the entire installation, unless different design pressures are indicated for each floor.

.2 Pressure test condensate piping to the same test conditions as the steam system to which they are connected.

.3 Fill the system with water and conduct a pressure test at 150% of the design pressure for 10 minutes, then reduce pressure to design pressure.

(a) Maintain pressure and examine each joint with commercial leak detector solution.

Standard of Acceptance

- Snoop
- Leak-tec

(b) Repair leaks and retest using leak detector solution with piping under pressure specified.

.4 As an alternative to leak testing of each joint, conduct a 24 hour standing pressure test:

(a) Raise the water pressure to 150% of the design pressure for 10 minutes, then reduce pressure to design pressure.

(b) Record the test pressure one (1) hour after establishing the system hydrostatic test pressure Record ambient air temperature at the same time.

(c) Maximum pressure loss over 24 hours: not more than 1% of test pressure, corrected for ambient temperature.

(d) Repair leaks and retest until satisfactory.

3.5 Pressure and Leak Testing - Steam

.1 This test procedure applies to piping normally containing steam.

.2 Test steam piping in accordance to the requirements for liquid piping described above, except as follows:

.1 For hydrostatic pressure testing of steam piping, install temporary pipe supports for steam piping to provide spans between supports equal to that for heating water piping.

3.6 Pressure Test Report

.1 Maintain a log of all pressure tests, including locating of where leaks have been repaired. Submit the log to the Consultant for review when requesting prior to substantial completion of the Work. Where a piping system is subject to AHJ inspection, provide evidence of such inspection by means of an AHJ inspection report or name of the AHJ inspector and the date they witnessed the pressure test.

3.7 Piping Material Selection Schedule

.1 Provide piping material in accordance with schedule Table 1 at the end of this specification section.

Table 1: Piping and Valve Material and Specification by System Type

Piping System	Abbrev	Pipe Material	Pipe Specification	Valve Specification
Hydronic heating and cooling - closed loop (with or without glycol)	HTS/R HS/R LTS/R GHS/R CHS/R GCS/R RV	Carbon Steel	23 21 13.23	23 05 23.13
		Copper	23 21 13.33	23 05 23.13
Condenser Water - open-loop	CTS/R	Carbon Steel	23 21 13.23	23 05 23.13
		Stainless Steel	23 21 13.26	23 05 23.16
Cooling Tower Overflow and Drain	DR	Galvanized Steel	23 21 13.23	23 05 23.13
Process Chilled Water	PCHS/R	Carbon Steel	23 21 13.23	23 05 23.13
		Stainless Steel	23 21 13.26	23 05 23.16
Process Cooling Water (with city water back-up)	PCWS/R	Stainless Steel	23 21 13.26	23 05 23.16
Snow Melting (buried)	SMHS/R	Polyethylene	23 21 13.37	23 05 23.13
Instrumentation Piping	---	Stainless Steel	23 21 13.29	
Underground Steam and Condensate Piping	S-xxx PC-xxx GC	Various	23 22 13.13	23 05 23.23
Distribution Steam, Condensate and Boiler Feedwater	S-xxx PC-xxx GC, HD V, RV	Carbon Steel	23 22 13.23	23 05 23.23

Table 1: Piping and Valve Material and Specification by System Type				
Piping System	Abbrev	Pipe Material	Pipe Specification	Valve Specification
Steam Boiler Plant - Steam, Condensate and Feedwater	S-xxx PC-xxx GC, HD BF, BO CBO, HD, V, RV	Carbon Steel	23 22 13.23	23 05 23.26
Clean Steam, Clean Condensate and Clean Feedwater (no chemical treatment)	CS-xxx CPC-xxx CGC CBF BF, BO CBO V, RV	Stainless Steel	23 22 13.26	23 05 23.29
Non-potable make-up water (no pre-treatment, no added chemicals)	NPWH	Copper	23 21 13.33	23 05 23.13
		Stainless Steel (tube or pipe)	22 11 16.16 or 23 21 13.26	23 05 23.16
Water Pre-Treatment for HVAC Services (softened water and dealkalized water)	SWH DALK	Copper	23 21 13.33	23 05 23.13
		Galvanized Steel	23 21 13.23	23 05 23.13
Reverse Osmosis water for HVAC Services	ROS/R	Stainless Steel	23 21 13.26	23 05 23.19
Chemical Feed (chemical water treatment)	CF, CS	Various	23 25 11	
Equipment and piping system drainage for HVAC liquid systems	DR	Galvanized Steel	23 21 13.23	23 05 23.13
		Copper	23 21 13.33	23 05 23.13
Equipment and piping system drains for steam and condensate system.	DR	Same as associated steam and condensate system.		
Brine	BRS/R	PVC	23 21 13.36	

END OF SECTION

GENERAL-DUTY VALVES FOR HVAC WATER PIPING
23 05 23.13

1 GENERAL

1.1 Scope

.1 Provide valves for general duty service in HVAC water piping systems, including shut-off valves, check valves, and manual balancing valves, for piping systems with a design pressure of 3500 kPa (507 psig) or less and a design temperature of 121°C (250°F) or less.

.2 This specification applies to hydronic heating and cooling water systems (with or without glycol additives) and other piping systems required to be carbon steel pipe, galvanized steel pipe, and/or coper tubing as specified in section 23 05 01, except as otherwise required for specific duty valve in other specification sections.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section integrates with or refers to the following specification sections:

.1 20 05 23 General Requirements for Valves

.2 23 05 01 Heating and Cooling Piping Systems

1.3 Submittals

.1 Refer to section 20 05 23.

1.4 Applicable Codes and Standards

.1 Refer to section 20 05 23 and as specified herein.

.2 Where an HVAC liquid piping system is subject to registration as a pressure piping system as identified in specification section 23 05 01, all valves shall have Canadian Registration Numbers in accordance with CSA B51. In the following valve specifications, where the identified model does not have a current CRN, provide a valve of equal or greater performance which has a current CRN from the same manufacturer.

.3 For the purpose of this article, "current CRN" means a registration which does not expire for at least 12 months from the date of submittal of shop drawings.

2 PRODUCTS

2.1 Ball Valves – bronze/brass body

.1 NPS 2 and under:

.1 To MSS SP-110, 600 CWP/150 SWP, two-piece bronze or DZR brass body, full port, solid stainless steel or chrome plated bronze ball, PTFE seat and seals.

.2 Handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

.3 Required MCPR: 2300 kPa (335 psig) at 121°C (250°F).

.4 Solder ends:

Standard of Acceptance

- Kitz - fig. 59, 69AM-LL
- Apollo - fig. 77-200
- Nibco - fig. S-585-70
- Anvil - fig. 171S

.5 NPT threaded ends.

Standard of Acceptance

- Kitz - fig. 58, 68AM-LL
- Apollo - fig. 77-100
- Nibco - fig. T-585-70
- Anvil - fig. 171N

2.2 Ball Valves – carbon steel body

.1 NPS 2 and under:

.1 To MSS SP-110, 1500 CWP/150 SWP, carbon steel body, regular port, stainless steel or chrome plated carbon steel ball, PTFE seat and seals.

.2 Handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

.3 ISO 5211 mounting pad.

.4 Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

.5 Two-piece body style, NPT threaded ends:

Standard of Acceptance

- Apollo - fig. 89-100
- MAS - fig. CSCR-2
- Velan - fig. S-M1102-SSGA

.6 Three-piece body style, NPT threaded ends:

Standard of Acceptance

- Apollo - fig. 83A-140
- Nibco - fig. TM-590-CS-R-66-FS-LL
- MAS - fig. CSS-F-3N
- Velan - fig. S-K1802-SSGA

.7 Three-piece body style, socket weld ends:

Standard of Acceptance

- Apollo - fig. 83A-240
- Nibco - fig. KM-590-CS-R-66-FS-LL
- MAS - fig. CSS-F-3N-SW
- Velan - fig. W-K1802-SSGA

.2 NPS ½ to NPS 4:

.1 To MSS SP-72, ASME Class rated, carbon steel two-piece split body, full port, stainless steel or chrome plated carbon steel ball, PTFE seat and seals, ASME Class 150 flanged ends.

.2 Handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

.3 ISO 5211 mounting pad.

.4 Class 150:

(a) Required MCPR: 1600 kPa (230 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 150SCTDZM-N
- Apollo - fig. 88A-200
- Nibco - fig. F-515-CS-F-66-FS
- Velan - fig. SB-150

.5 Class 300:

(a) Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 300SCTDZM-N
- Apollo - fig. 88A-900
- Nibco - fig. F-535-CS-F-66-FS
- Velan - fig. SB-300

2.3 Globe Valves

.1 NPS 2 and under:

.1 To MSS SP-80, Class 150, bronze body, renewable PTFE composition disc, union bonnet, and lockshield handles where shown.

(a) Required MCPR: 1600 kPa (230 psig) at 121°C (250°F).

(b) Solder ends.

Standard of Acceptance

- Kitz - fig. 10
- Crane - fig. 1310 (class 300)
- Jenkins - fig. 106BPJ (class 300)
- Nibco - fig. S-235-Y

(c) NPT threaded ends.

Standard of Acceptance

- Kitz - fig. 09
- Crane - fig. 7TF
- Jenkins - fig. 106BJ
- Nibco - fig. T-235-Y

.2 To MSS SP-80, Class 300, bronze body, hardened stainless steel plug, renewable seat and union bonnet, with NPT threaded ends.

(a) Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 17S
- Crane - fig. 382P
- Jenkins - fig. 592J
- Nibco - fig. T-276-AP

.3 To ASME B16.34, Class 800, forged steel body, bolted bonnet, hard faced disc and seat ring, with NPT threaded ends.

(a) Required MCPR: 12 MPa (1740 psig) at 121°C (250°F).

Standard of Acceptance

- Crane - fig. B3644XU-T
- Powell - fig. LG08TA58GB
- Beric - fig. 502-T-X-8-A-08

.2 NPS 2½ and over, flanged:

.1 To MSS SP-85, Class 125, cast iron body, bronze trim, OS & Y bolted bonnet, bronze disc and seat ring, flat faced flanges,

(a) Required MCPR:

- NPS 2-12: 1200 kPa (174 psig) at 121°C (250°F).
- NPS 14-24: 860 kPa (125 psi) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 76
- Crane - fig. 351
- Jenkins - fig. 2342J
- Nibco - fig. F-718-B

.2 To ASME B16.34, Class 300, ASTM A216 Gr WCB cast steel body, 13% chrome stellite trim, OS & Y, bolted bonnet, and raised face flanges.

(a) Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 300SCJS
- Crane - fig. 151XU
- Jenkins - fig. J1042B2
- Powell - fig. 3031-FC8G
- Beric - fig. 203-RF-EA08-H

2.4 Gate Valves

.1 NPS 2 and under:

.1 To MSS SP-80, Class 150 with bronze body, OS&Y rising stem, bronze wedge disc and union or screw-in bonnet, and NPT threaded ends.

(a) Required MCPR: 1600 kPa (230 psig) at 121°C (250°F).

Standard of Acceptance

° Kitz - fig. 42
° Crane - fig. 431UB
° Nibco - fig. T-131

.2 To MSS SP-80, Class 300, bronze body, OS&Y rising stem, copper nickel alloy or stainless steel trim, solid wedge disc, union bonnet, and NPT threaded ends.

(a) Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

° Kitz - fig. 37
° Crane - fig. 622E
° Jenkins - fig. 2280UJ
° Nibco - fig. T-174-A

.3 To ASME B16.34, Class 800, forged steel body, standard port, OS&Y rising stem, solid wedge disc, bolted bonnet, and NPT threaded ends.

(a) Required MCPR: 12 MPa (1740 psig) at 121°C (250°F).

Standard of Acceptance

° Bonney Forge - fig. HL-11-T
° Crane - fig. B-3604XU-T
° Powell - fig. GA08TA58GB
° Beric - fig. 501-T-X-8-A-02

.2 NPS 2½ and over, flanged:

.1 To MSS SP-70, Class 125, cast iron body, OS&Y rising stem, flat faced flanges, bronze trim, and bolted bonnet, and flat-faced flanges.

(a) Required MCPR:

- NPS 2-12: 1200 kPa (174 psig) at 121°C (250°F).
- NPS 14-24: 860 kPa (125 psi) at 121°C (250°F).

Standard of Acceptance

° Kitz - fig. 72
° Crane - fig. 465½
° Jenkins - fig. 454J
° Nibco - fig. F-617-O

.2 To ASME B16.34, Class 300, ASTM A216 Gr WCB cast steel body, OS&Y rising stem, flexible disc, 13% chrome stellite trim, bolted bonnet, and raised face flanges.

(a) Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 300SCLS
- Crane - fig. 33XU-F
- Jenkins - fig. J1010B8F
- Powell - fig. 3003-FC8G
- Beric - fig. 103-RF-AA08-H

2.5 Butterfly Valves – Low Pressure (type "LP")

.1 NPS 2½ to NPS 24, for flange installation:

.1 To MSS SP-67, ductile or cast iron flange-less lug body style, flange holes drilled and tapped for ANSI 150 flange pattern.

.2 Stainless steel shaft, bronze or ductile iron disc with nickel chrome seating edge and replaceable EPDM resilient seat to provide bubble tight shut-off under system pressure from either side with flange removed from un-pressurized side.

.3 ISO 5211 mounting pad.

.4 Locking handles up to NPS 4, and gear operators for NPS 6 and over.

.5 Required MCPR:

(a) NPS 2 to 12: 1380 kPa (200 psig) at 107°C (225°F).

(b) NPS 14 to 24: 1030 kPa (150 psig) at 107°C (225°F).

Standard of Acceptance

- Nibco - fig. LD-2000
- Crane - fig. Center Line RS-200
- Kitz - fig. 6100 series
- DeZurik - fig. BOS-US
- Bray - fig. 31H
- Watts - fig. BF-03-M2
- MAS - fig. D series

.2 NPS 2½ to 12, for grooved end pipe:

.1 To CSA B242, malleable or ductile iron body with corrosion inhibiter finish, with grooved ends.

.2 Stainless steel shaft, aluminum-bronze or nickel plated ductile iron or EPDM encapsulated ductile iron disc, and replaceable EPDM resilient seat for bi-directional flow and bubble tight shut-off under system pressure.

.3 ISO mounting pad.

.4 Locking handles up to NPS 4, and gear operators for NPS 6 and over.

.5 Required MCPR: 1380 kPa (300 psig) at 107°C (225°F).

Standard of Acceptance

- Victaulic - fig. 761 Vic-300
- Gruvlok - fig. 7700 series
- MAS - fig. W50-A-ED-GG-S-LL

.3 NPS 14 to NPS 24, for grooved end pipe:

.1 To CSA B242, ductile iron body with corrosion inhibiter finish, with grooved ends.

.2 Stainless steel shaft, corrosion-inhibiter encapsulated ductile iron disc with offset design, and replaceable EPDM resilient sealt for bi-directional flow and bubble tight shut-off under system pressure.

.3 ISO mounting pad.

.4 Gear operator.

.5 Required MCPR: 2065 kPa (300 psig) at 107°C (225°F).

Standard of Acceptance

° Victaulic - fig. AGS Vic-300 W709

2.6 Butterfly Valve - High Pressure (type "HP")

.1 NPS 2½ to NPS 36:

.1 To MSS SP-68, high pressure offset-disc type, carbon steel lug body with flange bolt holes drilled and tapped, suitable for single flange connection to ASME/ANSI B16.5 flanges (NPS 24 and under) and ASME/ANSI B16.47 Series A flanges (NPS 30 to NPS 48).

.2 316 or 17-4 stainless steel disc and shaft, PTFE seat complete with titanium or 316 stainless steel spiral wound back-up ring, bi-directional bubble tight shut-off under system pressure for dead-end service with flange removed from one side.

.3 ISO 5211 mounting pad.

.4 Locking handles up to NPS 4, and gear operators for NPS 6 and over.

.5 Class 150 valve (NPS 2½ to 36):

(a) Required MCPR: 1600 kPa (230 psig) at 121°C (250°F).

Standard of Acceptance

° DeZurik - fig. BHP
° Crane - fig. Flowseal 3LA series
° Apollo - fig. 230L
° WKM - fig. DynaCentric
° Nibco - fig. LCS-6822
° Keystone - fig. K-Lok 36
° Nibco SureSeal - fig. G1L
° Bray - fig. McCannalok

.6 Class 300 valve (NPS 2½ to NPS 24)

(a) Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

° DeZurik - fig. BHP
° Crane - fig. Flowseal 3LA series
° Apollo - fig. 230L
° WKM - fig. DynaCentric
° Nibco - fig. LCS-7822
° Keystone - fig. K-Lok 37
° Bray - fig. McCannalok

2.7 Inline Silent Check Valves

.1 NPS 2 and under, bronze, threaded:

.1 To MSS SP-80, Class 125, bronze body, spring-controlled inline style (non flapper), body guided disc, resilient EPDM or PTFE seat or disc; bronze, Inconel or stainless steel spring; with NPT threaded ends.

.2 Required MCPR: 1200 kPa (174 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 36
- Nibco - fig. T-480-Y
- Apollo - fig. CVBB 61-500
- Valmatic - fig. 1400THR

.2 NPS 2 ½ to NPS 12, wafer style:

.1 To MSS SP-125, Class 125 or 150, cast or ductile iron body, stainless steel trim and spring-controlled inline globe-style (non flapper), body guided disc, resilient BUNA-N seat, wafer body style for installation between flat-faced flanges.

.2 Valve design provides both a metal-to-metal and metal-to-resilient seat for zero leakage sealing.

.3 Required MCPR: 1200 kPa (174 psig) at 65°C (150°F).

Standard of Acceptance

- Dezurik - fig. APCO 300 Series
- Valmatic - fig. 1400A series
- Mueller - fig. 101MAT
- Nibco - fig. W-910

.3 NPS 2½ to NPS 24, flanged ends:

.1 To MSS SP-125, Class 125 or 150, cast or ductile iron body, stainless steel trim and spring-controlled inline globe-style (non flapper), body guided disc, resilient BUNA-N seat, with Class 125/150 flanges.

.2 Valve design provides both a metal-to-metal and metal-to-resilient seat for zero leakage sealing.

.3 Required MCPR:

- NPS 2-12: 1200 kPa (174 psig) at 65°C (150°F).
- NPS 14-24: 860 kPa (125 psi) at 65°C (150°F).

Standard of Acceptance

- Dezurik - fig. APCO 600 Series
- Valmatic - fig. 1800 series
- Mueller - fig. 107MAT
- Nibco - fig. F-960

.4 NPS 2½ to NPS 24, carbon steel, flanged:

.1 To MSS SP-126, Class 150 and 300, ASTM A216 WCB carbon steel body, stainless steel trim and spring-controlled inline globe-style (non flapper), body guided disc, stainless steel seat, with Class 150 / 300 flanges.

.2 Valve design provides both a metal-to-metal and metal-to-resilient seat for zero leakage sealing.

.3 Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

- Dezurik - fig. APCO 600 Series
- Durabla - fig. GLC
- Mueller - fig. 109MDT

2.8 Swing Check Valves

.1 NPS 2 and under:

.1 To MSS SP-80, Class 125, bronze body, bronze swing disc, screw in cap, regrindable seat.

(a) Required MCPR: 1200 kPa (174 psig) at 121°C (250°F).

(b) Soldered ends

Standard of Acceptance

- Kitz - fig. 23
- Crane - fig. 1342
- Jenkins - fig. 4093J
- Nibco - fig. S-413-B

(c) NPT threaded ends:

Standard of Acceptance

- Kitz - fig. 22
- Crane - fig. 37
- Jenkins - fig. 4037J
- Nibco - fig. T-413-B

.2 To MSS SP-80, Class 300, bronze body, bronze swing disc, screw in cap, regrindable seat, with NPT threaded ends.

(a) Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 19
- Crane - fig. 76E
- Jenkins - fig. 4962J
- Nibco - fig. T-473-B

.2 NPS 2½ to NPS 10, cast iron, flanged

.1 To MSS SP-71, Class 125, cast iron body, flat faced flange, renewable bronze seat ring, bronze disc, bolted cap, with ASME Class 125 flanged ends.

(a) Required MCPR: 1200 kPa (174 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 78
- Crane - fig. 373
- Jenkins - fig. 587J
- Nibco - fig. F-918-B

.3 NPS 2 to NPS 30, carbon steel, flanged:

.1 To ASME B16.34, Class 300, ASTM A216 Gr WCB cast steel body, renewable stainless steel seat ring, stainless steel or 13% Cr overlay disc, bolted cap.

(a) Required MCPR: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

- Kitz - fig. 300SCOS
- Crane - fig. 159XU
- Beric - fig. 303-RF-EA08

.4 NPS 2 to NPS 12, for grooved end pipe

.1 Ductile iron body, ductile iron or bronze disc, nickel seat, EPDM liner, stainless steel spring, with grooved ends.

.2 Required MCPR: 2000 kPa (290 psig) at 110°C (230°F)

Standard of Acceptance

- Victaulic - fig. 716H/716
- Gruvlok - fig. 7800

2.9 Double Regulating Valves ("DRV")

.1 NPS 3 and under:

.1 Bronze or DZR brass body, plug type stem with flow measurement ports and tamper-proof setting.

.2 NPT threaded or soldered ends.

.3 Required MCPR: 1500 kPa (215 psig) at 121°C (250°F) water temperature.

Standard of Acceptance

- S.A. Armstong - fig. CBV
- Victaulic - fig. 787
- Bell and Gossett - fig. Circuit Setter Plus
- Preso - fig. B-Plus
- Nexus - fig. UltraMB(NL)
- Red White - fig. 9517

.2 NPS 2½ to NPS 12:

.1 Cast or ductile iron body, copper alloy trim, with flow measurement ports, tamper-proof setting, with groove or Class 250/300 flanges.

.2 Required MCPR: 1720 kPa (250 psig) at 110°C (230°F)

Standard of Acceptance

- S.A. Armstrong - fig. CBV II
- Victaulic - fig. 788/789
- Preso - fig. B-PLUS
- Nexus- fig. UltraMB
- Red White - fig. 9519

.3 Flow meter for DRVs

.1 Differential pressure gauge with calibrated chartes or direct digital flow meter type.

.2 Hose and fittings to suit manual double regulating valves.

.3 In addition to equipment and materials used during start-up and testing, supply one complete set of clean un-used calibrated flow charts or one (1) digial flow meter, to the owner at the completion of the project.

2.10 Plug Valves with Flow Balancing Ports

.1 NPS 6 to 24, flanged:

.1 To MSS SP-78, cast or dutile iron body, lubricated bronze or nickel plated cast iron plug, lubrication assembly, short pattern, with Class 125 flat-face flange ends.

.2 Two pressure test ports with pet cocks for differential pressure measurement, and calibrated flow charts.

.3 Worm gear operator with memory stop.

.4 Class 125:

(a) Required MCPR:

- NPS 2-12: 1200 kPa (174 psi) at 121°C (250°F)
- NPS 14-24: 1000 kPa (145 psi) at 121°C (250°F)

Standard of Acceptance

° Hattersley - fig. 611
° DeZurik - fig. Hilton Balancing Valve

.5 Class 250:

(a) Required MCPR:

- NPS 2-12: 2700 kPa (390 psi) at 121°C (250°F)
- NPS 14-24: 1700 kPa (245 psi) at 121°C (250°F)

Standard of Acceptance

° Hattersley - fig. 602
° DeZurik - fig. Hilton Balancing Valve

2.11 Triple Duty Valves

.1 Combination discharge non-slam check valve, isolation valve and balancing valve (“triple-duty”).

.2 NPS 1-1/4 to NPS 2:

.1 Ductile iron body, Class 125, non-slam bronze disc with stainless steel spring, EPDM seat ring, plug type stem, flow measurement ports, tamper-proof setting, with NPT threaded ends.

.2 Required MCPR: 900 kPa (130 psig) at 110°C (230°F)

Standard of Acceptance

° S.A. Armstrong - fig. FLO-TREX FTV-T
° ITT Bell & Gossett

.3 NPS 2 to NPS 12:

.1 Cast or ductile iron body, non-slam bronze disc with stainless steel spring, EPDM seat ring, plug type stem, flow measurement ports, tamper-proof setting, with flanged or groove pipe ends.

.2 Class 125 required MCPR: 900 kPa (130 psig) at 110°C (230°F)

.3 Class 250 required MCPR: 2070 kPa (300 psig) at 110°C (230°F)

Standard of Acceptance

- S.A. Armstrong - fig. FLO-TREX FTV series
- ITT Bell & Gossett

3 EXECUTION

3.1 General

.1 Refer to section 20 05 23 and as required herein.

3.2 Valve Selection Based on Pressure Rating

.1 Unless otherwise specified herein or shown, select valves that have a Minimum Component Pressure Rating (MCPR) which exceed the applicable piping system Design Pressure and Design Temperature specified in section 23 05 01.

.2 Where drawings indicate either: (a) a pressure rating; or (b) a pressure rating and Class rating, by floor level then select valves as follows:

.1 For all valves, select a valve with a MCPR rating equal to or greater than the pressure rating indicated on the drawings for each floor level.

.2 For clarity, even if a valve has an ASME Class rating, do not select a valve based on its Class to match any Class rating shown on the drawings.

3.3 Butterfly valves

.1 Where butterfly valves are used, provide high pressure HP type butterfly valves as follows:

.1 at hot water boiler inlet and outlet connections,

.2 at refrigeration equipment evaporator and condenser water inlet and outlet connections,

.3 where valves are installed in pipe risers in vertical service shafts,

.4 where valves are used to isolate piping service to a building,

.5 as required based on valve size and pressure ratings, or

.6 at other locations as shown on drawings.

.2 For butterfly valves with automatic control actuators, select RS or HP type valves as required so that valve torque requirements do not exceed 75% of installed valve actuator torque rating.

3.4 Check Valves

.1 Provide an inline silent check valve on the pump discharge under any of the following conditions:

.1 multi-parallel pump installation,

.2 where the pump discharge piping rises to more than 5 m (15 ft) above the pump discharge, and

.3 at other locations as shown on drawings.

.2 Provide an inline silent check valve where a check-valve is shown on drawings other than at a pump discharge.

.3 Provide swing check or silent check valves at other locations.

End of Section

GENERAL-DUTY VALVES FOR STEAM SYSTEM PIPING
23 05 23.23

1 GENERAL

1.1 Scope

.1 Provide valves for general duty service in steam and condensate distribution piping systems, including shut-off valves, check valves, and manual balancing valves for:

.1 saturated steam piping with design pressures of 1750 kPa (250 psig) or less,

.2 condensate piping with design pressures of 2750 kPa (400 psig) or less, and

.3 boiler feedwater piping serving boilers that have a MAWP of 103 kPa (15 psig) or less.

.2 This specification also applies to:

.1 Boiler External Piping valves for steam boilers with a MAWP of 103 kPa (15 psig) or less, including valves for feedwater, steam, blowdown, blowoff, boiler drains, chemical feed, instrument vent and drains and bypass valves, except where such valves are supplied with the boiler;

.2 steam and condensate valves on the supply (primary-side) piping to unfired steam-to-steam generators; and

.3 ancillary system valves including equipment drain valves and distribution system drain valves.

.3 For clarity, this specification section does not apply to:

.1 steam, condensate and feedwater piping for steam boiler plants which have steam boilers with an MAWP greater than 103 kPa (15 psig); refer to specification section 23 05 23.26.

(a) for additional clarity, where a steam boiler plant contains a mix of boilers with MAWP less than 103 kPa (15 psig) as well as greater than 103 kPa (15 psig), then all valves for steam, condenate and feedwater in the steam boiler plant shall comply with specification section 23 05 23.26.

.2 steam and condensate valves on the load (secondary-side) piping from unfired steam-to-steam generators; refer to specification section 23 05 23.29.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section integrates with or refers to the following specification sections:

.1 20 05 23 General Requirements for Valves

.2 23 05 01 Heating and Cooling Piping Systems

.3 23 05 23.26 Valves for High Pressure Steam Boiler Plant.

.4 23 05 23.29 Stainless Steel Valves for Clean Steam Piping

1.3 Definitions

.1 In this specification section, the following definitions apply.

.1 ***Boiler External Piping*** (“BEP”) has the same meaning as defined in ASME B31.9 for steam boilers with a MAWP of 103 kP (15 psig) or less.

.2 ***Distribution piping:*** means piping located outside of steam boiler plant service rooms.

.3 ***Steam boiler plant:*** means the steam boilers, feedwater equipment, condensate receivers, other steam or condensate equipment, and associated piping systems located within the steam boiler plant service room(s).

.4 ***Steam boiler plant service room:*** the room or rooms which contain the steam boiler plant.

1.4 Submittals

.1 Refer to section 20 05 23.

1.5 Applicable Codes and Standards

.1 Refer to section 20 05 23 and as specified herein.

.2 All valves shall have Canadian Registration Numbers in accordance with CSA B51. In the following valve specifications, where the identified model does not have a current CRN, provide a valve of equal or greater performance that has a current CRN from a manufacturer listed herein or as listed in section 20 05 23.

.3 For the purpose of this article, "current CRN" means a registration that does not expire for at least 12 months after the date of submittal of shop drawings.

2 PRODUCTS

2.1 Ball Valves

.1 NPS 2 and under, bronze body:

.1 To MSS SP-110, 600 CWP/150 SWP, two-piece bronze or DZR brass body, full port, solid stainless steel ball, PTFE seat and seals, NPT threaded ends.

.2 Handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

.3 Required MCPR:

Water / Condensate
1600 kPa at 121°C (230 psig at 250°F).

Standard of Acceptance

- Apollo - fig. 77-140
- Nibco - fig. T-585-70
- MAS - fig. CSCR-2-250

.2 NPS 2 and under, carbon steel body:

.1 To MSS SP-72 or 110, ASME Class 150 or 1000 CWP, CF8M stainless steel two-piece union body, full port, solid stainless steel or chrome plated carbon steel ball, glass or carbon reinforced (R)PTFE seat and seals, NPT threaded ends.

.2 Handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

.3 Required MCPR:

Steam / Condensate	Water / Condensate
1030 kPa at 185°C (150 psig at 365°F).	1600 kPa at 121°C (230 psig at 250°F).

Standard of Acceptance

- Apollo - fig. 76F-100-A
- Nibco - fig. T-585-S6-R-66-LL
- MAS - fig. G-2-250

.3 NPS ½ to NPS 4:

.1 To MSS SP-72, ASME Class rated, carbon steel two-piece split body, full port, stainless steel or chrome plated carbon steel ball, glass or carbon reinforced (R)PTFE seat and seals, flanged ends.

.2 Handle extensions suitable to clear 50 mm (2 in) pipe insulation thickness.

.3 ISO 5211 mounting pad.

.4 Class 150 - Required MCPR (steam, condensate and water):

Steam / Condensate	Water / Condensate
1030 kPa at 185°C (150 psig at 365°F).	1600 kPa at 121°C (230 psig at 250°F).

Standard of Acceptance

- Apollo - fig. 88A-240
- Nibco - fig. F-515-CS-F-66-FS
- Velan - fig. SB-150

.5 Class 300 – Required MCPR (water and condensate only):

Water / Condensate	Water / Condensate
3100 kPa at 121°C (450 psig at 250°F).	1700 kPa at 185°C (245 psig at 366°F)

Standard of Acceptance

- Apollo - fig. 88A-940
- Nibco - fig. F-535-CS-F-66-FS
- Velan - fig. SB-300

2.2 Globe Valves

.1 NPS 2 and under, threaded end:

.1 To MSS SP-80, Class 125, bronze body, threaded or union bonnet, reinforced RPTFE disc and bronze seat, NPT threaded ends.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
860 kPa at 178°C (125 psig at 353°F).	1030 kPa at 121°C (150 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 03
- Crane - fig. 5TF
- Jenkins - fig. 106BJ
- Nibco - fig. T-211-Y
-

.2 To MSS SP-80, Class 150, bronze body, union bonnet, stainless steel plug type disc and seat and lockshield handles where shown, NPT threaded ends.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
1030 kPa at 185°C (150 psig at 365°F).	1480 kPa at 121°C (215 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 17S
- Crane - fig. 14-½P
- Jenkins - fig. 2032J
- Nibco - fig. T-256-AP

.3 To MSS SP-80, Class 300, bronze body, hardened stainless steel plug, renewable seat and union bonnet, NPT threaded ends.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
2060 kPa at 216°C (300 psig at 421°F).	3100 kPa at 121°C (450 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 17S
- Crane - fig. 382 P
- Jenkins - fig. 592J
- Nibco - fig. T-375-B (angle)

.4 To ASME B16.34, Class 800, forged carbon steel body, full port, rising stem, hard faced plug disc and seat rings, and bolted bonnet, NPT threaded ends.

(a) Required MCPR for water only:

- Water: 3100 kPa (450 psig) at 121°C (250°F).

Standard of Acceptance.

- Bonney Forge - fig. HL-31-T
- Crane - fig. B-3644XU-T
- Powell - fig. GL08TA58GB

.2 NPS 2½ and over, flanged:

.1 To MSS SP-85, Class 125, cast iron body, cast iron disc, OS & Y bolted bonnet, bronze seat ring, with flat faced flanges,

(a) NPS 2 ½ to NPS 24 only.

(b) Required MCPR:

Steam / Condensate	Water / Condensate
680 kPa at 169°C (100 psig at 337°F).	860 kPa at 121°C (125 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 76
- Crane - fig. 351
- Jenkins - fig. 2342J
- Nibco - fig. F-718-B
-

.2 To ASME 16.34, Class 150, ASTM A216 Gr WCB cast steel body, exelloy and stellite trim, OS & Y and bolted bonnet, with raised face flanged ends.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
1030 kPa at 185°C (150 psig at 365°F).	1600 kPa at 121°C (230 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 150 SCJS
- Crane - fig. 143XU
- Jenkins - fig. J1040B2
- Powell - fig. 1531-FC8G

.3 To ASME B16.34, Class 300, ASTM A216 Gr WCB cast steel body, 13% chrome stellite trim, OS & Y, bolted bonnet, and raised face flanges.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
2060 kPa at 216°C (300 psig at 421°F).	3100 kPa at 121°C (450 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 300SCJS
- Crane - fig. 151XU
- Jenkins - fig. J1042B2
- Powell - fig. 3031-FC8G

2.3 Gate Valves

.1 NPS 2 and under:

.1 To MSS SP-80, Class 125, bronze body, union or threaded bonnet, rising stem with bronze body and solid wedge disc, NPT threaded ends.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
860 kPa at 178°C (125 psig at 353°F).	1170 kPa at 121°C (170 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 24
- Crane - fig. 428
- Jenkins - fig 810J
- Nibco - fig. T-111

.2 To MSS SP-80, Class 150 with bronze body, OS&Y rising stem, bronze wedge disc and union bonnet, and NPT threaded ends.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
1030 kPa at 185°C (150 psig at 365°F).	1600 kPa at 121°C (230 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 42T
- Crane - fig. 431UB
- Jenkins - fig. 47CUJ
- Nibco - fig. T-134

.3 To MSS SP-80, Class 300, bronze body, OS&Y rising stem, copper nickel alloy solid wedge disc, integrated seats or stainless steel trim, union bonnet, and NPT threaded ends.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
2060 kPa at 216°C (300 psig at 421°F).	3100 kPa at 121°C (450 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 37
- Crane - fig. 622E
- Jenkins - fig. 2280UJ
- Nibco - fig. T-174-A

.2 NPS 2½ and over:

.1 To MSS SP-70, Class 125, cast iron body, OS&Y rising stem, bolted bonnet, cast iron disc and bronze trim, flat-faced flanges.

(a) NPS 2 ½ to NPS 24 only.

(b) Required MCPR:

Steam / Condensate	Water / Condensate
680 kPa at 169°C (100 psig at 337°F).	860 kPa at 121°C (125 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 72
- Crane - fig. 465½
- Jenkins - fig. 454J
- Nibco - fig. F-617-O

.2 To ASME 16.34, Class 150, ASTM A216 Gr WCB cast steel body, OS&Y rising stem, 13Cr/carbon steel flexible wedge disc, 13Cr hardfaced trim, bolted bonnet, and raised face flanges.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
1030 kPa at 185°C (150 psig at 365°F).	1600 kPa at 121°C (230 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 150 SCLS
- Crane - fig. 47XUF
- Jenkins - fig. J1009B8F

.3 To ASME B16.34, Class 300, ASTM A216 Gr WCB cast steel body, OS&Y rising stem, flexible wedge disc, 13Cr hardfaced trim, bolted bonnet, and raised face flanges.

(a) Required MCPR:

Steam / Condensate	Water / Condensate
2060 kPa at 216°C (300 psig at 421°F).	3100 kPa at 121°C (450 psig at 250°F).

Standard of Acceptance

- Kitz - fig. 300SCLS
- Crane - fig. 33XUF
- Jenkins - fig. J1010B8F

2.4 Butterfly Valves

.1 NPS 3 to NPS 24:

.1 To ASME B16.34, triple offset-disc type, one piece forged or cast ASTM A216 WCB carbon steel body with double flange ends. Face-to-face flange dimensions to be compatible with gate valve dimensions in accordance with ASME B16.10. Replaceable hardfaced seat bolted to the valve body.

.2 ASTM A216 WCB carbon steel or CF8M stainless steel disc, stainless steel shaft, torque seated flexible stainless steel seal ring to provide resilient seating with uniform contact pressure. Disc mounted on shaft with a triple offset design to prevent rubbing of the disc on the valve seat.

.3 Valve leakage: zero-leakage with bi-directional shut-off for dead-end service.

.4 ISO 5211 mounting pad.

.5 Gear operators for all sizes.

.6 Required MCPR for saturated steam:

(a) Class 150: 1030 kPa (150 psig)

(b) Class 300: 2070 kPa (300 psig)

Standard of Acceptance

- Bray - fig. TriLok
- Velan - fig. Torqseal

2.5 Horizontal Lift Check Valves

.1 NPS 2 and under:

.1 For low-pressure steam trap assemblies.

.2 To MSS SP-80, Class 125, bronze body, PTFE body-guided lift disc style, metal body seat, with NPT threaded ends.

(a) Required MCPR: 1170 kPa (170 psig) at 121°C (250°F) for water and condensate

Standard of Acceptance

- Crane - fig. 27TF
- Jenkins - fig. 117ATJ
- Spirax Sarco - fig. LCV1

.2 NPS ½ to NPS 4:

.1 For intermediate to high pressure steam trap assemblies.

.2 To ASME B16.34, Class 150 and Class 300, ASTM A216 WCB carbon steel body, body-guided bronze or stainless steel disc with stainless steel control-spring, and stainless steel trim;

(a) NPS ½ to NPS 2: NPT threaded ends.

(b) NPS 2 ½ to NPS 4: ASME flanged ends.

(c) Required MCPR – Class 150:

Steam / Condensate	Water / Condensate
1030 kPa at 185°C (150 psig at 365°F).	1600 kPa at 121°C (230 psig at 250°F).

(a) Required MCPR:

Steam / Condensate	Water / Condensate
2060 kPa at 216°C (300 psig at 421°F).	3100 kPa at 121°C (450 psig at 250°F).

Standard of Acceptance

- Spirax Sarco - fig. LCV4
- Crane - fig. 366E

2.6 Inline Silent Check Valves

.1 NPS 2 and under:

.1 To MSS SP-80, Class 125, bronze or stainless steel body, in-line spring-controlled inline center-guided style (non flapper), body guided disc, resilient PTFE or FKM seat or disc; bronze, Inconel or stainless steel spring; with NPT threaded ends.

(a) Required MCPR: 1170 kPa (170 psig) at 121°C (250°F).

Standard of Acceptance

- Nibco - fig. T-480-Y
- Apollo - fig. CVBB 61-500

.2 NPS 2½ to NPS 24, carbon steel, flanged:

.1 To MSS SP-126, Class 150 and 300, ASTM A216 WCB carbon steel body, stainless steel trim and spring-controlled inline globe-style, center guided disc, stainless steel seat, style with raised face flanges.

.2 Valve design provides both a metal-to-metal and metal-to-resilient seat for zero leakage sealing.

.3 Required MCPR:

(a) Class 150: 1600 kPa (230 psig) at 121°C (250°F).

(b) Class 300: 3500 kPa (507 psig) at 121°C (250°F).

Standard of Acceptance

- Dezurik - fig. APCO 600 Series
- DFT - fig. GLC
- Mueller - fig. 109MDT

3 EXECUTION

3.1 General

.1 Refer to section 20 05 23 and as required herein.

3.2 Valve Selection Based on Pressure Rating

.1 Except as otherwise specified herein or shown, select valves that have a Minimum Component Pressure Rating (MCPR) which exceed the applicable piping system Design Pressure and Design Temperature specified in section 23 05 01.

.2 For water and condensate piping systems, where drawings indicate either a Design Pressure rating or a Class rating, then select valves based on meeting or exceeding the indicated Design Pressure.

(a) For clarity, even if a valve has an ASME Class rating, do not select a valve based on its Class to match any Class rating shown on the drawings.

.3 For steam piping systems, select valves based on their Class or SWP rating in accordance with the following table:

Design Pressure	Ball	Gate, Globe, Angle and Check	Butterfly
0 to 550 kPa (0 to 80 psig)	600 CWP/150 SWP or Class 150	Class 125 or higher	Class 150 or higher
1000 kPa (150 psig) and less	Class 150	Class 150 or higher	Class 150 or higher
1720 kPa (250 psig) and less	Not permitted	Class 300 or higher	Class 300

3.3 Manual Valve Selection Based on Service

.1 Select manual valves (excluding check valves) based on service in accordance with the following table, subject to the requirements for valve selection based on pressure rating.

Service	Fluid	Ball	Globe, Angle	Gate	Butterfly
Boiler isolation (MAWP ≤ 103 kPa	Steam	● [7] [8]		●	●
	Feedwater	● [6] [7]		●	
	Drains	● [6] [7]	●	●	
Distribution Isolation	Steam	● [5] [7] [8]		●	●
	Steam bypass		●		

Service	Fluid	Ball	Globe, Angle	Gate	Butterfly
(except PRV's) [3]	Condensate	● [5] [6] [7]		●	
	Line drains	● [5] [6] [7]	●	●	
PRV isolation	Steam	● [5] [7] [8		●	●
Terminal device and equipment [4] Isolation	Steam	● [5] [7] [8]	●	●	●
	Condensate	● [5] [6] [7]	●	●	
Steam trap assemblies	Condensate	● [5] [6] [7]	●	●	

Notes:

[1] Specific valve product selection apply.

[2] Boiler steam isolation valves means those valves which form part of "boiler external piping" as defined in ASME B31.1.

[3] Distribution means valves other than boiler isolation valves and terminal device and equipment shut-off valves.

[4] Includes end-use equipment such as humidifiers, domestic hot water heaters, steam coils, condensate pumps and pumpsets, sterilizers, etc.

[5] Limited to 1030 kPa (150 psig) piping system design pressure.

[6] Bronze body ball valve.

[7] Stainless steel body ball valve.

[8] Carbon steel ball valve.

3.4 Check Valve Selection Based on Service

.1 Select check valves based on service in accordance with the following requirements, subject to the requirements for valve selection based on pressure rating;

.1 Horizontal lift check valves on condensate piping downstream of steam traps where condensate is lifted up to a higher level above the trap.

.2 Inline check valves on condensate pump discharge.

.2 Where a check valve is shown on steam lines for low pressure boilers, select an inline check valve with a pressure drop not exceedin 3.5 kPa (0.5 psig) at design steam flow rate.

3.5 Bypass and Drip Valves on Steam Piping

.1 Provide ancillary drain and bypass valves on steam piping as shown and as follows.

.2 Provide NPS ¾ drain valves within 150 mm (6 in) above steam valves that are installed in the vertical position, unless a steam trap assembly is provided in this location.

.3 Pipe outlet of drain valve down to nearest floor drain.

.4 Provide warm-up bypass valves around shut-off valves on main steam distribution piping:

.1 warm-up valves to be the same pressure rating as the associated main steam valve,

.2 NPS 1 size for main steam valves of NPS 4 to NPS 6

.3 NPS 2 size for NPS 8 and larger main steam valves.

End of Section

WATER SPECIALTIES - HEATING AND COOLING
23 21 11

1 GENERAL

1.1 Scope

.1 Provide water specialties in accordance with this Section for systems where working temperatures are in range of -12°C to 120°C (10°F to 248°F) and working pressure up to 1035 kPa (150 psi).

.2 This section covers specialties for:

.1 Hot water and low temperature heating system

.2 Exterior zone heating and cooling system

.3 Water system relief valve vents & overflows

.4 Glycol heating and cooling systems

.5 Condenser water system

.6 Chilled water system

1.2 Shop Drawings

.1 Submit manufacturer's data sheets for:

.1 air vents,

.2 separators,

.3 strainers,

.4 pressure reducing valves,

.5 pressure relief valves,

2 PRODUCTS

2.1 Automatic air vents

.1 Float operated with brass or cast iron body;

.1 design pressure: [690 kPa (100 psi)][1035 kPa (150 psi)][2070 kPa (300 psi)] working pressure.

Standard of Acceptance

- Maid-O-Mist No. 75
- Taco 418
- Amtrol No. 720
- Spirax Sarco - Fig. 13W
- Grinnell - Fig. 1401
- ITT Bell & Gossett - Model 107

2.2 Air separator (in-line)

.1 Scoop separation type;

.1 design pressure: 860 kPa (125 psi).

- Taco - 430 Series
- ITT Bell & Gossett - IAS
- Amtrol - 400 Series

- Armstrong - PMA

.2 Centrifugal separation type;

.1 designed as unfired pressure vessel,

.2 design pressure: 860 kPa (125 psi).

Standard of Acceptance
- Taco - Air separator
- ITT Bell & Gossett - Rolairtrol
- Amtrol -Tangential air separator
- Armstrong - VA

2.3 Water make-up assemblies

.1 Iron body water pressure regulator with integral check, and fast fill /purge lever;

.1 stainless steel strainer, and

.2 iron body diaphragm operated relief valve
- Watts - No.1450F series
- A.W. Cash Valve - Type CBL

2.4 Hydronic system pressure safety relief valves

.1 Brass or iron body to ASME Section IV;

.1 adjustable pressure setting from 55 to 172 kPa (8 to 25 psi),

.2 operating differential pressure from open to close not more than 20 kPa (3 psi).

2.5 Strainers:

.1 "Y" pattern:

.1 NPS 3 and smaller, WOG service:

(a) bronze, cast iron or steel bodies,
(b) design pressure: 1030 kPa (Class 150)
(c) fittings: screwed or flanged to match specification for fittings in section of piping system where strainer is to be installed,
(d) basket: stainless steel, 0.8 mm ($^{1}/_{32}$ in) diameter perforations.

.2 NPS 4 and larger, WOG service:

(a) bronze, cast iron or steel bodies,
(b) design pressure: 1030 kPa (Class 150)
(c) fittings: flanged,
(d) basket: stainless steel, 3.2 mm (⅛ in) diameter perforations,
(e) baskets with 3.2 mm (⅛ in) diameter perforations: made from 0.9 mm (0.037 in) stock reinforced with 13 mm x 0.9 mm (½ in x 0.037 in) bands of same material spot welded to baskets.
(f) Blow-down NPS 3/4 threaded connection.

.2 Basket pattern:

.1 NPS 2 to 12, WOG Service;

(a) Single basket,
(b) Class 150 (1033 kPa) cast iron body with quick release cover,

(c) Bottom blow down valve.

.2 NPS 2 to 12, Steam Service;

(a) Single basket,
(b) Class 125 (860 kPa) cast iron body with bolted cover,
(c) Bottom blow down valve.

.3 Basket Screens

(a) Stainless steel,
(b) NPS 2 and 3: 1.15 mm (0.045") perforation mesh,
(c) NPS 4 and over: 3.2 mm (⅛") perforation mesh.

Standard of Acceptance
- Erwel
- Spirax Sarco
- Streamflo
- Brooks - Hart

.3 Custom fabricated “Y” pattern strainers:

.4

2.6 Water pressure reducing valves:

.1 Construction:

.1 self-contained hydraulic pilot controlled type,

.2 single seated with resilient disc in iron body.

.3 bronze seat for pressure drops below 480 kPa (70 psi), and

.4 stainless steel seat for 480 kPa (70 psi) and over,

.5 diaphragm suitable for 120°C (250°F) service.

Standard of Acceptance
- Singer Valve (Syntec)
- Cla-Val
- GA

3 EXECUTION

3.1 Air vents

.1 Provide isolating valves installed between unit and piping.

.2 Install air vents at high points, and in sections of piping subject to air binding, in both supply and return mains.

.3 Pipe vent outlets to discharge to drain, over janitors sinks, over floor drains in mechanical rooms and other similar visible locations.

3.2 Pressure safety relief valves

.1 Install on hot water boilers, heating convertors, expansion tanks and other pressure vessels in accordance with relevant codes

.2 Pipe outlets to drain.

3.3 Strainers

.1 Install strainers in horizontal or down flow lines with clearance for removal of basket.

.2 Up to NPS 2 size provide screwed blind caps.

.3 On water and glycol systems NPS 2½ and over provide NPS 1 valved blowout connection, consisting of ball valve with hose end and chained cap. Pipe valved blowout connections from strainers at pumps to open drain.

.4 Provide line size strainer in each of following locations

- .1 On inlet side of water meters
- .2 On inlet side of control valves (except at reheat coils with piping connections NPS ¾ or less, radiation, or radiant panels)
- .3 On inlet side of pressure reducing valves
- .4 On suction side of water circulating pumps

3.4 Pressure reducing valves

.1 Install pressure reducing valve stations with shut-off valve on either side of assembly and 115 mm (4½ in) pressure gauges on upstream and downstream sides of station.

END OF SECTION

HYDRONIC PIPING – CARBON STEEL
23 21 13.23

1 GENERAL

1.1 Scope

.1 Provide carbon steel pipe and fittings for HVAC liquid piping systems. Refer to section 23 05 01 for piping system applicability.

.2 This specification applies to liquid piping systems with design pressures not exceeding 2750 kPa (400 psig) at temperatures not exceeding 121°C (250°F, except as otherwise specified.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	20 05 24	Welding and Brazing
.2	23 05 01	HVAC Piping Systems General Requirements
.3	23 25 05	HVAC Pipe Cleaning

1.3 Applicable Codes and Standards

.1 Legislation:

.1 Refer to section 23 05 01.

.2 Installation standards and codes:

.1 Refer to section 23 05 01.

.3 Product standards:

.1	ANSI A21.11	Rubber Gasket joints for Ductile-Iron Pressure Pipe and Fittings
.2	ANSI B1.20.1	Pipe Threads, General Purpose (inch)
.3	ASME B16.1	Cast Iron Pipe Flanges And Flanged Fittings
.4	ASME B16.3	Malleable Iron Threaded Fittings.
.5	ASME B16.5	Pipe Flanges and Flanged Fittings
.6	ASME B16.9	Factory Made Wrought Steel Buttwelding Fittings
.7	ASME B16.11	Forged Steel Fittings, Socket-Welding and Threaded
.8	ASME B16.20	Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.
.9	ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges.
.10	ASME B18.2.1	Square and Hex Bolts and Screws,
.11	ASME B18.2.2	Square and Hex Nuts
.12	ASME B16.39	Malleable Iron Threaded Pipe Unions: Classes 150, 250 and 300.
.13	ASTM A47	Standard Specificatin for Ferritic Malleable Iron Castings.
.14	ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.15	ASTM A105	Standard Specification for Carbon Steel Forgings for Piping Applications
.16	ASTM A106	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
.17	ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts and Bolts for High-Pressure or High-Temperature Service, or Both.
.18	ASTM A536	Standard Specification for Ductile Iron Castings.
.19	CSA B242	Groove and Shoulder Type Mechanical Pipe Couplings

2 PRODUCTS

2.1 Pipe

.1 Carbon steel:

.1 NPS 2 and under:

(a) ASTM A106 Gr B, schedule 40 seamless, or
(b) ASTM A53 Gr B, schedule 40 Electric Resistance Weld (ERW).

.2 NPS 2-1/2 to 10:

(a) ASTM A53 Gr B, schedule 40 Electric Resistance Weld (ERW).

.3 NPS 12 to NPS 18:

(a) ASTM A53 Gr B, schedule Standard (0.375 in. wall thickness) ERW.

.4 NPS 20 to NPS 24:

(a) ASTM A53 Gr B, schedule 30 ERW.

2.2 Pipe Joints and Fittings

.1 Threaded fittings:

.1 End connections: NPT thread to ANSI B1.20.1.

.2 Fittings: Class 150 and Class 300, malleable iron to ASME B16.3..

.3 Unions: Class 150 and Class 300, malleable iron body with ground joint and bronze face to ASME B16.39.

.4 Threaded joint compound: pulverized lead paste or Teflon pipe tape sealant.

Standard of Acceptance

- Masters Pro-Dope
- Masters Orange or White Tape.

.2 Welding fittings:

.1 Butt weld fittings:

(a) Forged to ASME B16.9,
(b) wall thickness to match pipe,
(c) long radius elbows.

.2 Welding outlet fittings:

(a) forged to ASTM A105,

(b) dimensions and pressure ratings to MSS SP-97, Standard Class for buttwelding branch connection and Class 3000 for threaded or socket welded branch connection,
(c) NPT ends to ASME B1.20.1.

.3 Socket welded fittings:

(a) forged to ASTM A105,
(b) dimensions and pressure ratings to ASME B16.11, Class 3000.

.4 Half couplings:

(a) forged carbon steel to ASTM A105,
(b) dimensions and pressure rating to ASME B16.11, Class 3000 socket weld or threaded ends,
(c) NPT ends to ASME B1.20.1.

.3 Flanges:

.1 Flat-faced cast iron to ANSI B16.1, Class 125.

.2 Raised-face forged carbon steel to ASME B16.5, Class 150 and Class 300, weld neck with wall thickness to match pipe, or slip on type.

.3 Studs, bolts and nuts to ANSI B18.2.1, ANSI 18.2.2 and ASTM A194, “high strength” type.

.4 Gaskets to ANSI B16.21, ANSI B16.20 or ANSI A21.11.

Standard of Acceptance

- Chesterton - fig. 100, 195 and 450
- Beldam

3 EXECUTION

3.1 Piping Installation

.1 Refer to section 23 05 01 for piping design criteria and general requirements for piping installation.

.2 Slope main piping horizontal or up in direction of flow nominally at a slope of 1:500 (0.2%);

.1 branch piping to have greater slope,

.2 slope piping up in direction of terminal heating and cooling devices,

.3 where supply and return piping are grouped together and flow is in opposite directions, arrange piping horizontal.

.3 Use eccentric reducers at pipe size changes arranged flat-on-top to assist venting.

.4 Cap ends during construction to prevent entry of foreign matter.

3.2 Class Rated Fittings and Flanges

.1 Select ASME Class rated fittings and flanges in accordance with the following table for design pressure limits at coincident design temperature limits unless otherwise shown on drawings.

Class	Maximum Design Pressure	Maximum Coincident Design Temperature
125 Note [1]	900 kPa (130 psi)	≤ 65°C (150°F)
125 Note [1]	700 kPa (100 psi)	≤ 121°C (250°F)

Class	Maximum Design Pressure	Maximum Coincident Design Temperature
150	1720 (250 psi)	≤ 38°C (100°F)
150	1400 kPa (200 psi)	≤ 121°C (250°F)
300	3700 kPa (535 psi)	≤ 38°C (100°F)
300	3100 kPa (450 psi)	≤ 121°C (250°F)

Notes:

[1] For flanges only.

3.3 Pipe Joints and Fittings

.1 Make pipe joints as follows.

.1 Piping NPS 2-1/2 and under:

(a) NPT threaded joint to ANSI B1.20.1 and made with Teflon tape or pipe dope, or
(b) socket weld joints.

.2 Piping NPS 2-1/2 and larger:

(a) welded,
(b) flanged.

.2 For flange joints, select gasket materials in accordance with the following table so that gasket pressure and temperature both exceed the piping system design pressure and design temperature.

Gasket Temperature Limit	**Gasket Pressure Limit**	**Gasket Material**	**Gasket Thickness**	**Chesterton Figure**
80°C (180°F)	1720 kPa (250 psig)	Red rubber	1.6 m (1/6 in)	100
200°C (390°F)	2400 kPa (350 psig)	Synthetic fiber with nitrile binder	1.6 m (1/6 in)	450
400°C (750°F)	3700 kPa (535 psig)	Synthetic fiber with nitrile binder	1.6 m (1/6 in)	195

3.4 Equipment connections

.1 Make pipe connections to equipment as follows:

.1 NPS 2 and smaller: threaded fittings.

.2 NPS 2 ½ and larger:

(a) flanged connections,
(b) grooved end where equipment has compatible factory-prepared grooved ends

.2 Where connection is made to equipment with a threaded fitting, provide a union between the isolation valve and the equipment connection.

3.5 Welding

.1 Comply with section 20 05 24 and as specified herein.

3.6 Branch Connections

.1 Make branch connections to mains in accordance with Table 2a and 2b.

.1 These tables are valid for design pressures up to 2070 kPa (300 psig), without adding reinforcement material where branch pipe is directly welded to the main. For welded branch connections at higher design pressures, use buttweld, socket weld, or integrally reinforced outlet fittings only.

.2 In these tables, the following abbreviations apply.

Abbreviations:

TH	Threaded fitting to ASME B16.3
SW	Socket weld fittings to ASME B16.11
HC	Half coupling to ASME B16.11
BW	Buttweld fitting to ASME B16.9
OF	Reinforced Outlet Fittings to MSS SP-97
DP	Direct welding of Branch Pipe to Main without added reinforcement.

Table 2a – Allowable Branch to Main Connections (NPS 1 to NPS 10)										
Branch NPS	Mains Pipe, NPS									
	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10
3/ 4	TH SW	TH SW	TH SW	TH SW	BW SW	BW, OF SW HC DP	BW, OF SW HC DP	BW, OF HC DP	BW, OF HC DP	BW, OF HC DP
1	TH SW	TH SW	TH SW	TH SW	BW SW	BW, OF SW DP	BW, OF SW HC DP	BW, OF HC DP	BW, OF HC DP	BW, OF HC DP
1-1/4	---	TH SW	TH SW	TH SW	BW SW	BW, OF SW DP	BW, OF SW DP	BW, OF HC DP	BW, OF HC DP	BW, OF HC DP
1-1/2	---	---	TH SW	TH SW	BW SW	BW, OF SW DP	BW, OF SW DP	BW, OF HC DP	BW, OF HC DP	BW, OF HC DP
2	---	---	---	TH SW	BW SW	BW, OF SW	BW OF SW DP	BW, OF DP	BW, OF HC DP	BW, OF HC DP
2-1/2	---	---	---	---	BW SW	BW, OF SW	BW, OF SW	BW, OF DP	BW, OF DP	BW, OF DP
3	---	---	---	---	---	BW	BW, OF SW	BW, OF DP	BW, OF DP	BW, OF DP
4	---	---	---	---	---	---	BW	BW, OF	BW, OF DP	BW, OF DP
6	---	---	---	---	---	---	---	BW	BW, OF	BW, OF DP
8	---	---	---	---	---	---	---	---	BW	BW, OF
10	---	---	---	---	---	---	---	---	---	BW

Table 2b – Allowable Branch to Main Connections (NPS 12 to NPS 30)								
Branch NPS	Mains Pipe, NPS							
	12	14	16	18	20	22	24	30
¾ to 2	OF HC DP	OF HC DP	OF HC	OF HC	OF HC	OF HC	OF HC	OF HC
2-1/2	OF DP	OF DP	OF	OF	OF	OF	OF	OF
3	OF DP	OF DP	OF	OF	OF	OF	OF	OF
4	BW OF DP	OF DP	OF	OF	OF	OF	OF	OF
6	BW OF DP	BW OF DP	BW OF	OF	OF	OF	OF	OF
8	BW OF DP	BW OF DP	BW OF	BW OF	BW OF	OF	OF	OF
10	BW OF DP	BW OF DP	BW OF	BW OF	BW OF	BW OF	BW OF	OF
12	BW	BW OF DP	BW OF	BW OF	BW OF	BW OF	BW OF	OF
14	---	BW	BW OF	BW OF	BW OF	BW OF	BW OF	BW OF
16	---	---	BW	BW OF	BW OF	BW OF	BW OF	BW OF
18	---	---	---	BW	BW OF	BW OF	BW OF	BW OF
20	---	---	---	---	BW	BW OF	BW OF	BW OF
22	---	---	---	---	---	BW	BW OF	BW OF
24	---	---	---	---	---	---	BW	BW OF
30	---	---	---	---	---	---	---	BW

.2 Use of Class 3000 half-couplings as a branch connector (“HC”), and direct welding of branch piping to main piping (”DP”), is permitted in accordance with the following requirements:

.1 half-coupling or branch pipe sits-on mains pipe, and does not insert into the main pipe,

.2 the opening size in the main pipe to closely follow the inside diameter of the half-coupling or branch pipe,

.3 half-coupling or branch pipe attachment end is shaped and beveled to closely following the surface of the main pipe, suitable for a pull-penetration weld,

.4 the half-coupling or direct branch pipe is attached with a groove weld and covered with a smooth finishing fillet weld in accordance with the requirements of the applicable piping code.

.3 Where integrally reinforced outlet fittings, half-couplings or direct welding of branch pipe is used, hole saw or drill and ream mains pipe to maintain full inside diameter of branch line prior to welding.

.4 Where multiple branch pipes are to connect to the main pipe in close proximity to each other, provide a minimum separation between the centerlines of adjacent branch pipes equal to or greater than the sum of the OD dimensions of the adjacent branch pipes.

.5 If threaded fittings have been installed where the specification requires welded fittings, either cut-out and replace the fitting, or fully seal-weld the exposed threads.

.6 Where saddle type branch welding fittings are used on mains, hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding.

3.7 Groove joint piping

.1 Make pipe ends clean and free of indentations, projections and roll marks, between the end of the pipe and the groove.

.2 Verify gasket style and material grade with supplier for use with intended service.

.3 Provide for manufacturers' service representative to conduct on-site training prior to piping rough-in and installation.

3.8 Pressure Testing

.1 Conduct pressure and leak tests in accordance with section 23 05 01.

3.9 Flushing and Cleaning

.1 After pressure testing, clean piping in accordance with Section 23 25 05.

.2 For piping changes to existing systems, which consist of NPS 2 and smaller branch piping to terminal heating or cooling equipment, the following abbreviated cleaning and flushing procedure may be used:

.1 After cutting of threads and de-burring, and before installation of piping, manually clean the interior of the pipe with wire-brush on an extended rod, while washing the inside of the pipe with a solution of non-foaming, phosphate free detergent, 3% by weight, followed by a hose rinse flushed to drain until water runs clear.

.2 After installation of piping, check strainers are clean, and open isolation valves to use service water for pressure testing and final flush.

.3 After pressure testing, isolate new piping from existing piping, fully open control valves (where installed) and flush service water to drain. Use compressed air at not more than 70 kPa (10 psig) to assist in flushing the water.

.4 Refill system with service water and circulate for two hours. Inspect strainers, and repeat drain, fill and recirculate routine until strainers are free of debris.

END OF SECTION

STEAM AND CONDENSATE PIPING – CARBON STEEL
23 22 13.23

1 GENERAL

1.1 Scope

.1 Provide pipe and fittings for steam, condensate and related systems. Refer to section 23 05 01 for piping system applicability.

.2 This specification applies to:

.1 saturated steam piping with design pressures of 1750 kPa (250 psig) or less,

.2 condensate piping with design pressures of 2750 kPa (400 psig) or less, and

.3 boiler feedwater piping with design pressures of 2750 kPa (400 psig) or less.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	20 05 24	Welding and Brazing
.2	23 05 01	HVAC Piping General Requirements
.3	23 25 05	HVAC Pipe Cleaning

1.3 Applicable Codes and Standards

.1 Legislation:

.1 Refer to section 23 05 01.

.2 Installation standards and codes:

.1 Refer to section 23 05 01.

.3 Product standards:

.1	ANSI B1.20.1	Pipe Threads, General Purpose (inch)
.2	ASME B16.1	Cast Iron Pipe Flanges And Flanged Fittings
.3	ASME B16.3	Malleable Iron Threaded Fittings.
.4	ASME B16.5	Pipe Flanges and Flanged Fittings
.5	ASME B16.9	Factory Made Wrought Steel Buttwelding Fittings
.6	ASME B16.11	Forged Steel Fittings, Socket-Welding and Threaded
.7	ASME B16.20	Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.
.8	ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges.
.9	ASME B18.2.1	Square and Hex Bolts and Screws,
.10	ASME B18.2.2	Square and Hex Nuts
.11	ASME B16.39	Malleable Iron Threaded Pipe Unions: Classes 150, 250 and 300.
.12	ASTM A47	Standard Specificatin for Ferritic Malleable Iron Castings.

.13	ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
.14	ASTM A106	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
.15	ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts and Bolts for High-Pressure or High-Temperature Service, or Both.
.16	ASTM A536	Standard Specification for Ductile Iron Castings.

1.4 Shop Drawings

.1 Submit shop drawings where headers and pipe assemblies with fittings, elbows and flanges are shop fabricated.

.2 This specification is limited to steam system design pressures of 1720 kPa (250 psi).

2 PRODUCTS

2.1 Pipe

.1 Carbon steel:

.1 To ASTM A106 Gr B seamless (S), or ASTM A53 Gr B Electric Resistance Weld (ERW), and pipe schedule in accordance with the following table.

Pipe Service	Joint Method	Pipe Size NPS	Maximum System Design Pressure	Schedule
Feedwater	Welding (butt weld, socket weld)	NPS ½ to NPS 10	2750 kPa (400 psig)	40
		NPS 12	2750 kPa (400 psig)	40
	Threaded	NPS ½ to NPS 2	2750 kPa (400 psig)	Standard (0.375 in. wall)
Steam	Welding (butt weld, socket weld)	NPS ½ to NPS 10	1750 kPa (250 psig)	40
		NPS 12 to 18	1750 kPa (250 psig)	Standard (0.375 in. wall)
		NPS 20 to 24	1750 kPa (250 psig)	30
	Threaded	NPS ½ to NPS 2	1750 kPa (250 psig)	40
Condensate	Welding (butt weld, socket weld)	NPS ½ to NPS 12	2750 kPa (400 psig)	80
	Threaded	NPS ½ to NPS 2		

2.2 Pipe Joints and Fittings

.1 Threaded fittings:

.1 End connections: NPT thread to ANSI B1.20.1.

.2 Fittings: Class 150 and Class 300, malleable iron to ASME B16.3..

.3 Unions: Class 150 and Class 300, malleable iron body with ground joint and bronze face to ASME B16.39.

.4 Threaded joint compound: pulverized lead paste or Teflon pipe tape sealant.

Standard of Acceptance

- Masters Pro-Dope
- Masters Orange or White Tape.

.2 Welding fittings:

.1 Butt weld fitting:

(a) Forged to ANSI B16.9
(b) wall thickness to match pipe,
(c) long radius elbows.

.2 Welding outlet fittings:

(a) forged to MSS SP-97, Standard Class for buttwelding branch connection, and Class 3000 for threaded or socket welded branch connection,
(b) NPT ends to ASME B1.20.1.

.3 Socket welded fittings:

(a) forged to ASTM A105,
(b) dimensions and pressure ratings to ASME B16.11, Class 3000.

.4 Half couplings:

(a) (a) forged carbon steel to ASTM A105,
(b) dimensions and pressure rating to ASME B16.11, Class 3000 socket weld or threaded ends,
(c) NPT ends to ASME B1.20.1.

.3 Flanges:

.1 Flat-faced cast iron, Class 125 to ANSI B16.1;

.2 Raised-face forged steel, Class 150 and Class 300 to ANSI B16.5, weld neck with wall thickness to match pipe, or slip on type;

.3 Studs, bolts and nuts to ANSI B18.2.1, ANSI 18.2.2 and ASTM A194, “high strength” type;

.4 Gaskets to ANSI B16.21, ANSI B16.20 or ANSI A21.11 of red rubber sheet 1.6 mm ($^{1}/_{16}$ in) thick.

Standard of Acceptance

- Chesterton - fig. 195, 450
- Beldam

3 EXECUTION

3.1 Piping Installation

.1 Refer to section 23 05 01 for piping design criteria general requirements for piping installation.

.2 Steam piping:

.1 Slope mains down in direction of flow 1:250 (½ in in 10 ft).

.2 Install branches with greater slope.

.3 Provide concentric reducers at pipe size changes in vertical runs.

.4 Provide eccentric reducers at pipe size changes in horizontal runs, arranged flat-on-bottom.

.5 Provide eccentric reducers arranged flat-on-bottom at valve inlet and flat-on-top at valve outlet, in horizontal runs at throttling or control valves where pipe connection size is greater than valve size. Pitch piping on both sides of valve to drain away from the valve.

.3 Condensate piping:

.1 Slope return mains down in the direction of flow 1:160 (¾ in in 10 ft).

.2 Install return branches with greater slope.

.3 Provide concentric reducers at pipe size changes in vertical runs.

.4 Provide eccentric reducers at pipe size changes in horizontal runs, arranged flat-on-bottom.

.4 Cap pipe ends during construction to prevent entry of foreign matter.

3.2 Class Rated Fittings and Flanges

.1 Select ASME Class rated fittings and flanges in accordance with the following table for design pressure limits at coincident design temperature limits unless otherwise shown on drawings.

Class	Steam	Condensate	
	Maximum Design Pressure Saturated Steam	Maximum Design Pressure	Maximum Coincident Design Temperature
125 Note [1]	550 kPa (80 psig)	700 kPa (100 psi)	≤ 121°C (250°F)
150 Note [2]	1030 kPa (150 psi)	1400 kPa (200 psi)	≤ 121°C (250°F)
300 Note [2]	2060 kPa (300 psi)	3100 kPa (450 psi)	≤ 121°C (250°F)
3000 Note [3]	2060 kPa (300 psi)	3100 kPa (450 psi)	≤ 121°C (250°F)

Notes:
[1] Flanges only.
[2] Flanges and fittings.
[3] Welding outlet fittings and socket weld fittings.

3.3 Pipe Joints and Fittings

.1 Make pipe joints as follows:

.1 NPS 2-1/2 and under:

(a) NPT threaded joint to ANSI B1.20.1 with Teflon tape or pipe thread dope; or
(b) socket weld joints.

.2 NPS 2-1/2 and larger:

(a) flanged or welded.
(b) provide flanges at all equipment connections.

.3 For clarity, pipe size of NPS 2-1/2 may be either type of joint specified.

.2 For flange joints, select gasket materials in accordance with the following table so that gasket pressure and temperature both exceed the piping system design pressure and design temperature.

Gasket Temperature Limit	Gasket Pressure Limit	Gasket Material	Gasket Thickness	Chesterton Figure
175°C (350°F)	2400 kPa (350 psi)	Synthetic fiber with nitrile binder	1.6 m (1/6 in)	450
400°C (750°F)	3700 kPa (535 psi)	Synthetic fiber with nitrile binder	1.6 m (1/6 in)	195

3.4 Equipment Connections

.1 Make pipe connections to equipment as follows:

.1 NPS 2 and smaller: unions and threaded fittings;

.2 NPS 2 ½ and larger: flanged connections.

.2 Where connection is made to equipment with a threaded fitting, provide a union between the isolation valve and the equipment connection.

3.5 Welding

.1 Comply with section 20 05 24 and as specified herein.

3.6 Branch Connections

.1 Make branch connections to mains in accordance with Table 2 and 2b :

.1 These tables are valid for design pressures up to 2070 kPa (300 psig), without adding reinforcement material where branch pipe is directly welded to the main. For welded branch connections at higher design pressures, use buttweld, socket weld, or integrally reinforced outlet fittings only.

.2 In these tables, the following abbreviations apply.

Abbreviations:

TH Threaded fitting to ASME B16.3
SW Socket weld fittings to ASME B16.11
HC Half coupling to ASME B16.11
BW Buttweld fitting to ASME B16.9
OF Reinforced Outlet Fittings to MSS SP-97
DP Direct welding of Branch Pipe to Main without added reinforcement.

Table 2a – Allowable Branch to Main Connections (NPS 1 to NPS 10)

Table 2a – Allowable Branch to Main Connections (NPS 1 to NPS 10)

Branch NPS	Mains Pipe, NPS									
	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10
3/ 4	TH SW	TH SW	TH SW	TH SW	BW SW	BW, OF SW HC DP	BW, OF SW HC DP	BW, OF HC DP	BW, OF HC DP	BW, OF HC DP
1	TH SW	TH SW	TH SW	TH SW	BW SW	BW, OF SW DP	BW, OF SW HC DP	BW, OF HC DP	BW, OF HC DP	BW, OF HC DP
1-1/4	---	TH SW	TH SW	TH SW	BW SW	BW, OF SW DP	BW, OF SW DP	BW, OF HC DP	BW, OF HC DP	BW, OF HC DP
1-1/2	---	---	TH SW	TH SW	BW SW	BW, OF SW DP	BW, OF SW DP	BW, OF HC DP	BW, OF HC DP	BW, OF HC DP
2	---	---	---	TH SW	BW SW	BW, OF SW	BW OF SW DP	BW, OF DP	BW, OF HC DP	BW, OF HC DP
2-1/2	---	---	---	---	BW SW	BW, OF SW	BW, OF SW	BW, OF DP	BW, OF DP	BW, OF DP
3	---	---	---	---	---	BW	BW, OF SW	BW, OF DP	BW, OF DP	BW, OF DP
4	---	---	---	---	---	---	BW	BW, OF	BW, OF DP	BW, OF DP
6	---	---	---	---	---	---	---	BW	BW, OF	BW, OF DP
8	---	---	---	---	---	---	---	---	BW	BW, OF
10	---	---	---	---	---	---	---	---	---	BW

Table 2b – Allowable Branch to Main Connections (NPS 12 to NPS 30)

Branch NPS	Mains Pipe, NPS							
	12	14	16	18	20	22	24	30
¾ to 2	OF HC DP	OF HC DP	OF HC	OF HC	OF HC	OF HC	OF HC	OF HC
2-1/2	OF DP	OF DP	OF	OF	OF	OF	OF	OF

Table 2b – Allowable Branch to Main Connections (NPS 12 to NPS 30)

Branch NPS	Mains Pipe, NPS							
	12	14	16	18	20	22	24	30
3	OF DP	OF DP	OF	OF	OF	OF	OF	OF
4	BW OF DP	OF DP	OF	OF	OF	OF	OF	OF
6	BW OF DP	BW OF DP	BW OF	OF	OF	OF	OF	OF
8	BW OF DP	BW OF DP	BW OF	BW OF	BW OF	OF	OF	OF
10	BW OF DP	BW OF DP	BW OF	BW OF	BW OF	BW OF	BW OF	OF
12	BW	BW OF DP	BW OF	BW OF	BW OF	BW OF	BW OF	OF
14	---	BW	BW OF	BW OF	BW OF	BW OF	BW OF	BW OF
16	---	---	BW	BW OF	BW OF	BW OF	BW OF	BW OF
18	---	---	---	BW	BW OF	BW OF	BW OF	BW OF
20	---	---	---	---	BW	BW OF	BW OF	BW OF
22	---	---	---	---	---	BW	BW OF	BW OF
24	---	---	---	---	---	---	BW	BW OF
30	---	---	---	---	---	---	---	BW

.2 Use of Class 3000 half-couplings as a branch connector (“HC”), and direct welding of branch piping to main piping (”DP”), is permitted in accordance with the following requirements:

.1 half-coupling or branch pipe sits-on mains pipe, and does not insert into the main pipe;

.2 the opening size in the main pipe to closely follow the inside diameter of the half-coupling or branch pipe;

.3 half-coupling or branch pipe attachment end is shaped and beveled to closely following the surface of the main pipe, suitable for a pull-penetration weld;

.4 the half-coupling or direct branch pipe is attached with a groove weld and covered with a smooth finishing fillet weld in accordance with the requirements of the applicable piping code..

.3 Where integrally reinforced outlet fittings, half-couplings or direct welding of branch pipe is used, hole saw or drill and ream mains pipe to maintain full inside diameter of branch line prior to welding.

.4 Where multiple branch pipes are to connect to the main pipe in close proximity to each other, provide a minimum separation between the centerlines of adjacent branch pipes equal to or greater than the sum of the OD dimensions of the adjacent branch pipes.

.5 If threaded fittings have been installed where the specification requires welded fittings, either cut-out and replace the fitting, or fully seal-weld the exposed threads.

.6 Where saddle type branch welding fittings are used on mains, hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding.

3.7 Drip Trap Assemblies

.1 Provide drip trap assemblies in accordance with section 23 22 11.

.2 Pipe condensate discharge from drip trap assemblies to drain by gravity to the nearest flash tank or condensate receiver taking condensate from equipment or drip assemblies connected to steam supplies at same pressure.

3.8 Pressure Testing

.1 Conduct pressure and leak tests in accordance with section 23 05 01.

3.9 Flushing and Cleaning

.1 After pressure testing, clean piping in accordance with Section 23 25 05.

.2 For piping changes to existing systems, which consist of NPS 2 and smaller branch piping to terminal heating equipment or process equipment, the following abbreviated cleaning and flushing procedure may be used:

.1 After cutting of threads and de-burring, and before installation of piping, manually clean the interior of the pipe with wire-brush on an extended rod, while washing the inside of the pipe with a solution of non-foaming, phosphate free detergent, 3% by weight, followed by a hose rinse flushed to drain until water runs clear,

.2 After installation of piping, check strainers are clean, and fill steam piping and condensate piping with water mixed with corrosion inhibiter compatible with steam plant chemical treatment.

.3 After pressure testing, drain steam and condensate piping to drain.

.4 Open new piping isolation valves to place system under steam pressure. After one day of piping in-service, inspect strainers; if readily visible dirt and slag are present, then repeat cleaning until strainers are free of debris.

END OF SECTION

AIR DISTRIBUTION - GENERAL
23 31 01

1 GENERAL

1.1 Scope

.1 Provide labour, materials and equipment for installation, testing and putting into operation ventilating and air conditioning systems

1.2 Qualified tradesmen

.1 Work to be done by qualified tradesmen holding certificates of competency.

1.3 Applicable standards

.1 The Ontario Building Code

.2 Regulations of Toronto, or local authority having jurisdiction.

2 PRODUCTS

2.1 Not Used

3 EXECUTION

3.1 Ductwork

.1 Ductwork system routing is shown diagrammatically. Drawings are not considered to be fabrication or installation drawings.

.2 Locate mains, risers and runouts to be concealed behind furrings or above ceilings except in mechanical equipment rooms and access spaces where ductwork is to be exposed.

.3 Determine areas without ceilings from Architectural Drawings and Room Finish Schedules, and in these areas keep ductwork as high as possible.

.4 Anchor, guide and support vertical and horizontal runs of ductwork to resist dead load and absorb thrust.

3.2 Air supply equipment

.1 Install and connect air handling units, and air conditioning units, and build casing and plenums.

3.3 Air exhaust equipment

.1 Install and connect exhaust fans, roof and wall exhausters and dust and fume collectors.

3.4 Terminals devices

.1 Locate and install terminal boxes, registers, diffusers, and grilles

3.5 Life safety

.1 Install fire dampers, smoke dampers, and combination smoke and fire dampers to protect openings in fire separations.

.2 Provide smoke stopping around unprotected ducts passing through smoke separations.

3.6 Air balancing

.1 Co-operate with air balancing agency; install supplementary dampers, access openings and access doors to facilitate testing and adjustment.

END OF SECTION

DUCTWORK
23 31 13

1 GENERAL

1.1 Scope

.1 Provide metal ductwork systems as shown.

1.2 Applicable Codes and Standards

.1 Installation standards and codes

.1	NFPA 90A	Installation of air conditioning and ventilating systems.
.2	NFPA 90B	Installation of warm air heating and air conditioning systems.
.3	ASHRAE	Letter and number designations, shown as “CR3-16" etc., are taken from ASHRAE Duct Fitting Data Base.(DFDB)
.4	ANSI/SMACNA	HVAC Duct Construction Standards - Metal and Flexible (2005 edition)

.2 Product standards:

.1	ASTM A90/M	Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
.2	ASTM A653/M	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
.3	ASTM A924/M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
.4	ASTM A1011/M	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
.5	ASTM A283/M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
.6	ASTM A36/M	Standard Specification for Carbon Structural Steel
.7	ASTM A480/M	Specification for General requirements for Flat Rolled Plate, Sheet, and Strip
.8	ASTM A463/M	Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
.9	ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.3 Shop Drawings and Application Details

.1 Submit manufacturer's catalogue literature for;

.1 Proprietary joints,

.2 Hardware.

.2 Submit field/fabrication drawings at 1:50 (¼ inch=1 foot) or larger scale, with piping, ductwork, and fittings in double line format, to show;

.1 arrangements in congested areas,

.2 where installation proposed deviates substantially from layout shown, and

.3 where installation requires joints for field assembly in welded duct construction.

.3 For greater clarity, do not submit field/fabrication drawings for other areas of the Work.

.4 Submit schedules and details to show;

.1 fabrication details of

(a) connections to risers in duct shafts
(b) balancing damper construction,
(c) fittings where geometry contemplated is different from that specified.

.2 in chart form

(a) duct system pressure class,
(b) duct sheet gauges,
(c) joint types and application criteria,
(d) location criteria and dimensions for bracing, stiffeners and balancing dampers
(e) duct leakage class, and
(f) extent of sealing.

1.4 Record Drawings

.1 As work progresses, mark-up field drawings and submit as part of record of “As-Built” conditions.

1.5 Qualifications

.1 Ductwork systems to be provided by firm having an established reputation in this field.

2 PRODUCTS

2.1 Basic material

.1 Galvanized steel:

.1 Ducts and connectors: lock forming quality to ASTM A653 or ASTM A924,

(a) Z275(G90) for indoor ductwork,
(b) Z275 (G90) zinc coating for outdoor ductwork.

.2 Miscellaneous pipe, angles, strips and threaded rod in contact with ductwork: galvanized with a minimum thickness equal to ASTM A653 - Z180 (G60).

.2 Stainless steel:

.1 To ASTM A480, Type 304L

.3 Aluminum:

.1 To ASTM B209;

(a) alloy 3003-H14 or 5052-H32 for sheet material.
(b) alloy 6061-T6 for plate material
(c) alloy 6061-T4 or T6 for shapes material.

.4 Plain mild carbon steel:

.1 To ASTM A1011, A283, A572 and A36 as applicable.

2.2 Joints

.1 Flanged duct joints:

.1 proprietary roll-formed flanges, corner pieces, integral edge seals, gaskets and cleats.

.2 material to match that of ductwork being joined.

Standard of Acceptance
- Ductmate – System 25/35/45
- Carlisle Canada - Nexus

2.3 Sealant and tape

.1 To section 23 33 05 Duct Accessories.

2.4 Hangers and supports

.1 Upper hanger attachments;

.1 in new concrete: manufactured concrete inserts.

Standard of Acceptance
- Myatt Fig. 485

.2 for steel joist: galvanized joist clamps or steel plate washer.

Standard of Acceptance
- Anvil Fig. 61 or 86
- Anvil Fig. 60 for plate washer

.3 for steel beams: galvanized beam clamps.

Standard of Acceptance
- Anvil Fig. 60

.2 Seismic supports and restraints to Section 20 05 49 Seismic Restraint

2.5 Duct access doors

.1 To section 23 33 05 Duct Accessories.

3 EXECUTION

3.1 Construction

.1 Construction details, sheet gauges, reinforcing, and bracing to be taken from SMACNA HVAC Duct Construction Standards - Metal and Flexible except as otherwise shown.

.2 Rectangular ductwork:

.1 longitudinal seams: Pittsburgh Lock, with specified sealant applied prior to hammering of joint,

.2 transverse joints: to SMACNA HVAC standards based on pressure class and reinforcement used and sealing requirements.

.3 Round ductwork, 500 Pa (2 in wg) pressure class and higher:

.1 spiral flat type longitudinal seam, button punched.

3.2 Pressure classification and seal class

.1 Low pressure ductwork construction classification:

Table 1: Duct Pressure Classification

Pressure class Pa (in wg)	Operating pressure Pa (in wg)	Velocity m/s (fpm)	Leakage Test Pressure Pa (in wg)
125 (½)	up to 125 (½)	10.0 (2000)	125 (½)
250 (1)	125 to 250 (½ to 1)	12.5 (2500)	250 (1)
500 (2)	250 to 500 (1 to 2)	12.5 (2500)	500 (2)
750 (3)	500 to 750 (2 to 3)	15.0 (3000)	750 (3)
Greater than 750 (3)	High Pressure Ductwork		Not less than 1000 (4)

.2 Assemble ductwork seams and joints with joint sealant as shown in table 2.

.3 Sealant application:

.1 store duct sealant at room temperature for 24 hours before use,

.2 apply sealant on seams as noted in table 1, and brush or extrude sealant to cover fasteners,

.3 on bell and spigot style joints apply sealant on male section with caulking gun and spread sealant evenly on mating surface with brush,

(a) insert fitting and secure with sheet metal screws
(b) brush sealant onto outside of assembled joint in 50 mm (2 in) wide band covering fastener heads,

.4 allow 40 hours curing time before pressure testing.

Table 2: Duct System Pressure and Seal Class

No.	Ductwork System	Static pressure construction class Pa (in.wg.)	Seal class	Sealing requirements (1)(2)(3)(4)
1	Induction unit supply from fan discharge to unit plenum box inlet.	+1000 (4) and up	A	Transverse joints, longitudinal seams, ductwall penetrations, and other connections
2	Supply risers in vertical service space (duct shafts).	+1000 (4)	B	Transverse joints, longitudinal seams, and other connections
3	Supply air ductwork from discharge side of fan to inlet of terminal box or reheat coil in healthcare and laboratory facilities.	+1000 (4)		

Table 2: Duct System Pressure and Seal Class

No.	Ductwork System	Static pressure construction class Pa (in.wg.)	Seal class	Sealing requirements (1)(2)(3)(4)
4	Return/exhaust air ductwork between HEPA filters and suction side of fan.	-1000 (4)		
5	Return/exhaust air ductwork between a Heat Recovery Wheel and suction side of fan.	-1000 (4)		
6	Autopsy exhaust ductwork.	-1000 (4)		
7	Supply air ductwork from discharge side of fan to inlet of terminal box or reheat coil; Return air ductwork on discharge side of fan.	+750 (3)		
8	Return/Exhaust risers in mechanical rooms and vertical service spaces (duct shafts).	-750 (3)		
9	Supply air ductwork upstream of HEPA filters, including diffusers with integral HEPA filters.(5)	+750 (3)		
10	Return and/or exhaust air ductwork on suction side of fans other than in mechanical rooms and vertical service spaces.	-500 (2)	C	Transverse joints and other connections
11	Supply air ductwork on downstream side of terminal units or reheat coil; Exhaust air ductwork on discharge side of fan; Fan coil units, suction and discharge.	250 (1)	C	Transverse joints only
12	Supply air and return air ductwork from roof top air conditioning units, 5 tons or less	125 (½)	D	No sealing

Notes for table 2:

(1) Transverse joints are connections of two duct or fitting elements oriented perpendicular to flow,
(2) Longitudinal seams are joints oriented in direction of flow,
(3) Duct wall penetrations are openings made by screws, non-self-sealing fasteners, pipe, tubing, rod and wire,
(4) Other connections such as spin-ins taps and other branch fittings inserted into cut openings in duct, access door frames, insertion type control elements and duct joints at equipment are to be treated as *transverse joints.*
(5) This pressure class also applies to supply ductwork downstream of a terminal box or reheat coil which serve diffusers with integral HEPA filters.

3.3 Fittings - Rectangular Ductwork

.1 Refer to Annex A at the end of this Section for illustrations of referenced fitting types.

.2 Elbows:

.1 Elbows are to be installed as shown, or if not shown, in descending order as listed in table 3.

(a) for clarity, elbows types are to be selected based on the highest order number (where 1 is the highest) which will fit the available space.

Table 3: Rectangular Duct, Elbows

Order No.	ASHRAE Fitting No.	Description	Throat Radius Ratio R/W	Duct Width Limit mm (in)	Minimum Throat Radius mm (in)	Remarks
1	CR3-1	Smooth radius Unvaned elbow	1.5	≤ 300 (12)	---	Default
			1.0	> 300 (12)	---	
2	CR3-3	Smooth radius Vaned elbow	0.75	≤ 900 (36)	150 (6)	One full radius single thickness splitter vane
	CR3-4	Smooth radius Vaned elbow	0.75	> 900 (36) ≤ 1500 (60)	150 (6)	Two full radius single thickness splitter vane
	CR3-5	Smooth radius Vaned elbow	0.75	> 1500 (60)	150 (6)	Three full radius single thickness splitter vane
3	CR3-15	Square Mitred Vaned elbow	Square throat; Square heel.	--	---	Double thickness turning vanes; 50 (2) heel radius vane; 54 mm (2.125 in) vane spacing.
4	CR3-2	Radius Heel Sharp Throat	0.5	---	---	Double thickness turning vanes as per CR3-3, 4 or 5 depending on duct width

.2 First elbow on discharge side of fan:

(a) fitting CR3-1, unvaned elbow with throat radius 1.0 times duct width, with the required upstream effective length L_e of straight length of duct in accordance with fitting type SR7-5 or SR7-9 as applicable.

.3 Wye and tee branch fittings - Supply air systems:

.1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 4.

Table 4 : Rectangular Duct, Wye and Tee Branch Fittings - Supply Air Systems

Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
1	For 750 Pa (3 in.w.g) pressure class and above: branch take-off from ducts in shafts, and ducts upstream of terminal boxes, filters and reheat coils	Smooth radius wye; diverging	SR5-1
		Dovetail wye	SR5-14
		Divided flow fittings	(SMACNA) 4A or 4B
		45° entry branch diverging	SR5-13
2	Supply ducts downstream of terminal boxes, fan coil units, reheat coils or heat pumps	Tee, rectangular main to round conical tap	SR5-12
		Tee, 45° entry branch diverging	SR5-13
		Smooth radius wye; diverging	SR5-1

.4 Wye and tee branches - Return/Exhaust air systems:

.1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 5.

Table 5 : Rectangular Duct, Wye and Tee Branch Fittings - Return/Exhaust Air Systems

Ref. No.	Return/Exhaust Ductwork System	Fitting Type	ASHRAE Fitting No
1	All pressure classes including branch connections at duct shafts	Smooth radius wye; converging	ER5-1
		Dovetail wye	ER5-4
		Divided flow fittings	(SMACNA) 4A or 4B
		45° entry branch diverging, where shown on drawings	ER5-3

.5 Transitions (Rectangular and Round):

.1 converging: maximum 20° angle between ductside and direction of flow,

.2 diverging: maximum 15° angle between ductside and direction of flow.

.6 Fabricate duct offsets using elbows selected in accordance with table 2 and as follows:

.1 single offset in single plane, less than duct height: made up with two 45° elbows,

.2 single offset, of greater displacement, made up with 90° elbows,

.3 double offset in single plane, less than duct height, made up with four 45° elbows,

.4 double offset in single plane, of greater displacement than duct height, made up with 90° elbows.

.7 Obstructions passing through duct:

.1 covered by round nosed streamline enclosure where free area of duct is reduced by less than 15%,

.2 fitted in round nosed streamline enclosure with duct width increase, SMACNA HVAC FIG 2-10, Detail E , with converging and diverging transition angle requirements as specified above.

3.4 Fittings - Round Ductwork

.1 Refer to Annex A at the end of this Section for illustrations of referenced fitting types.

.2 Elbows:

.1 Elbows are to be installed as shown, or if not shown, in order of available space as listed in table 6.

Table 6 : Round Duct, Elbows					
Ref. No.	Description	ASHRAE Fitting No.	Throat Radius Ratio R/W	Duct Width Limit mm (in)	Remarks
1	30° elbow	CD3-3*	1.5	≤ 300 (12)	Die stamped
		CD3-14*	1.5	> 300 (12)	2-Gore
2	45° elbow	CD3-3	1.5	≤ 300 (12)	Die stamped
		CD3-14	1.5	> 300 (12)	3-Gore
3	60° elbow	CD3-3*	1.5	≤ 300 (12)	Die stamped
		CD3-14*	1.5	> 300 (12)	4-Gore
4	90° elbow	CD3-1	1.5	≤ 200 (8)	Die stamped
		CD3-9	1.5	>200 (8) and ≤ 350 (14)	5-Gore
		CD3-10	1.5	>350 (14) and ≤ 900 (36)	7-Gore
			2.5	> 900 (36)	7-Gore

.3 Wye branches:

.1 Wye and tee branch fittings are to be installed as shown, or if not shown, as selected from table 7.

Table 7 : Round Duct, Wye and Tee Branch Fittings			
Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
1	Downstream of supply fan.	Wye branch plus 45° elbow	SD5-2
		Tee, tapering	SD5-12
2	Downstream of terminal boxes.	Wye branch plus 45° elbow	SD5-1
		Tee, tapering	SD5-10
3	Return or exhaust duct branches.	Wye branch plus 45° elbow	ED5-2
4	Return or exhaust duct branches; equal main and branch duct size.	Tee, tapering, with 45° elbow	SD5-2

Table 7 : Round Duct, Wye and Tee Branch Fittings			
Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
5	Return or exhaust duct branches; smaller branch size.	Tee, tapering, with 45° elbow	SD5-12

3.5 Balancing dampers

.1 Provide splitter dampers where branch connections are taken from supply mains.

.2 Provide single blade dampers on each branch of supply air systems downstream of terminal boxes.

.3 Provide Opposed Blade Dampers (OBD) at branch and main connection on exhaust and return air systems.

3.6 Finishing, fastening and supports

.1 Hammer edges and slips to leave smooth finished surface inside duct.

.2 Support vertical ducts with angles riveted to duct and bearing on building structure.

.3 Hangers;

.1 Duct side up to maximum 500 mm (20 in) supported with strap hangers of same material as duct but one sheet metal thickness heavier.

.2 Extend strap hangers down duct side and turn under 50 mm (2 in) fastening securely to side and underside of duct.

.3 Duct side greater than 500 mm (20 in) supported with trapeze hangers constructed from galvanized steel angle with steel rods in accordance with table 8;

Table 8 : Duct Hangers		
Duct size mm (in)	Angle size mm (in)	Rod size mm (in)
up to 750 (up to 30)	25x25x3 (1x1x⅛)	6 (¼)
750 to 1050 (30 to 40)	40x40x3 (1½x1½x⅛)	6 (¼)
1050 to 1500 (40 to 60)	40x40x3 (1½x1½x⅛)	10 (⅜)
1500 to 2400 (60 to 90)	50x50x3 (2x2x⅛)	10 (⅜)
2400 and over (90 and over)	50x50x6 (2x2x¼)	10 (⅜)

.4 Maximum hanger spacing: 2.4 m (8 ft) on centre.

.5 Seismic restraints: to Section 20 05 49 *Seismic Restraints*.

3.7 Sheet metal plenums:

.1 50 mm (2 in) thick thermally insulated double wall construction,

.2 inner (cold side) wall of galvanized steel,

.3 outer (room side) wall of galvanized steel,

.4 50 mm (2 in) thick, 72 kg/m^3 (4 lb/ft^3) density, glass fibre insulation, foil backed with vapour barrier on inner wall side,

.5 watertight, welded stainless steel type 304 floor panels, with upturned 50 mm (2 in) perimeter lip,

.6 thermal break; between adjacent wall panels, between wall panels and plenum roof panels, and between wall/roof panels and building structure.

SPEC NOTE: include the following for watertight ducts

3.8 Watertight ducts for dishwashers, humidifiers and showers

.1 Construction:

- .1 locate longitudinal seams at top of horizontal ducts,
- .2 with soldered or welded transverse joints between bottom sheets and side sheets, and
- .3 with other longitudinal and transverse joints sealed with tape and duct sealer.

.2 Dishwasher exhaust:

- .1 type 304 stainless steel, extended from stub connections on dishwasher to inlet connection to exhaust fan,
- .2 horizontal duct at discharge from dishwasher built as a drain pan, with 50 mm (2 in) deep sides,
- .3 slopped back to drain into dishwasher connection stubs where horizontal run is less than 3m (10 ft),
- .4 sloped to base of riser where horizontal run is more than 3 m (10 ft), with NPS ¾ drain connection from low points in bottom of duct, trapped and piped to drain.

.3 Duct section at duct-mounted humidifiers:

- .1 type 304 stainless steel, extended minimum of 1.0 m (3 ft) upstream and 3.0 m (10 ft) downstream from humidifier,
- .2 welded transverse and longitudinal seams,
- .3 built as a pan pan, with 50 mm (2 in) deep sides,
- .4 sloped down in direction of airflow, with
- .5 NPS ¾ drain connection from lowest point in bottom of duct, trapped and piped to drain.

.4 Shower exhaust ducts:

- .1 aluminum construction, extended minimum of 1500 mm (5 ft) from shower exhaust grilles and sloped down to drain back through exhaust grilles served.

3.9 Protection of duct openings

.1 Cap off ends of unfinished ducts while plastering, drywall and other finishing operations are in progress,

.2 Cover open ends or registers of active exhaust/return ducts with 25 mm (1 in) thick filter media secured with tape. Maintain media until dust producing finishing operations are completed.

3.10 Duct access doors

.1 Provide for inspection and servicing of duct mounted components and cleaning of duct system;

.1 located such that any section of duct is not more than 15 m (50 ft) from point of access,

.2 at not more than 6 m (20 ft) intervals on supply air ductwork installed after HEPA filter,

.3 at base of each accessible duct riser,

.4 in front of and behind duct mounted coils,

.5 at activation side of fire, smoke, and combination fire/smoke dampers,

.6 and motorized dampers where damper actuator is located inside of duct or plenum.

.2 Door size:

.1 Select access door sizes based on smallest duct dimension in accordance with table 9.

Table 9 : Access Door Sizes

Smallest Duct Dimension mm (in)	Bottom of duct height above floor m (ft)	Location	Door Size mm (in)
≤ 350 (14)	Any	Side or bottom	300 x 150 (12x6)
>350 and ≤500 (>14 and ≤20)	Any	Side or bottom	450 x 250 (18x10)
>500 (>20)	≤3.6 (12)	Side or bottom	530x350 (21x14)
	>3.6 (12)	Bottom	635x430 (25x17)

3.11 Leak testing

.1 Test air duct systems for leaks at 1.00 times pressure specified for class as follows;

.1 between supply air handling units and terminal units

.2 between supply air handling units and air supply outlets on supply systems without terminal units

.3 between inlet grilles and exhaust/return fan inlet, and fan outlet and exhaust or mixing plenum, on return/exhaust systems,

.4 following parts of system are exempt from pressure testing;

(a) short duct runs of 15 metres (45 feet) or less, operating at 37 Pa (1/8 in) SP or less.
(b) ductwork installed downstream of terminal boxes and fan coil units.

.2 Conduct test in accordance with Associated Air Balance Council (AABC) recommended procedures.

.3 Where audible air noise is detected during test, remove test, pressure apply sealant to leaking joints and seams, and retest after 48 hours. Continue testing and sealing until leaks are inaudible.

.4 Allowable ductwork leakage to be lesser of,

.1 1% of system airflow, or

.2 value calculated from following formula;

$$F = K \times C_L \times P^{0.65}$$

$$L = (A \times F) / 100, \text{ or}$$

$$L = (A \times K \times C_L \times P^{0.65}) / 100$$

Table 10: Flow Measurement Units

	Term	Flow Measurement		
		m^3/s	l/s	CFM
F	leakage coefficient	m^3/s per $100m^2$	l/s per m^2	CFM per 100 ft^2
C_L	leakage coefficient	Refer to table 11 below		
P	test pressure	kPa	kPa	in.wc.
L	Allowable leakage	m^3/s	L/s	CFM
A	Duct surface area	m^2	m^2	ft^2
K	unit conversion	1.24×10^{-2}	1	1

Table 11: Leakage Coefficient, C_L

Duct Type	Seal Class		
	C	B	A
Rectangular metal	24	12	6
Round Metal	12	6	3
Unsealed rectangular metal duct	48	48	48
Unsealed round or oval metal duct	30	30	30

.5 Calculate duct surface area for each test section and determine allowable leakage in accordance with formulae above. Test duct at pressure for specified class for 15 minutes. If leakage rate exceeds allowable value, caulk and seal joints, and repeat testing caulking and sealing process until measured leakage rate is less than calculated allowable value for section under test.

.6 Maintain set of drawings on site, coloured each day during testing to indicate extent of duct satisfying leakage criteria under test.

.7 Submit a written report, verified by TAB Agent, identifying each segment of duct system tested, showing calculation of allowable leakage, test pressure and leakage value measured under test, and certifying that leakage testing has been satisfactorily completed.

3.12 Duct cleaning

.1 Cleaning to be performed by agent specializing in this field of work, be a member in good standing with National Air Duct Cleaners Association (NADCA), and to comply with NADCA standards.

.2 Clean new horizontal and vertical ducts (supply, return, exhaust, transfer), as well as, existing supply and return ductwork connected to new fan systems.

.3 Clean ductwork using high powered vacuum system, hand tools and mechanical brushing systems such that metal surfaces are visibly clean.

.4 Reset balancing dampers to original settings if moved during work. Have TAB Agent confirm damper settings.

.5 Maintain set of drawings on site, coloured each day during cleaning to indicate extent of duct cleaning completed.

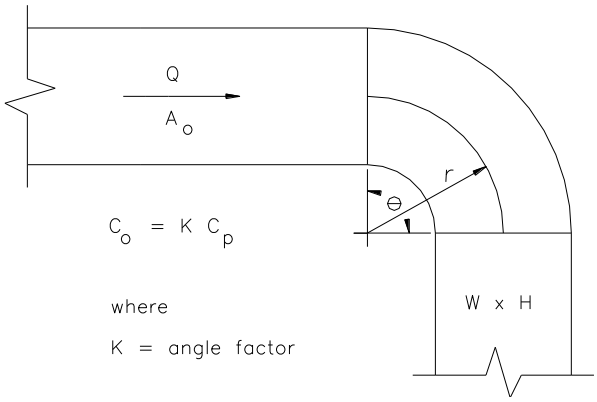
.6 Submit a written report, verified by TAB Agent, identifying extent of duct system cleaning and certifying that NADCA standards have been met.

3.13 Fitting Illustrations

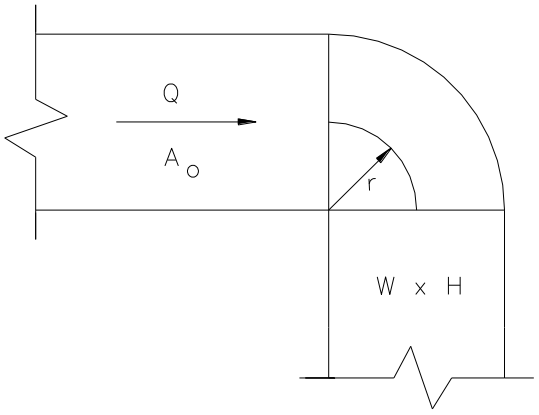
.1 Illustrations of fitting referenced in this specification follows in Annex A.

Annex A – Illustration of Referenced Fittings

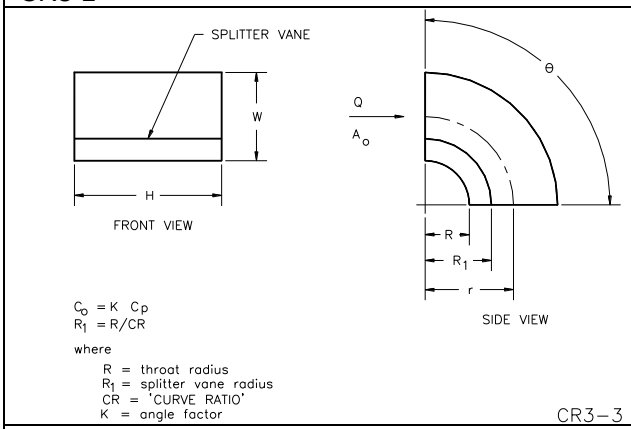
Rectangular Elbows (see Table 3)



CR3-1



CR3-2



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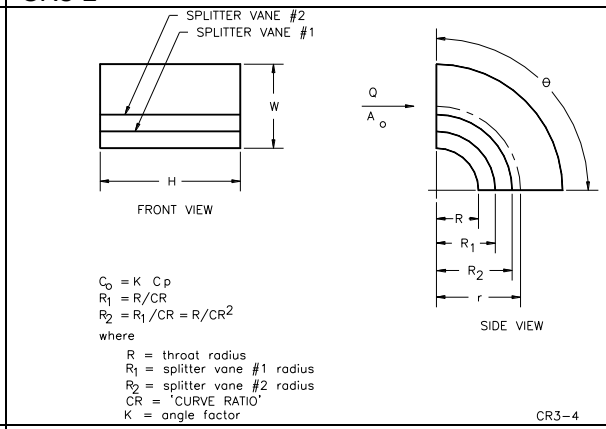

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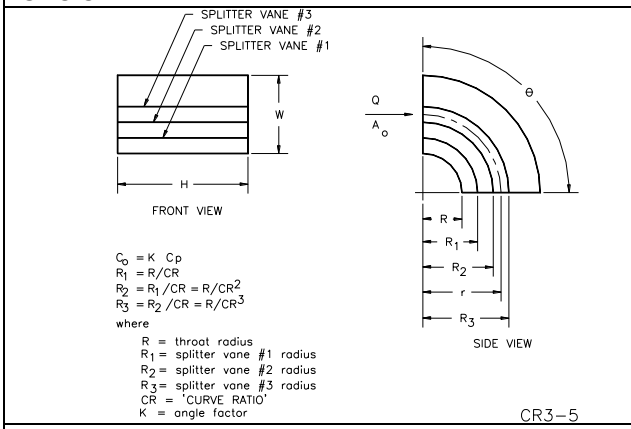
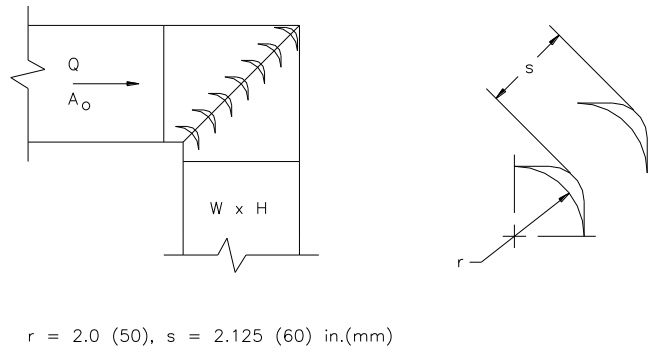
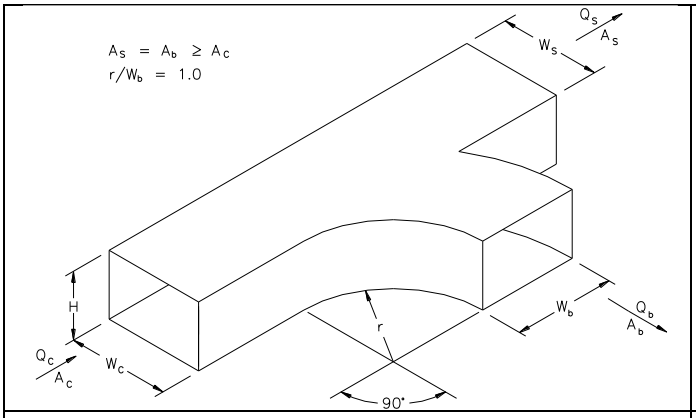


CR3-5

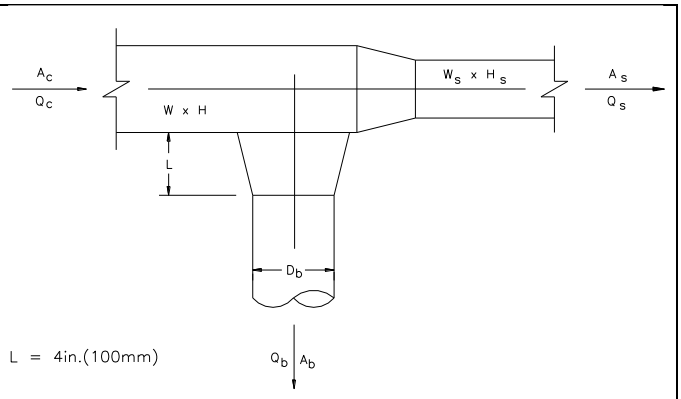


CR3-15

Rectangular Wyes and Tee's – Supply Ductwork (see Table 4)



SR5-1



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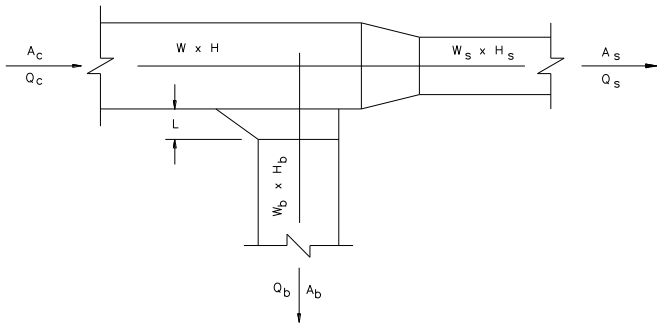

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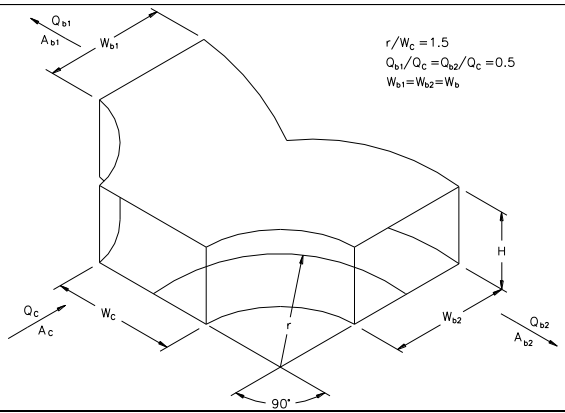

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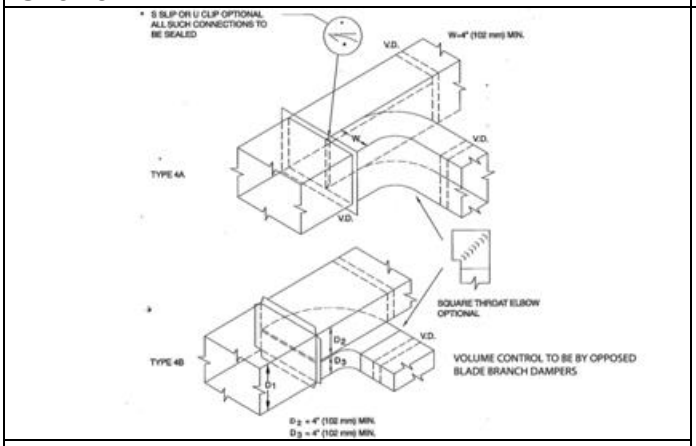
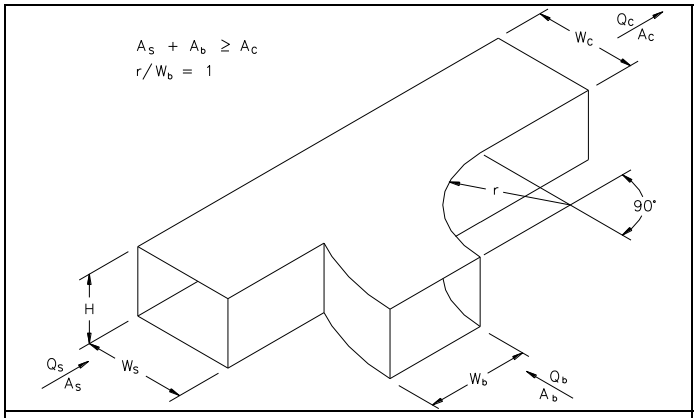
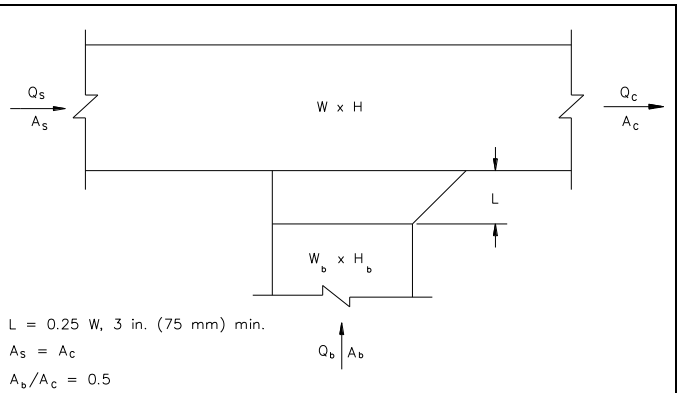


SMACNA Fig. 4A/4B

Rectangular Wyes and Tee's – Return/Exhaust Ductwork (see Table 5)



ER5-1



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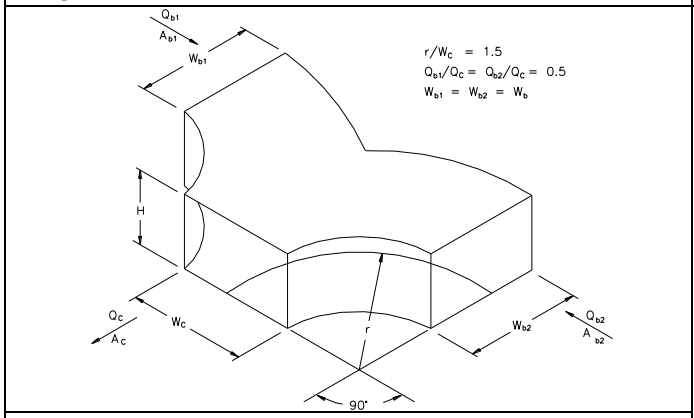
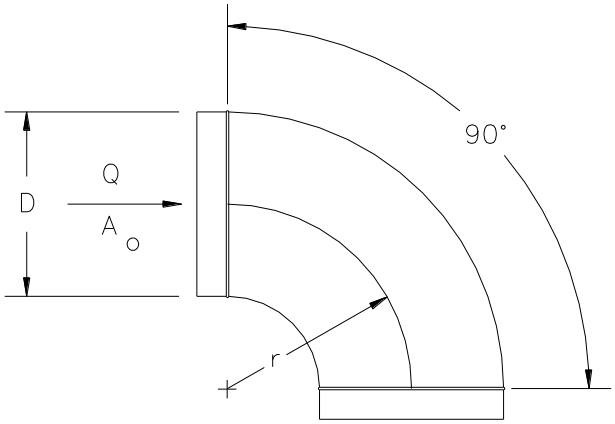
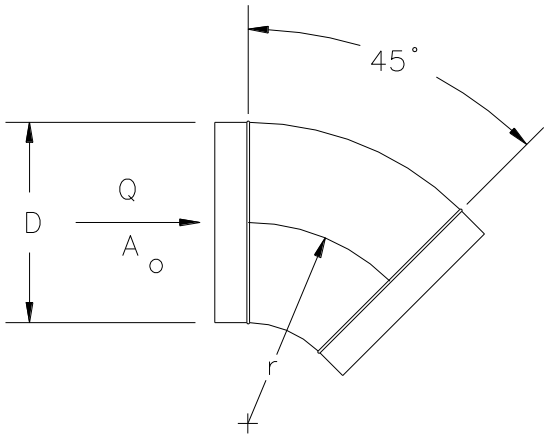


ER5-4

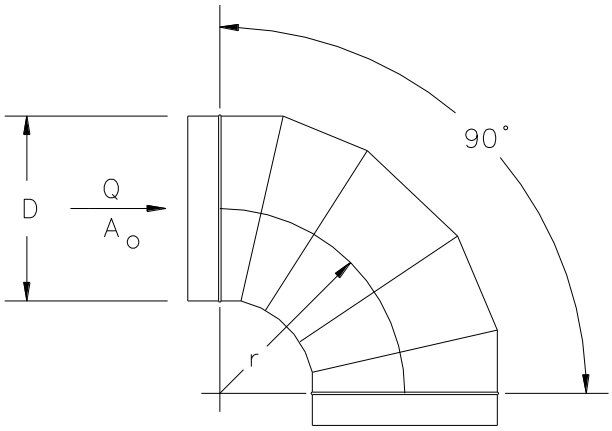
Round Elbows (see Table 6)



CD3-1



CD3-3



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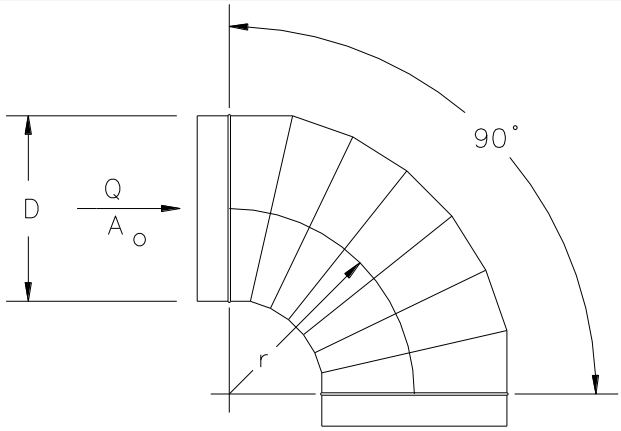

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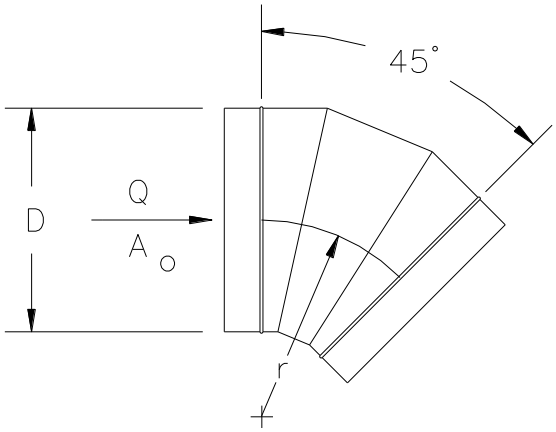
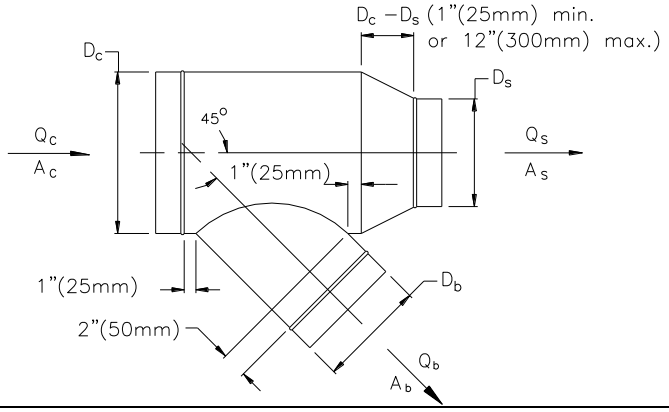
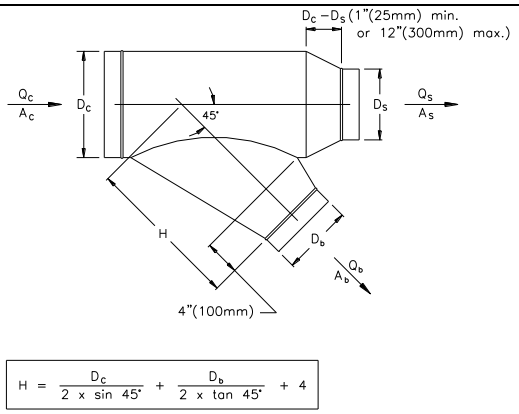


CD3-14

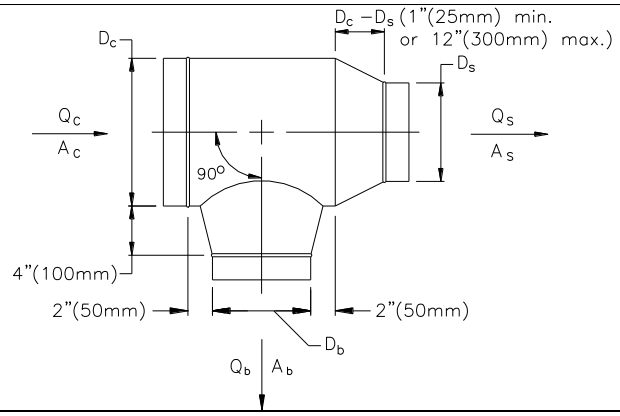
Round Wyes and Tees (see Table 7)



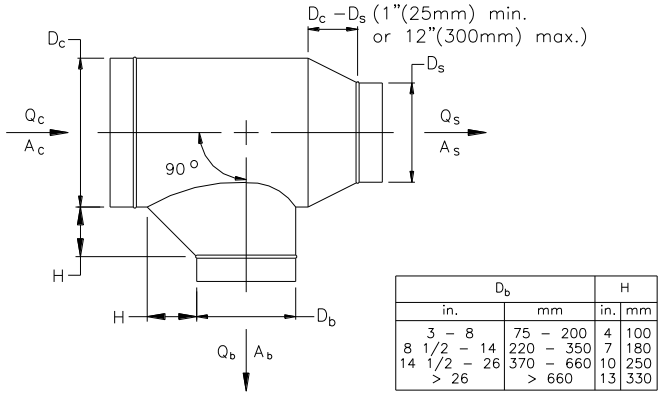
SD5-1



SD5-2

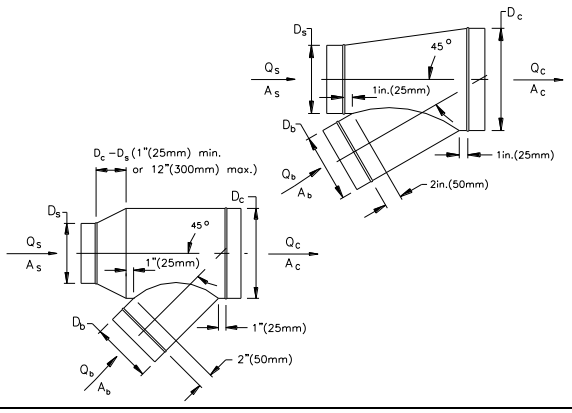


SD5-10



Db		H	
in.	mm	in.	mm
3 – 8	75 – 200	4	100
8 1/2 – 14	220 – 350	7	180
14 1/2 – 26	370 – 660	10	250
> 26	> 660	13	330

SD5-12



ED5-2

END OF SECTION

DUCT ACCESSORIES
23 33 05

1 GENERAL

1.1 Scope

.1 Provide duct accessories as shown.

1.2 Shop drawings

.1 Submit product data sheets for:

.1 flexible connections

.2 sealants

.3 tapes

.4 duct access doors and hardware

.5 instrument test ports

2 PRODUCTS

2.1 Flexible connections

.1 Neoprene:

.1 galvanized 0.66 mm (24 ga) sheet metal frame, with fabric clenched with double locked seams,

.2 fire resistant, self-extinguishing, neoprene coated glass fabric,

.3 operating temperature: -40°C to 90°C (-40°F to 194°F),

.4 density: 0.653 kg/m^2 (0.13 lb/sq ft) in conventional systems.

Standard of Acceptance
- Duro-Dyne - Durolon
- Ventfabric - Ventglas
- Elgin - Neoprene

.2 Vinyl coated, insulated:

.1 flame resistant, 0.56 mm (0.022 in) thick vinyl coated fabric envelope, enclosing 32mm (1¼ in),12kg/m^3 (0.75 lb/cu ft) fiberglass insulation,

.2 operating temperature: 82°C (180°F) continuous and 93°C (200°F) intermittent,

.3 installed;

(a) in connections for insulated duct systems,
(b) in circular duct connections subject to negative pressure with diameter less than 250mm (10 in), and
(c) in rectangular duct connections subject to negative pressure with smallest side less than 300mm (12 in)

Standard of Acceptance
- Duro-Dyne - Insulflex [][

.3 Non-grease duct exhaust - silicon rubber:

.1 silicon rubber coated woven fiberglass fabric to UL 214,

.2 operating temperature: up to 260°C (500°F),

.3 density of 0.461 kg/m^2 (0.094 lb/sq ft),

.4 installed for [kitchen][kitchen and fume hood][fume hood] exhaust systems.

Standard of Acceptance
- Duro-Dyne - Thermafab

2.2 Sealant

.1 water based polymer emulsion type flame resistant duct sealing compound.

.2 operating temperature range: -29°C to 93°C (-20°F to 200°F).

Standard of Acceptance
- Bakor 530 - 14
- RCD #6
- 3M Fastbond 900
- Childers CP-145a & CP-146
- United Duct Sealer (water based)
- Duro Dyne DWN (water based)

2.3 Tape

.1 polyvinyl treated open weave glass fibre tape, 50mm (2") wide.

Standard of Acceptance
- Duro-Dyne FT-2

2.4 Duct access doors

.1 Construction - uninsulated duct or plenum:

.1 shop or field fabricated from same material as duct, one sheet metal thickness heavier but not less than 0.6mm (26ga.) thick,

.2 with gasketed sheet metal angle frame.

.2 Construction - insulated duct or plenum:

.1 shop fabricated as double wall insulated sandwich, of same material as duct, one sheet metal thickness heavier but not less than 0.6mm (26ga) thick,

.2 with gasketed sheet metal angle frame and 25 mm (1 in) thick rigid glass fibre insulation.

.3 gasketed with neoprene or foam rubber.

.4 fitted with hardware as follows: two sash locks for doors up to 300 mm x 300 mm (12 in x 12 in).

.1 four sash locks for doors up to 301 mm x 450 mm (13 in x 18 in).

.2 piano hinge and minimum 2 sash locks for doors up to 451 mm x 1000 mm (19 in x 40 in)

.3 piano hinge and 2 handles operable from both sides for doors over 1000 mm (40 in) in height.

Standard of Acceptance
- Duro-Dyne SP-21 for door handles

2.5 Instrument test ports

.1 Construction:

.1 1.6 mm (16 ga.) thick steel body zinc plated after manufacture,

.2 chain secured neoprene expansion plug with cam lock handle,

.3 28 mm (1 in) minimum inside diameter, length to suit insulation thickness,

.4 Neoprene mounting gasket: flat for rectangular duct and moulded for round duct.

Standard of Acceptance

° Duro-Dyne IP1 or IP2

3 EXECUTION

3.1 Flexible connections

.1 Provide to isolate air handling equipment, fans, ductwork, and as shown.

.2 Minimum length: 75 mm (3 in) length of fabric measured in direction of air flow,

.3 Minimum distance between metal parts when system is in operation: 25 mm (1 in).

.4 Anchored on static side of connection.

3.2 Sealant and tape

.1 Apply to ductwork joints and seams as detailed in other sections.

3.3 Access doors

.1 Install in ductwork;

.1 before and after reheat coils, and at

.2 fire dampers,

.3 duct smoke detectors,

.4 volume control devices, and

.5 control elements.

.2 Weld door frames in place for plenums, casings, and high velocity ductwork.

.3 Door sizes:

.1 as large as possible, with 1:1.5 aspect ratio, for duct sides up to and including 360 mm (14 in),

.2 300 mm x 380 mm (12 in x 15 in) for duct sides 380 mm (15 in) and larger,

.3 1500 mm (60 in) high by 450 mm (18 in) wide in casings and plenums.

3.4 Instrument test ports

.1 Install for duct velocity traverse readings and for duct air temperature readings.

.2 Locate across duct or plenum at right angles to flow, at not more than 250 mm (10 in) intervals for traverses and at not more than 500 mm (20 in) for temperature measurements.

.3 Install for velocity traverses;

.1 at ducted inlets to roof and wall exhausters,

.2 at inlet to and outlet from other fan systems, and

.3 at main and branch where branch serves more than one outlet. Ports in main to be upstream of branch in both diverging and converging flow.

.4 Install for temperature measurement;

.1 at outside air intakes,

.2 at inlet and outlet of coils, and

.3 downstream of intersection of converging air streams of different temperatures.

END OF SECTION

DAMPERS - BALANCING
22 33 13

1 GENERAL

1.1 Scope

.1 Provide balancing dampers as shown.

2 PRODUCTS

2.1 Splitter dampers

.1 Construction:

.1 single thickness construction, of same material as duct but one sheet metal thickness heavier where both dimensions of damper blade are less than 300 mm (12 in),

.2 double thickness construction, one metal thickness lighter than duct, where either dimension of damper blade is 300 mm (12 in) or larger,

.3 of height equal to full depth of branch duct and length 1½ times branch duct width.

.4 fitted with piano hinge pivot, control rod, and locking device accessible from outside fitting.

2.2 Single blade dampers in rectangular ductwork

.1 Construction:

.1 shop fabricated of same material and sheet metal thickness as duct, stiffened with longitudinal V-grooves.

.2 maximum aspect ratio: 3:1,

.3 maximum blade height: 250 mm (10 in).

.4 fitted with locking quadrant and inside and outside bearings.

2.3 Multi-blade dampers in rectangular ductwork

.1 Construction:

.1 shop fabricated of same material and sheet metal thickness as duct, stiffened with longitudinal V-grooves.

.2 opposed blade configuration

.3 channel frame with angle blade stop,

.4 maximum blade height: 100 mm (4 in),

.5 maximum blade length: 1200 mm (48 in).

.6 bearings with bronze bushings.

.7 shaft extension with locking quadrant.

2.4 Single blade dampers in round ductwork

.1 Construction:

.1 shop fabricated butterfly type with round edged 3.5 mm (10 ga) disk set in round sheet metal housing, fitting snugly when closed, 10 degrees from vertical,

.2 fitted with rubber packing glands, shaft extension, wing nuts, and indexing device to indicate disk position.

3 EXECUTION

3.1 Motorized dampers

.1 Install motorized dampers supplied under Section 25 35 00 - BAS Instrumentation and Actuators.

3.2 Manual dampers

.1 Install dampers:

.1 where branch serving more than two outlets is taken from main supply duct, use splitter damper in take-off fitting, or single or multiple blade damper in branch.

.2 where branch joins main return or exhaust duct use single or multiple blade damper in branch .

.2 Install splitter dampers and single or multiple blade dampers where branches are taken from or feed into main ducts as specified above.

.3 Provide other manual dampers as shown.

3.3 Access for adjustment

.1 Locate dampers to allow adjustment of blade position and locking of quadrant and for servicing damper actuators on motorized dampers.

END OF SECTION

DAMPERS - OPERATING
23 33 14

1 GENERAL

1.1 Scope

.1 Provide motorized dampers as shown.

1.2 Related sections

.1 Dampers complying with this section:

.1 23 73 23: Custom Air Handling Units

.2 25 35 01: B.A.S. Instrumentation and Actuators

1.3 Shop drawings and product data

.1 Submit manufacturer's catalogue literature with:

.1 performance charts, pressure drop vs approach velocity for range of blade angles from 0 to 90°

.2 torque requirements.

.3 construction details.

2 PRODUCTS

2.1 Multi-leaf dampers

.1 Parallel blade type:

.1 for two position, OPEN/CLOSED, service

.2 for modulating fresh and return service in air handling units.

.2 Opposed blade type

.1 for other modulating service.

.3 Performance:

.1 leakage in closed position: maximum 2% of rated air flow at 500Pa (2 in wg) differential across assembly,

.2 pressure drop in open position: maximum 50 Pa (0.2 in wg) differential at 5 m/s (1000 fpm).

.4 Construction:

.1 blades, non-insulated: formed galvanized steel interlocking blades,

.2 frame, non-insulated: formed and welded galvanized steel

.3 blades, insulated: extruded aluminum interlocking double thickness insulated blades,

.4 frame, insulated: extruded aluminum, thermally broken,

.5 seals: extruded vinyl seals, and spring stainless steel side seals,

.6 maximum blade width: 125 mm (5 in),

.7 maximum blade length: 1200 mm (4 ft).

.8 self-lubricated bronze bearings.

.9 blade linkage with steel tie rods, brass pivots and steel brackets.

.5 Actuator:

.1 24 Volt electric actuator with spring return, stroking damper from closed to open with 4 -20 mA signal.

Standard of Acceptance

° Belimo - electric actuators

2.2 Isolation/ Control Valves:

.1 Single blade type for modulating and two position, OPEN/CLOSED, service.

Standard of Acceptance

° Square M

.2 Performance:

.1 leakage in closed position: maximum 0.01% of rated air flow at 7 kPa (28 in wg) differential across assembly,

.2 linear characteristic with 20:1 turndown,

.3 sized using C_v numbers in 65% open position for pressure drop of less than 150 Pa (0.6 in wg) differential at 5 m/s (1000 fpm),

.3 Construction:

.1 body: 316L stainless steel

.2 trim: 316L stainless steel

.3 shaft: 316L stainless steel, and teflon packing glands

.4 seat: elastomer seat compatible with paraformaldehyde and ethylene gas

.5 flanged gasketed connections for 7 kPa (28 in wg) service

.6 actuator torque requirement: maximum 205 N.m (150 lb.ft) to seat and unseat

.4 Actuator:

.1 24 Volt electric actuator with spring return, stroking damper from closed to open with 4 -20 mA signal.

Standard of Acceptance

° Belimo - electric actuators

3 EXECUTION

3.1 Installation

.1 Secure dampers within ductwork, air handling units and at air inlets an exhaust outlets, and as shown.

.2 Caulk around frames and between multiple damper modules with UL listed silicone-free sealant.

END OF SECTION

DAMPERS - FIRE AND SMOKE
23 33 15

1 GENERAL

1.1 Scope

.1 Provide fire dampers

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 20 05 13.16 Wiring Requirements for Mechanical Services

1.3 Definitions

.1 The following definitions apply for this specification section:

.1 ***Damper*****:** means a smoke damper, motorized fire damper or combination smoke/fire damper.

(a) ***Balancing damper:*** : a damper with an electric actuator that is listed for operation as a modulating damper in normal service, to allow setting the damper at a position between open and closed, for system air balancing purposes.

(b) ***Dynamic damper***: a fire damper rated to close with airflow through damper at specified air velocities and operating pressure.

(c) Modulating damper: a damper with an electric actuator that is listed for operation as a modulating damper in normal service, to allow modulating control of the damper in response to a normal (non-emergency) process control requirement.

(d) Reopenable damper: a motorized fire damper of combination smoke/fire damper that can be electrically re-opened by bypassing the primary heat detection device.

(e) ***Static damper***: a fire damper rated only to close with essentially no airflow through the damper.

1.4 Applicable Codes and Standards

.1 Installation codes and standards:

.1	NFPA 80	Installation, Testing, and Maintenance of Fire Dampers
.2	NFPA 105	Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives

.2 Product standards:

.1	AMCA 500-D	Laboratory Methods of Testing Dampers for Ratings.
.2	CAN/ULC - S112	Standard Method of Fire Test of Fire Damper Assemblies
.3	CAN/ULC - S112.1	Standard for Leakage Rated Dampers for Use in Smoke Control Systems
.4	CAN/ULC - S112.2	Standard Method of Fire Test of Ceiling Firestop Flap Assemblies
.5	CSA C22.2 No. 14	Industrial Control Equipment

1.5 Submittals

.1 Submit manufacturer catalogue cut-sheets for the following materials;

.1 fire dampers,

.2 smoke dampers,

.3 combination smoke and fire dampers,

.4 motorized fire and smoke damper control accessories,

.5 fire stop flaps.

2 PRODUCTS

2.1 General

.1 Approvals:

.1 Fire dampers and combination smoke/fire dampers listed to CAN/ULC-S112.

.2 Smoke dampers and combination smoke/fire dampers listed to CAN/ULC-S112.1.

.3 Ceiling fire stop flaps listed to CAN/ULC-S112.2.

2.2 Fire and Smoke Dampers - General Requirements

.1 Curtain damper styles:

.1 Type A: blade pack and frames in airstream,

.2 Type B: blade pack out of airstream,

.3 Type C:

(a) blade pack and frame out of airstream,
(b) for rectangular, round and flat oval ductwork, and
(c) sleeve joints and damper/sleeve joints sealed.

.2 Fire damper fire-resistance rating:

.1 Fire separation ratings 2 hr and less: 1-1/2 hrs.

.2 Fire separation rating 3 hr or more: 3 hr.

.3 Installation orientation:

.1 Dynamic and static dampers suitable for installation in vertical and horizontal separations.

.2 Dampers that are only listed for one orientation are not permitted.

.4 Rating class, dynamic dampers:

.1 Standard performance;

(a) air velocity, maximum 10 m/s (2000 fpm),
(b) operating static pressure, maximum 1000 Pa (4 in wc.)

.2 Extended performance (“EPxx”);

(a) air velocity, maximum 15 m/s (3000 fpm),
(b) operating static pressure, maximum 1000 Pa (4 in wc.)

.3 High velocity performance (“HVxx”);

(a) air velocity, maximum 20 m/s (4000 fpm),
(b) operating static pressure, maximum 1000 Pa (4 in wc.)

.5 Manufacturers:

Standard of Acceptance

- Nailor
- EH Price (National Controlled Air)
- Ruskin

2.3 Fire Dampers - Curtain Type

.1 Construction:

.1 Frame: G60 roll formed galvanized steel frame.

.2 Blades: curtain type, interlocking blades, G60 galvanized steel.

.3 Sleeve:

(a) same material as damper frame, length to suit application with steel enclosure and transition collars, and retaining angles.
(b) for type B damper sleeves, top of sleeve is formed closely around top of damper; sleeve construction that leaves the blade pack in the airstream is not permitted.

.4 Sleeve type: type A, B, or C as specified in Part 3.

.5 Fusible link: 71°C (160°F) unless otherwise shown.

.6 Notwithstanding the above, frame, sleeve, and blades to be stainless steel where damper is installed in a duct system which is stainless steel.

.7 Dynamic dampers: fitted with stainless steel closure spring, and rated for velocity and operating pressure based on rating class.

.8 Static dampers: fitted with stainless steel closure spring.

2.4 Fire Dampers - Multiblade Type

.1 Construction:

.1 Type: dynamic.

.2 Frame: G60 galvanized steel hat channel.

.3 Blades: airfoil multiblade type, interlocking blades, G60 galvanized steel;

(a) Parallel blade for Open-Closed operation,
(b) Opposed blade for modulating control or balancing control.

.4 Blade linkage: plated steel, concealed in frame (out of airstream).

.5 Bearings:

(a) On-Off control, and balancing: self-lubricated oil-tight bronze,
(b) modulating control: stainless steel.

.6 Jackshaft: cadmium plated steel.

.7 Internal locking quadrant for balancing maximum opening position.

.8 Sleeve: same material as damper frame, length to suit application with steel enclosure and transition collars, and retaining angles.

.9 Sleeve type: type A, B, or C as per listing requirements.

.10 Notwithstanding the above, the frame, sleeve, and blades to be stainless steel where damper is installed in a duct system that is stainless steel.

.2 Operator - fusible link:

.1 Torsion spring, with 74°C (165°F) fusible link unless otherwise shown.

.3 Operator – electric damper actuator:

.1 Factory installed electric damper actuator in accordance with article on Damper Actuators as required

(a) by certification listing for large dampers/damper bank applications, or
(b) where otherwise shown.

.2 Electric resettable heat detection switches, Normally Closed contacts opening on temperature rise above setpoint;

(a) setpoint temperature, non-reopenable damper: 74°C (165°F),
(b) setpoint temperature, reopenable damper:
- primary switch: 74°C (165°F),
- secondary switch: 176°C (350°F).

2.5 Damper Actuators - Electric

.1 Actuators listed as part of the smoke and/or fire damper assembly.

.2 Actuators, components, wiring leads and position switches rated for 176°C (350°F).

.3 Two-position dampers:

.1 Spring return, fail-safe to a closed damper position.

.2 Open-Closed operation, with reduced motor load at holding (open) position, allowing continuous operation at open position without overheating or overload.

.3 Visual position indicator.

.4 Motor running time (to open): maximum 30 seconds.

.5 Spring running time (to close): maximum 30 seconds.

.6 Maximum power demand (motor driving): 40 VA.

.7 Power supply: 120 VAC, 60 Hz.

.4 Modulating dampers:

.1 Spring return, fail-safe to a closed damper position.

.2 True modulating control with proportional 0-10 VDC or 4-20 mA control input (floating point control not permitted), with 2-10 VDC position feedback.

.3 Visual position indicator.

.4 Motor running time (to open): maximum 60 seconds.

.5 Spring running time (to close): maximum 30 seconds.

.6 Maximum power demand (motor driving): 30 VA.

.7 Power supply: 24 VAC, 60 Hz.

.5 Damper position switches:

.1 Provided as part of the each actuator.

(a) Exception: where more than one actuator is mounted to the same damper shaft for torque rating requirements, only one actuator connected to a damper shaft is required to have the damper position switch.

.2 Required for both two-position dampers and modulating dampers.

.3 Integral or factory installed damper position switches;

(a) 2 x SPST switches, 3 A resistive rating @ 120 VAC,
(b) prove damper open,
(c) prove damper closed.

3 EXECUTION

3.1 Installation – General Requirements

.1 Install fire dampers and fire stop flaps throughout supply, return and exhaust air systems in fire separations marked as having a fire resistance rating and as shown.

.2 Install smoke dampers and combination smoke/fire dampers at locations as shown.

.3 Install fire, smoke, and combination smoke/fire dampers in accordance with manufacturer's instructions, with sleeve, duct connections and angle supports to comply with terms and conditions of listing or classification and maintain integrity of fire wall and/or fire separation.

.4 Install stainless steel dampers in stainless steel duct systems and/or wherever ductwork is specified to be watertight construction.

3.2 Fire Damper Selection

.1 Select fire damper types as follows:

.1 “Dynamic” - all locations unless otherwise shown,

.2 “Static” - restricted to un-ducted transfer air openings.

.2 Select curtain-type fire damper styles as follows:

.1 For dynamic and static dampers:

(a) duct height in the following tables is the duct dimension perpendicular to blade length orientation.

Damper Velocity Class	Duct Height mm	Curtain Damper Style
Standard Performance (≤ 10 m/s)	> 300	A
	≤ 300	B
Extended Performance (10 to ≤ 12.5 m/s)	> 200	B
	≤ 200	C
High Velocity Performance (> 12.5 m/s)	Any	C

Damper Velocity Class	Duct Height In.	Curtain Damper Style
Standard Performance (≤ 2000 fpm)	> 12	A
	≤ 12	B
Extended Performance (2000 to ≤ 2500 fpm)	> 8	B
	≤ 8	C
High Velocity Performance (> 4000 fpm)	Any	C

3.3 Fire Damper Installation

.1 Where the duct size exceeds the maximum listing size of a multiple curtain damper assembly, provide multiblade fire dampers.

.2 Where fire dampers are shown to be motorized, provide multiblade fire damper with electric operator.

3.4 Damper Sleeves

.1 Provide factory-made damper sleeves in accordance with damper listing requirements, and as described herein.

.2 For multiblade dampers, smoke dampers, and combination smoke/fire dampers, fabricate sleeve style based on damper size listing requirements.

.3 Install damper sleeves with retaining angles in accordance with the damper manufacturer instructions.

3.5 Damper Access Doors

.1 Provide duct access door at each fire damper to permit visual inspection and replacement of fusible link. Do not locate access doors in a vertical service space (shaft).

.2 Provide duct access door at each smoke damper and combination smoke/fire damper, to permit visual inspection and service of fire detection/actuation mechanism. Provide such access doors even where dampers are provided with electrically supervised damper position indication.

.3 For curtain-type fire dampers in vertical ducts, the preferred access location is from the floor above the damper.

.4 For motorized fire dampers, smoke dampers and combination smoke/fire dampers installed in vertical ducts, position the damper actuator assembly so that it is not located in a vertical service space (shaft). Preferred position in order of priority and applicability are:

.1 above floor level in a service room,

.2 in the ceiling space below the bottom of a vertical service space.

.5 Install damper actuator assemblies on the room side of a damper isolating the room from a corridor, except where the duct ends at a wall grill.

3.6 Damper Power Supplies; Non-Controlled Dampers

.1 This article applies to fire dampers requiring electric actuators due to the limitations of damper size in accordance with each manufacturer product listing, but are otherwise not remotely controlled.

.2 Where a multiblade fire damper assembly requires an electric actuator because of limitations of its listing but not otherwise designated as a motorized fire damper (“MFD”), provide power and conduit from the nearest normal-designated 120 VAC power distribution panel;

.1 provide 15 A breaker, with tamper lock, for each circuit,

.2 provide fuse protection for each actuator, sized as recommended by damper/actuator manufacturer installation instructions,

.3 maximum actuator load on each electrical circuit: 10 A,

.4 wiring and conduit:

(a) in accordance with specification section 20 05 13.16, and
(b) No. 14 AWG conductor size..

.5 each electrical circuit only to serve dampers located on the same floor (and same portion of a floor area if applicable) as the power distribution panel.

3.7 Testing

.1 Conduct installation tests of all fire dampers, smoke dampers, and combination smoke/fire dampers in accordance with NFPA 80, NFPA 90A and NFPA 105 as applicable to damper type and summarized as follows.

.2 Field test all fire dampers, smoke dampers, combination smoke/fire dampers and fire stop flaps as follows:

.1 operate dampers to demonstrate unobstructed operation of the damper from open-to-close-to open state. These tests are to be performed while the fan systems are not in operation (static test),

.2 for dynamic dampers, confirm air velocity through the open dampers under normal HVAC system operation, once air balancing is completed. Select dampers to confirm operation for ducts operating within 80% of the maximum air velocity of the damper listing,

.3 confirm accessibility to components of fire damper to permit maintenance and testing,

.4 where a damper is provided with an indicating device, confirm device functions and annunciates to the supervised location or system when the damper is in both the open and closed state, as applicable.

.3 In addition for multiblade fire dampers with electric operators, smoke dampers or combination smoke/fire dampers, cycle test dampers under normal HVAC operating conditions (dynamic test).

.4 Record test results as per the attached test form or similar containing the same information, and submit to Owner and Consultant as part of the Operations and Maintenance manual.

.5 Upon completion of testing, provide labour and resources necessary to conduct a demonstration re-test for up to [10%] of curtain-type dampers on each floor as selected and witnessed by Engineer.

.6 Upon completion of testing, provide labour and resources necessary to conduct a demonstration re-test of 100% of all motorized fire dampers, smoke dampers and combination smoke/fire dampers. This test may be combined as part of the demonstration test of a smoke control system or a smoke exhaust system used to air fire fighters.

3.8 Test Form

.1 Test form follows at the end of this section.

END OF SECTION

Fire, Smoke, and Fire/Smoke Damper Test Record

Project	***System***
Testing Company	***Technician Name***

Damper location	Inspection Date YYYY-MM-DD	Damper Type(1)	Static Op. Test(2)	Dyn Op. Test(3)	Access Test (4)	Air Flow(5)	Confirmed/ Deficiencies	Deficiency Corrected	Damper Audited

(1) Damper Type : FD, MFD, SD, or CSFD
(2) Static Operating Test without airflow
(3) Dynamic Operating Test with balanced airflow; multiblade FD, SD and CSFD only.
(4) Damper and components are accessible for inspection and testing
(5) Identify which damper air velocity is checked in accordance with the test selection criteria.

FLEXIBLE DUCTWORK
23 33 46

1 GENERAL

1.1 Scope

.1 Provide flexible ductwork as shown.

1.2 Reference standards

.1 Conform to;

.1	ULC S110	Fire tests for air ducts.
.2	ULC 181	Factory made air ducts and connections.
.3	NFPA 90A	Installation of air conditioning and ventilating systems.
.4	NFPA 90B	Installation of warm air heating and air conditioning systems.
.5	SMACNA	Flexible duct installation standards

1.3 Product data

.1 Submit manufacturer's data sheets for each product showing;

.1 Thermal properties.

.2 Friction loss characteristics,

.3 Acoustical loss factors,

.4 Leakage rates,

.5 Fire rating.

2 PRODUCTS

2.1 Flexible ductwork

.1 General requirements:

.1 maximum working pressure: 1.5 kPa (6 in wg),

.2 maximum negative working pressure: 1.25 kPa (5 in.wg.)

.3 pressure drop coefficients as listed below based on sheet metal duct pressure drop coefficient of 1.00,

.4 flame spread rating not to exceed 25 and smoke developed rating not to exceed 50.

.5 Listed to ULC-S110 as a Class 1 product.

Standard of Acceptance
- Flexmaster
- Peppertree Air Solutions Inc
- Trans Continental Equipment

2.2 Metallic flexible ductwork

.1 Construction:

.1 spiral wound flexible aluminum with interlocked seams,

.2 maximum pressure drop coefficient: 3,

.3 airtight.

2.3 Metallic insulated flexible ductwork

.1 Construction:

.1 spiral wound flexible aluminum with interlocked seams,

.2 factory applied flexible glass fibre thermal insulation with vapour barrier and vinyl or aluminum jacket, maximum “U” value of 1.25 W/m2/K (0.22 Btu/hr/sq.ft/°F),

.3 maximum pressure drop coefficient: 3,

.4 airtight.

2.4 Nonmetallic flexible ductwork

.1 Construction:

.1 coated mineral base fabric type helically supported by steel wire,

.2 maximum pressure drop coefficient: 3,

.3 airtight.

2.5 Nonmetallic insulated flexible ductwork

.1 Construction:

.1 coated mineral base fabric type helically supported by steel wire with factory applied flexible glass fibre thermal insulation with vapour barrier and vinyl or aluminum jacket, maximum “U” value of 1.25 W/m2/K (0.22 Btu/hr/sq.ft/°F),

.2 maximum pressure drop coefficient:3,

.3 airtight.

2.6

2.6 Sealing compound

Standard of Acceptance

- Durodyne
- Transcontinental Equipment
- Dyn Air

3 EXECUTION

3.1 Duct installation

.1 Length of flexible duct feeding ceiling outlet: 1.5 to 2 m (5 to 6 ft)

.2 Length of flexible duct feeding return/exhaust grilles: 1.5 to 2 m (5 to 6 ft).

.3 Do not install flexible duct on exhaust grilles serving high humidity spaces including shower rooms, bathing rooms, pools, equipment process rooms, cold rooms with temperatures below 15°C (60°F), kitchens including clean-up areas, and central sterile processing areas.

.4 Provide flexible duct and make connections to supply diffusers and grillesas shown. Do not use flexible duct connectors on return or exhaust air grilles unless shown.

.5 Use sealing compound and tape at connection points between sheet metal and flexible duct. Make a further mechanical connection using sheet metal screws.

.6 Centre-line radius of bends in flexible ductwork to be greater than one duct diameter.

.7 Do not install flexible ductwork through floors, partitions or masonry walls.

END OF SECTION

DUCT CLEANING
23 3347

1 GENERAL

1.1 Scope

.1 Professionally duct clean all existing and new supply and return duct systems connected to existing & new systems.

.2 Clean all existing and new exhaust ductwork revised or connected to as part of the renovation. Extent of exhaust ductwork cleaning will be limited to the same floor as the renovation. Cleaning is to be performed by robots to ensure maximum access to the ductwork while the Air Handling Unit System (AHU) is under a vacuum pressure and exhausted through a HEPA Filter System. An AHU system is considered to start at the air intake and end at the last diffuser in the duct run inclusive and all parts between. The system includes both supply, exhaust (relief air from the unit) and return air systems.

.3 Provide schedule details to the General contractor at the time of tender so duct cleaning can be factored into the overall schedule. The duct cleaning to be performed after all dust producing construction is complete and before the system is balanced. If not, then the balancer will have to verify and rebalance system to ensure dampers were not moved in the cleaning process. If duct cleaning is done too early and the ducts become re-contaminated as a result of the construction, the ducts will be re-cleaned at the contractor's cost.

1.2 Proof of Cleaning

.1 Submit written verification that duct work has been completely cleaned and verified on site. Provide a written report and a colour video of the system before and after cleaning

1.3 Qualifications

.1 Cleaning to be performed by agent specializing in this field of work, be a member in good standing with National Air Duct Cleaners Association (NADCA), and to comply with NADCA standards.

2 PRODUCTS

2.1 Self-propelling Full Contact Brushes for Unlined Ducts Only:

.1 Employ brushes specially made and shaped to fit the individual ducts or components in which they are used. Ensure continuous full contact and powerful scrubbing action of the interior surfaces of the ducts or components in which they are installed.

.2 Brush bristles to be of nylon, polypropylene or other non-metallic material.

.3 Brushes to be robotic or self-propelled, in either case having an integrally-mounted propulsion motor or drive. Motors or drives must be powerful enough to continue to propel the brush even when the brush bristles have been severely distorted

.4 Brushes to have the capability to clean ventilation ducts of 80 sq. mm. to 500 sq. mm.

2.2 Robotic Brush:

.1 A remote controlled self-propelled vehicle with robotic brush is to be used in all areas where a self-propelled brush is not suitable or cannot reach.

.2 To ensure continuous full contact and powerful scrubbing action of the interior surfaces of the ducts or components, the robot-manipulated brush is to be of the same material as all other brushes and to have a rotary action mounted on a shaft at right angles to the longitudinal axis of the duct.

.3 The rotary action brushes and mounting shaft to be adjustable in all dimensions to maintain contact with the interior surfaces of the duct.

.4 The robotic vehicle is to have a mounted camera device to monitor cleaning and record to video tape at all times.

2.3 Robotic Acoustic Lining Cleaner:

.1 Cleaning of acoustically-lined ductwork and components is to be carried out only with use of specially designed apparatus that has been demonstrated not to damage the lining, and is directly connected to the remote controlled, self-propelled video camera unit so that progress can be constantly monitored and maximum force can be used in vibrating the lining material without causing damage.

2.4 Robotic Acoustic Lining Sealing:

.1 Sealing of the acoustic lining shall be a specially designed self-propelled and robotic assembly which is equipped with a spraying mechanism that has been demonstrated not to damage the lining and is constantly video monitored to ensure that the application of the sealing material is properly directed and applied at the designed rate.

2.5 Robotic Video Camera - Cleaning:

.1 A remote vehicle is to have video camera device mounted to monitor cleaning process and record to video tape at all times the condition of the ventilation duct and components after cleaning as proof that cleaning has been completed as per the contract.

2.6 Robotic Video Camera - Inspection:

.1 The video camera used for the survey and visual inspections shall be a remote controlled, self-propelled unit capable of entering a duct as small as 175 x 175 mm square or 175 mm diameter round without any loss of maneuverability or control, and to continually provide video coverage of the duct or component of the system being checked.

.2 The camera shall be capable of being mounted on a probe of up to 3 meters in length and in this configuration shall be able to enter a duct as small as 100 mm x 100 mm diameter.

.3 For optimum clarity, the camera shall be of HD quality

.4 The video camera unit shall have full remote control, allowing it to stop at any time, turn left or right, back up and to focus on any object or feature within the duct.

.5 The video camera unit shall be equipped with sufficient light to illuminate the entire viewing area of the camera without causing "hot spots" or shadowed edges or corners on the monitor.

2.7 Vacuum Unit:

.1 Vacuum unit shall consist of fan, HEPA filter section, hose and vacuum head. All vacuum units shall be equipped with integral HEPA filters. Filters must be maintained in top condition.

.2 Vacuum cleaning units shall be used only to supplement direct contact brushing.

.3 Vacuum units shall be powerful enough and multiple units shall be used, to entrain all removed dirt and particulate matter in the airstream until captured by the vacuum units.

.4 No cleaning operations shall take place until vacuum units are in place and operating.

.5 Coils, walls, humidifiers, elements and heat exchangers are to be brushed and vacuumed and where necessary low pressure washed in place. Fan blades will be wiped and vacuumed.

.6 A HEPA filter system in the negative air pressure unit must be installed before any cleaning can take place.

.7 Any altered components such as dampers will be reset to their original positions after cleaning.

3 EXECUTION

.1 Complete a preliminary inspection of the ventilation ducts and components of individual specified ventilation systems in building identified in this Contract. At least 10 percent (10%) of all ductwork and components to be cleaned shall be checked, including proportionate representative samples of main supply and return ducts as well as branch ducts and other components.

.2 The section being cleaned must be isolated from other areas and put under vacuum pressure through a HEPA filter system.

.3 The cleaning must encompass all surfaces that air passes over in the AHU.

.4 Where brushing and vacuuming is not appropriate or sufficient to clean a component, dismantle and remove to the outside and clean with a pressure washer.

.5 The system’s state of cleanliness shall be determined through the use of the following three methods:

.6 Visual inspection: Through the use of robotic video camera and by direct inspection of various sections and components of the system;

.7 Particulate analysis: Identify certain locations in the system for particulate analysis. Take particulate samples using sterile wipes or containers and send for laboratory analysis. Locate all such sampling locations on a drawing or describe fully so that the same locations can be tested after cleaning; and

.8 Submit a preliminary inspection report outlining the general condition of the inspected ductwork describing both its physical state, its degree of cleanliness, and the results of the laboratory sample analysis.

3.2 Cleaning of Components:

.1 All components of the system are to be thoroughly cleaned, turning vanes, diffusers, grilles, reheat coils, control components including sensing bulbs, branch take-off points, fire dampers, balancing dampers, splitter dampers and any other internal duct or system features, especially corners and pockets where dirt or dust may accumulate.

.2 Before starting and cleaning, carefully mark and record all and any adjustable dampers or other air-flow balancing devices so that, if disturbed, they can be reset to their original positions. This includes all branch take-offs, balancing dampers, splitter dampers, grilles and diffusers and adjustable louvres in the system.

.3 Isolate sections of the duct with friction-fitted blocks of closed-cell polyurethane foam, install HEPA vacuums at one end, and inset the full contact brushes at the other. Energize brushes so that they travel towards vacuum units, changing brush sizes as necessary to ensure a constant interference fit within the duct or component.

.4 Clean all fittings, components and other features within the system on the same section-by-section basis so that dirt from a section being cleaned will never pass through a section that has already been cleaned.

.5 Pass brushes through sections or components as many times as necessary to achieve the degree of cleanliness required.

.6 Where brushing and vacuuming is not appropriate or not sufficient to clean a component of the system, dismantle and remove the component to the outside where it shall be pressure-washed to the required state of cleanliness.

3.3 Manual Cleaning:

.1 Cleaning operations performed by hand are acceptable only for purposes of cleaning individual components of the system such as fan blades, dampers, controls, turning vanes, etc. Manual brushing and vacuuming shall not be acceptable for purposes of cleaning the entire system.

.2 Compressed air or manual or hand cleaning is not to be used for cleaning of ventilation ducts except in isolated instances and when duct size is too small to use robotic equipment or only if specifically instructed by the Engineer in writing.

3.4 Cleaning Standards:

.1 The ventilation system being cleaned shall be cleaned to like-new condition throughout unless specifically noted otherwise in this specification.

.2 Ducting and components shall be cleaned to the following standards:

.1 Supply side ductwork and components: Particulate: Scale rating of 1; and microbial growth: Scale rating of 1.

.2 Exhaust and return side ductwork and components: Particulate: Scale rating of 2 or less; and microbial growth: Scale rating of 2 or less.\

3.5 Inspection After Cleaning:

.1 This inspection shall only take place after all systems and components have been cleaned.

.2 Follow the same video survey plan used for the preliminary survey.

.3 Perform video survey of same sections, features and points as were previously recorded for purposes of comparison.

.4 Perform visual inspections throughout wherever this method was used in preliminary examination.

.5 Incorporate all data, observations and recommendations in to the final report as described elsewhere in this specification.

3.6 Laboratory Analysis:

.1 An inspecting laboratory shall be engaged to perform sample analysis during this project and shall be experienced and able to demonstrate expertise in this type of analysis and work.

.2 Three methods of duct contaminant evaluation shall be used both before and after the duct cleaning has been performed, as follows:

.1 Visual inspection using remote controlled robotic or other self-propelled video camera;

.2 Particulate analysis using a Super Electron Microscope (SEM): Samples shall be taken using sterile wires for subsequent laboratory testing; and

.3 The following descriptions shall provide the basis for scaling the samples:

Particulate Scale No.	Description
1	Optically clean when examined by the unaided eye under a bright light (i.e. of 100W or more)
2	Slight film of particulate on the bottom of the duct, evenly dispersed across surface, with a maximum depth at any point, of less than one millimeter, and with no localized accumulations anywhere
3	Evenly dispersed build-up of 1-2 mm thickness with some localized accumulations.
4	Thicker accumulations than for scale 3, or the same as scale 2 or 3 if particulate analysis reveals asbestos, or material content deemed to be hazardous by the Engineer.

.4 The two main types of evaluation shall be performed to provide the following information to the following requirements:

.1 Visual inspection: The remote control video camera package shall be capable of entering a duct or space as small as 25mm square or round and of transversing the length of this duct. Direct visual examination of the system shall also be performed.

.2 Particulate Analysis: The particulate analysis shall be analyzed with a Super Electron Microscope (SEM) for the various components with all components identified and graded or rated by size in microns, as well as percentage of concentration of all substances.

4 REPORTS:

.1 Submit two (2) copies of separate reports both before and after the cleaning procedure has been undertaken. Both reports shall include the following:

.1 Name of facility and address

.2 Name and address of cleaning contractor

.3 Description of the ventilation system with drawings or clear neat sketches showing the various systems

.4 Identification scheme for all points in system that were examined and notes describing method of examination or testing used

.5 Description and location of problem areas encountered and special or unusual situations or conditions and any comments or recommendations

.6 Comments complete with photos illustrating each sampling location and other observed features of the system

.7 DVD format videos showing all areas tested for particulate analysis evaluation, all areas of special interest and general representative sections of the duct and components for each ventilation system cleaned.

.8 Report verification by a TAB Agent and Certification that NADCA standards have been met

.2 Submit two (2) USB sticks with all pre and final videos and pdfs of all reports and tests with each report.

.3 Reports shall be bound in binders, complete with index and title page.

END OF SECTION

LOUVRES
23 33 63

1 GENERAL

1.1 Scope

.1 Provide louvres as shown.

1.2 Shop drawings

.1 Submit manufacturer's data sheets for wall louvres with model numbers, design data, support and anchor details and outline dimensions.

2 PRODUCTS

2.1 Louvres

.1 Performance:

.1 free area not less than 40% of nominal size,

.2 Construction:

.1 material: extruded aluminum alloy [6063-T5],

.2 exposed joints ground flush and smooth,

.3 storm proof pattern blade with centre watershed, reinforcing bosses and maximum blade length of 1500 mm (60 in),

.4 frame, head, sill and jamb: 150 mm (6 in) deep one piece extrusions, minimum 3 mm (⅛ in) thick with integral caulking slot,

.5 mullions: at 1500 mm (60 in) maximum centres.

.6 fasteners: stainless steel to (Society of Automotive Engineers) SAE-194-AF with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt or between nut, stainless steel washer and aluminum body,

.7 screen:

(a) 2 mm (14 ga) wire in formed U-frame,
(b) exhaust louvres: 12 mm (½ in) mesh,
(c) intake louvres: 25 mm (1 in) mesh.

.8 finish: clear anodized satin.

Standard of Acceptance

- Construction Specialties - Model 6110
- Airolite - CB638
- Alumavent - AL-445-5
- Carnes -
- K.N. Crowder - Canadian Louvres 411S
- Leo Lisi - Series 445]

3 EXECUTION

3.1 Installation

.1 Confirm opening size and co-ordinate location of louvres with other Trades.

.2 Where blank-off openings at back of louvre are oversized, install 1.2 mm (18 ga) reinforced galvanized sheet steel blank-offs, sealed with fire resistant mastic between galvanized steel and aluminum.

END OF SECTION

FANS
23 34 05

1 GENERAL

1.1 Scope

.1 Provide fans of type, size and performance as shown.

1.2 Shop drawings and product data

.1 Submit shop drawings showing outline dimensions, motor mounting details, inlet and outlet connection details, motor characteristics, drive arrangement and weight.

.2 Submit certified performance curves for each fan showing efficiency, static pressure and power input as KW (brake horsepower) from shut-off to free delivery through scheduled point of rating[][and for fan rpm, 15% above and 15% below this curve].

.3 Submit certified sound power data for supply, return and exhaust fans rated at more than 2.0 m^3/s (4000 CFM).

.4 Where fan is equipped with motor over 7.5 kW (10 hp), has drive with more than three belts, and is specified to have variable frequency drive (VFD), select motor, fixed pulleys, and belt drive for power and rotational speed at 115% of fan rpm at point of rating.

1.3 Reference standards

.1 Fan ratings:

.1 established by tests performed in accordance with AMCA 210, (ASHRAE 51) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 Sound ratings;

.1 taken from tests performed in accordance with

(a) AMCA 300, Reverberant Room Method for Sound Testing of Fans,
(b) AMCA 320, Laboratory Methods of Sound Testing Fans Using Sound Intensity, or
(c) AMCA 330, Laboratory Method of Testing to determine Sound Power in a Duct,

.2 and presented using

(a) AMCA 301, Methods of Calculating Fan Sound Ratings from Laboratory Test Data.

.3 Construct fans to conform to AMCA 99, Standards Handbook.

.4 Fan class to conform with AMCA 99-2408, Operating Limits for Centrifugal Fans.

2 PRODUCTS

2.1 General

.1 Space allocation, motor sizes, base details, connection arrangements and performance are based on fan equipment by manufacturers as shown in schedules.

.2 Fans:

.1 labelled with Air Performance, or Sound and Air Performance AMCA Certified Rating Seals

.2 of same manufacture for similar applications, but may be chosen from other manufacturers' product lines for other different applications.

.3 selected from manufacturer's catalogued range of standard products.

Standard of Acceptance)

- Trane
- Aeroflo
- Greenheck
- Loren Cook
- Twin City
- Woods
- Carnes
- Acme

2.2 Selection criteria

.1 Select fan size, operating rpm and rating point on stable part of head flow curve with smooth characteristics.

2.3 Construction details

.1 Fans:

.1 statically and dynamically balanced

.2 running at least 20% below first critical speed when operating at maximum speed for class of construction, interior and exterior surfaces manufactured from steel factory cleaned and primed to CGBS 1-GP-181M+ Amdt-Mar-78

.3 surfaces contacting airstream zinc-coated

.2 Fan bearings:

.1 grease lubricated self aligning ball or roller type with oil retaining, dust excluding seals,

.2 cartridge type for shafts less than 37 mm (1 - 7/16 in) diameter,

.3 shaft adapter sleeves with horizontally split pillow blocks and mechanical flinger type grease valves for shafts 37 mm (1 - 7/16 in) diameter or larger,

.4 interference fit rather than adapter sleeve type on shafts 56 mm (2 - 3/16 in) and larger

.5 furnished with drain plugs,

.6 fitted with extended grease lubricating lines where access is restricted,

.7 packed with grease at factory,

.8 chosen for 125% of rotational speed at point of selection for [60,000][80,000][100,000][200,000] hour service life in accordance with ABMA L_{-10} life standard and ANSI B3.15 for ball bearings and ANSI B3.16 for roller bearings.

.3 Fan configuration (unless shown or noted otherwise):

.1 Arrangement #1 or #2 for single inlet, single width, belt driven fans up to and including 915 mm (36 in) wheel diameter.

.2 Arrangement #3 for belt driven single inlet fans with wheel diameter larger than 915 mm (36 in) diameter and belt driven double inlet fans.

.3 Arrangement #3 for plenum (plug) fans.

.4 Arrangement #10 for utility sets.

.5 Arrangement #8 for direct connected single inlet centrifugal fans.

.6 Arrangement #7 for direct connected double inlet fans.

.4 Variable volume devices:

.1 adjustable inlet vanes

.2 operated from mechanism, with locking device for manual operation, linked to each damper vane, and interconnecting vanes in each inlet of DWDI fans.

.5 Fan motors:

.1 not less than motor kW (horsepower) shown in schedule.

.2 sized in accordance with criteria specified under "Motors".

.3 capable of satisfactory operation over range of performance from shut-off to run-out at 115% of rotational speed at point of selection.

2.4 Centrifugal fans

.1 Arrangement:

.1 rotation, discharge and motor position to be as shown,

.2 fan classification to be established to permit operation at 125% of rotational speed at point of selection.

.2 Fan wheels:

.1 backward curved or backward inclined blades for fan wheel diameters less than 686 mm (27 in), backward curved air foil blades for fan wheel diameters 686 mm (27 in) and larger.

.3 Accessories:

.1 38 mm (1 - ½ in) casing drains where fans discharge vertically,

.2 quick opening access doors in scroll casing when equipped with variable inlet guide vanes,

.3 stuffing box style shaft seals on single inlet single width fans and utility sets.

2.5 Plenum (plug) fans

.1 Arrangement:

.1 rotation, discharge and motor position to be as shown, with motor mounted on frame,

.2 fan classification to be established to permit operation at 125% of rotational speed at point of selection.

.2 Fan wheels:

.1 backward curved air foil blades.

.3 Accessories

.1 outlet cage,

.2 inlet collar.

3 EXECUTION

3.1 Fan installation

.1 Mount fans as shown, with vibration isolation, restraining snubbers, flexible electrical leads, and flexible connections to inlet and discharge ductwork.

.2 Align shafts, belt drive and motor.

.3 Adjust belt tension.

.4 Check motor rotation before start-up.

3.2 Protection

.1 Provide temporary enclosures for open drip proof motors.

.2 Cover fan inlet and discharge openings during construction.

.3 Rotate fans, by hand, every month between delivery and acceptance of building.

3.3 Commissioning

.1 During balancing adjust sheaves on variable pitch belt drives, adjust blade pitch of axial flow fans, and change pulleys and belts on fixed pitch belt drives, to achieve specified air quantities.

END OF SECTION

TERMINAL BOXES
23 36 13

1 GENERAL

1.1 Scope

.1 Provide terminal boxes as shown.

1.2 Shop drawings

.1 Submit manufacturer's data sheets with equipment model numbers, performance and design data, outline dimensions, enclosure details, support and connection arrangements and electrical power requirements where applicable.

1.3 Applicable codes and standards

.1 ARI Standard 880 Standard for Air Terminals

.2 ARI Standard 885 Standard for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

.3 ASHRAE Standard 180 Methods of Testing for Rating Ducted Air Terminal Units

2 PRODUCTS

2.1 General

.1 Selection of units to meet air quantities shown to be based on;

.1 maximum Inlet Air Pressure; 750 Pa (3 in wg),

.2 minimum Inlet Air Pressure; 75 Pa (0.3 in wg),

.3 maximum room NC sound pressure level (2×10^{-4} microbar reference) at maximum inlet pressure to be less than 40 at discharge and 42 radiated for box with attenuator mounted exposed (without ceiling).

.2 Where sizes, model numbers and unit types are indicated, selections are taken from E.H. Price catalogue.

Standard of Acceptance

- E.H. Price
- Titus
- Environmental Technologies
- Nailor Industries.
- Carnes
- Metalaire

2.2 Terminal box

.1 Construction:

.1 pressure independent type with pneumatic velocity sensor, damper assembly, factory calibrated controller and actuator with adjustable minimum stop

.2 damper arranged "normally open" for morning warm-up.

.3 controller capable of maintaining air quantity within ±5% of set value, between zero and stipulated rated air flow,

.4 sound level below specified values when operating from minimum to maximum inlet static pressure.

.2 Silencer/attenuator:

.1 on box discharge, acoustically treated open end or multiple outlet attenuator 900mm (30 in) long on boxes up to Size 10 and 1.5 m (5 ft) long on boxes Size 12 and larger

.2 acoustic lining - fibreglass:[

(a) 20 mm (13/16 in) thick, 64kg/m^3 (4 lb/sq ft) density, rigid fibreglass with fire resistive reinforced aluminum foil-scrim-kraft (FSK) facing,
(b) flame spread rating not to exceed 25, smoke development rating not to exceed 50,
(c) fastened to interior sheet metal surface with 100% coverage of adhesive, and fasteners at 1 pin per 0.2m^2 (2 sq ft) but not less than 1 row on each duct side.
(d) edges concealed by metal nosings at inlet and discharge, with notch and tuck fabrication and seams protected by Z strips

Standard of Acceptance
° Steri-Liner][

.3 acoustic lining - elastomeric:

(a) spray coated, flexible, closed cell elastomeric insulation in sheet form, with self-adhering backing]
(b) flame spread rating not to exceed 25, smoke development rating not to exceed 50,
(c) fastened to interior sheet metal surface with 100% coverage of adhesive, and fasteners at 1 pin per 0.2m^2 (2 sq ft) but not less than 1 row on each duct side.

Standard of Acceptance
° Armacell AP Armaflex SA

.4 duct liner fasteners:

(a) 2.0 mm (1/16 in) diameter pins,
(b) length selected to suit thickness of insulation,
(c) 32 mm (1¼ in) square Nylon retaining clips.

2.3 Reheat boxes

.1 Construction:

.1 terminal units as specified above,

.2 outlet end of attenuator fitted with serpentine hot water reheat coils;

(a) copper tube, aluminum fin construction in galvanized steel casing,
(b) water side minimum working pressure 860 kPa (125 psi),

.3 access doors in attenuator section upstream of reheat coil.

2.4 Fan powered boxes

.1 Construction:

.1 reheat units or terminal units as specified above

.2 fitted with supply fan and supply/return air mixing arrangement capable of modulating from 100% cold air to 100% return air.

.3 statically and dynamically balanced forward curved fans with sleeve bearings, and brushless DC electronically commutated motor (ECM) with permanent magnet rotor and motor control package for single phase 120 VAC 60Hz power supply.]

2.5 Controllers

.1 Direct Digital Controllers (DDC) including actuators to be supplied[by Section 25 14 00, B.A.S. Equipment Controllers, and factory mounted by Terminal Box Manufacturer. Costs associated with receiving, storage, installation and calibration to be included by Terminal Box Manufacturer.

.2 Air flow sensor to be provided by Terminal Box Manufacturer.

.3 120 VAC to 24 VAC transformer for DDC controller to be supplied by Section 25 14 00, B.A.S. Equipment Controllers,and factory installed by the Terminal Box Manufacturer.

3 EXECUTION

3.1 Box installation

.1 Support terminal boxes from building structure with angles, hangers and supplementary steel before installation of piping and connecting ductwork.

.2 Provide access door in ductwork downstream of reheat coil.

3.2 Ductwork connections

.1 Connect inlet ductwork with spiral flat seam round duct of same diameter as terminal box inlet

.2 Support outlet ductwork independent from box.

.3 Seal openings in box and attenuator for [][reheat coil and connections,]control, and power wiring.

3.3 Piping connections

.1 Connect supply and return piping to reheat boxes

.2 Install isolating valve on supply and lock shield ball valve and automatic control valve on return of each reheat coil.

.3 Provide screw driver air vent at high point of piping to each coil.]

3.4 Electrical connections

.1 Electrical Division 26 will provided 120 Volt, single phase power supply with a junction box for each group of terminal boxes with maximum of 12 terminal box controls fed from one junction box.[][For fan powered terminal boxes Electrical Division 26 will provided 120 Volt, single phase power supply for fan motors and controls at a junction box adjacent each fan powered terminal box.]

.2 Extend power supply from these junction boxes and connect to terminal units.

3.5 Leakage testing

.1 Terminal boxes and attenuators to be included in ductwork leakage testing.

END OF SECTION

GRILLES, REGISTERS AND DIFFUSERS
23 37 13

1 GENERAL

1.1 Scope

.1 Provide grilles, registers, and diffusers as shown.

1.2 Shop drawings

.1 Submit manufacturer's data sheets with equipment model numbers, performance and design data, outline dimensions, support recommendations and connection details.

1.3 Samples

.1 Submit examples of each type and style of register, diffuser and grille with sample finishes when requested.

.2 Submit samples of laminar flow diffusers with HEPA filters, and low level exhaust grilles to be used in Operating Suites

2 PRODUCTS

2.1 General

.1 Grilles, registers and diffusers:

.1 product of one manufacturer where same model or type identification is used.

.2 standard catalogue products selected to meet capacity, throw, and noise level.

.3 prime coated, stamped or cold rolled steel material with mitred corners and exposed joints welded and ground smooth.

.4 extruded satin finish, clear anodized aluminum material with mitred corners and mechanical fasteners.

.5 Frames with full perimeter gaskets, plaster stops where set into plaster or gypsum board, and concealed fasteners.

2.2 Type designations

.1 Diffuser, register and grille schedule identifies model or type identifiers used on floor plans with model numbers taken from listed manufacturer's catalogue.

.2 Where several manufacturer's model numbers are given, these are acceptable alternatives.

.3 Where only one manufacturer's model number is given, provide designated item.

Standard of Acceptance
- E.H. Price
- Tuttle & Bailey
- Titus
- Hart & Cooley
- Carnes
- Nailor

- MetalAire

2.3 Supply registers

.1 double deflection style with face bars vertical and rear bars horizontal,

.2 perimeter border with gasket,

.3 opposed blade dampers (OPD) with concealed manual operator,

.4 of steel or aluminum material.

2.4 Return and exhaust grilles

.1 single deflection type, with horizontal face bars, 20 maximum turn up,

.2 perimeter border with gasket,

.3 opposed blade damper with concealed operator,

.4 of steel or aluminum material.

2.5 Diffusers

.1 circular or square multiple cone or perforated face type, with adjustable pattern control,

.2 of steel or aluminum material.

2.6 Linear grilles

.1 aluminum bar core type with margin as indicated, pattern adjustment, plaster frames, sealing strips, end caps, mitred corners and alignment key strips for multiple sections.

.2 capable of supporting {90kg}{200lb} point loads where installed as floor grilles.

2.7 VAV diffusers

.1 variable geometry thermostatically controlled type, with [electric][self-contained][pneumatically] operator.

Standard of Acceptance
- Acutherm
- Titus
- Warren

3 EXECUTION

3.1 Layout

.1 Drawings showing position of air distribution outlets are essentially diagrammatic. Coordinate exact location of diffusers with other elements in ceiling and shown on reflected ceiling drawings and select trim to suit ceiling materials listed in Finish Schedules.

3.2 Special installations

.1 Grilles, registers and diffusers penetrating fire walls and fire partitions, to have steel sleeves secured to structure in accordance with NFPA 90A-1985.

.2 In gymnasium provide safety chain on each diffuser face and core and bolt diffuser in place.

.3 For laminar flow diffusers, with or without HEPA filters, support diffuser from the building structure with steel cable, independent of ceiling system and ductwork.

.4 For security grilles and diffusers, and other grilles and diffusers exceeding 5 kg (12 lbs) weight, mechanically fasten grille/diffuser to ceiling or wall structure, independent of ductwork connection or support.

3.3 Installation of grilles and registers

.1 Install supply registers with face bars vertical and exhaust and return registers with face bars horizontal.

.2 Install registers and grilles with oval head cadmium plated screws in countersunk holes where fastenings are visible.

3.4 Installation of diffusers

.1 Diffusers to be installed with concealed fastenings.

.2 Round, square and rectangular diffusers to be provided with equalizing deflectors, mounted in neck, accessible from diffuser face, with blades oriented at right angles to direction from which air is flowing.

.3 Except for last diffuser on branch, each diffuser installed in underside of supply duct to have extract volume control damper.

END OF SECTION

FILTERS & FILTER GAUGES
23 41 13

1 GENERAL

1.1 Scope

.1 Provide filters banks with filters of size, type, number and arrangement as shown, and filter gauges as specified.

1.2 Shop drawings and product data

.1 Submit manufacturer's catalogue literature showing:

.1 Pressure drop vs air quantity,

.2 Media Area in each cell,

.3 Dust holding capacity,

.4 Maximum recommended pressure drop.

1.3 Reference standards

.1 Air filters to be tested in accordance with;

.1 ASHRAE 52.1 Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removal of Particulate Matter.

.2 ASHRAE 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 UL -S111 - Standard Method of Fire Tests of Air Filter Units.

.4 CAN/CGSB-115-10 Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems

.5 CAN/CGSB-115-11 Filters, Air, High Efficiency, Disposable, Bag Type

.6 CAN/CGSB-115-12 Filters, Air, Medium Efficiency, Disposable, Bag Type

.7 CAN/CGSB-115-13 Filter Media, Automatic Roll

.8 CAN/CGSB-115-14 High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems

.9 CAN/CGSB-115-15 High Efficiency Rigid Type Air Filters for the Removal of Particulate Matter from Ventilating Systems

.10 CAN/CGSB-115-16 Activated Carbon for Odour Removal from Ventilation Systems

.11 CAN/CGSB-115-17 HEPA and ULPA Filters

.12 CAN/CGSB-115-18 Filter, Air, Extended Area Panel Type, Medium Efficiency

.13 CAN/CGSB-115-19 Testing Cleanrooms

2 PRODUCTS

2.1 Filter operating conditions

.1 Continuous exposure to air at 12°C (55°F) and 100% RH and to operate satisfactorily over range of air temperatures between 3°C and 50°C (37°F and 122°F).

.2 Efficiency and dust holding capacity to be determined from testing.

2.2 Filter holding frames

.1 1.6 mm (16 ga) thick []["T" section construction] supporting structure of [galvanized steel][extruded aluminum],

.2 Gasketing between adjacent frames and between frames and plenum walls.

2.3 Side access housings

.1 1.6 mm (16 ga) galvanized steel construction.

.2 Gasketed slide track[][with lever locking to full face of frame].

.3 Gasketed access doors.

2.4 AF3 : Extended surface filters - MERV 8 (25 to 30% efficiency)

.1 Type:

.1 preformed disposable cartridges made up from non-woven reinforced cotton fibre media supported on metal grid bonded to fibre board frame.

.2 Class I rated by UL.

.3 arranged for [upstream][downstream][side access] servicing.

.4 nominal cartridge dimensions of 600 mm x 600 mm x 100 mm (24 in x 24 in x 4 in) depth.

.5 2.4 m^2 (25 sq ft) of media area

.2 Performance:

.1 face area velocity: [2.5 m/s (500 fpm)][2.0 m/s (400 fpm)] maximum

.2 XX% efficiency, YY% arrestance.

.3 maximum initial resistance: 80 Pa at 2.5 m/s (0.33 in wg at 500 fpm).

.4 final resistance: 250 pa (1.0 in wg).

Standard of Acceptance

- American Air Filter - AmAir 300E
- Camfil Farr - Type 30-30
- Airguard - Type DP4

2.5 AF4 : Supported bag type cartridge filters - MERV 7 (25 to 30% efficiency)

.1 Type:

.1 preformed collapsible disposable cartridges made up from polyester, or cotton/synthetic blend media designed to fit in filter element retaining frame.

.2 Class 2 rated by UL

.3 arranged for [upstream][downstream][side access] servicing.

.4 nominal cartridge dimensions of 600 mm x 600 mm x 305 mm (24 in x 24 in x 12 in) depth.

.5 supported by insertion in retainer assembly with sealer frame

.6 3.6 m^2 (40 sq ft) of media area

.2 Performance:

.1 face area velocity: [2.5 m/s (500 fpm)][2.0 m/s (400 fpm)] maximum.

.2 XX% efficiency, YY% arrestance.

.3 maximum initial resistance: 80 Pa at 2.5 m/s (0.3 in wg at 500 fpm).

.4 final resistance: 200 pa (0.75 in wg).

Standard of Acceptance
- American Air Filter - FlexPak FA Series
- Camfil Farr - HP 2A
- Airguard - Series AG-2A

2.6 AF5 : Bag type cartridge filters - MERV 13 (80 to 85% efficiency)

.1 Type:

.1 disposable filter cartridges with gasketed holding frame and retaining clips.

.2 preformed cells made up from fibrous glass high efficiency media[][to CAN/GGSB-115.12-M80].

.3 Class 2 rated by UL .

.4 arranged for [upstream][downstream][side access] servicing.

.5 nominal cartridge dimensions of 600 mm x 600 mm x 550 mm (24 in x 24 in x 22 in) depth.

.6 self supporting for VAV applications.

.7 6 m^2 (66 sq ft) of media area

.2 Performance:

.1 face area velocity: [2.5 m/s (500 fpm)][2.0 m/s (400 fpm)] maximum.

.2 XX% efficiency, YY% arrestance.

.3 maximum initial resistance: 100 Pa at 2.5 m/s (0.4 in wg at 500 fpm).

.4 final resistance: 250 pa (1.0 in wg).

Standard of Acceptance
- American Air Filter - Dri-pak
- Camfil Farr - S-flo
- Airguard - Venti-pak

2.7 AF6 : Rigid cartridge filters - MERV 13 (80 to 85% efficiency)

.1 Type:

.1 disposable filter cartridges with gasketed metal holding frame and retaining clips.

.2 preformed cells made up from high density microfine glass fibres laminated to reinforcing backing[][, to CAN/GGSB-115.12-M80,] supported on metal grid forming tapered radial pleats.

.3 Class 2 rated by UL.

.4 arranged for [upstream][downstream][side access] servicing.

.5 nominal cartridge dimensions of 600 mm x 600 mm x 300 mm (24 in x 24 in x 12 in) depth.

.6 4 m^2 (40 sq ft) of media area

.2 Performance:

.1 face area velocity: [2.5 m/s (500 fpm)][2.0 m/s (400 fpm)] maximum.

.2 XX% efficiency, YY% arrestance.

.3 maximum initial resistance: 165 Pa at 2.5 m/s (0.65 in wg at 500 fpm).

.4 final resistance: 325 pa (1.5 in wg).

- American Air Filter - FlexPak FA Series
- Camfil Farr - P Series Riga-flo
- Airguard - Series AG-100

2.8 AF7 : Bag type cartridge filters - MERV 14 (90 to 95% efficiency)

.1 Type:

.1 disposable filter cartridges with gasketed holding frame and retaining clips.

.2 preformed cells made up from fibrous glass high efficiency media[][to CAN/GGSB-115.15-M80].

.3 Class 2 rated by UL.

.4 arranged for [upstream][downstream][side access] servicing.

.5 nominal cartridge dimensions of 600 mm x 600 mm x 550 mm (24 in x 24 in x 22 in) depth.

.6 6 m^2 (66 sq ft) of media area

.2 Performance:

.1 face area velocity: [2.5 m/s (500 fpm)][2.0 m/s (400 fpm)] maximum.

.2 XX% efficiency, YY% arrestance.

.3 maximum initial resistance: 175 Pa at 2.5 m/s (0.7 in wg at 500 fpm).

.4 final resistance: 250 pa (1.0 in wg).

Standard of Acceptance

- American Air Filter - Dri-pak
- Camfil Farr - S-flo
- Airguard - Venti-pak

2.9 AF8 : 95% DOP filter banks (MERV 16)

.1 Type:

.1 disposable filter cartridges with gaskets on cartridge frame face and four bolt fasteners on each holding frame.

.2 preformed disposable cartridges made up from glass fibre paper high efficiency media[][to CAN/GGSB-115.15] pleated around aluminum separators and encapsulated top, bottom and sides with two part urethane in 1.6 mm (16 ga) metal frame.

.3 Class 2 rated by UL.

.4 arranged for [upstream][downstream][side access] servicing.

.5 nominal cartridge dimensions of 600 mm x 600 mm x 300 mm (24 in x 24 in x 12 in) depth.

.2 Performance:

.1 face area velocity: 2.5 m/s (500 fpm) maximum.

.2 95% efficient (minimum) on 0.3 micron particles (dioctyl phthalate smoke test).

.3 maximum initial resistance: 250 Pa (1.0 in wg) when operating at rated capacity of 1.0 m^3/s (2000 cfm).

Standard of Acceptance

- American Air Filter - Bio-cel I
- Camfil Farr - Micretain 95%
- Airguard - Micro guard -95

2.10 AF9 : 99.97% DOP "Absolute" filter banks

.1 Type:

.1 disposable filter cartridges with gaskets on cartridge frame face and four bolt-tensioned fasteners holding each cartridge.

.2 preformed disposable cartridges made up from glass fibre paper high efficiency media to CAN/GGSB-115.15 pleated around aluminum separators and encapsulated top, bottom and sides with two part urethane in 1.6 mm (16 ga) metal frame.

.3 Class 2 rated by UL .

.4 nominal cartridge dimensions of 600 mm x 600 mm x 300 mm (24 in x 24 in x 12 in) depth.

.5 30 m^2 (300 sq ft) of media area.

.2 Performance:

.1 99.97% efficient (minimum) on 0.3 micron particles (dioctyl phthalate smoke test).

.2 maximum initial resistance: 340 Pa (1.35 in wg) when operating at rated capacity of 1.0 m^3/s (2000 cfm).

.3 arranged for [upstream][downstream][side access] servicing.

Standard of Acceptance

- American Air Filter - Astrocel I Type A
- Camfil Farr - XH Absolute
- Airguard - MicroGuard 2000

2.11 AF10 : Roll filters

.1 Type:

.1 drive mechanism with [electric gear reducer motor][hand crank] to wind spool through chain and sprocket assembly.

.2 adhesive coated fibrous glass media to CAN/CGSB-115.13 with nominal thickness of 50 mm (2 in) when clean

.3 metal parts of galvanized steel minimum 2.0 mm (14 ga).

.4 roll width as shown, length 20 m (65 ft).

.5 automatic device to prevent reverse rotation of used media roll, and maintain tension.

.6 prewired control package arranged to advance media [after preselected operating period of time][when filter resistance exceeds preselected high limit]. Media runout switch stops travel and indicates runout. Manual switch overrides controls and advances media.

.7 clean roll of media completely enclosed in sheet metal housing or cover.

.8 Class 2 rated by UL .

.2 Performance:

.1 dust holding capacity: 1.85 kg/m^2 (170 gram/sq ft) at an average operating resistance of 100 Pa at 2.5 m/s (0.45 in wg at 500 fpm).

.2 active media area velocity: 2.5 m/s (500 fpm) maximum.

Standard of Acceptance
- American Air Filter - RoM Gold

2.12 AF11 : Combined roll and cartridge filters

.1 Automatic roll filter as specified above and bank of [85%][95%] cartridge filters in one unit.
- American Air Filter - Roll-o-Pak

2.13 AF12 : Activated carbon filters

.1 Type:

.1 activated carbon with perforated multiple cells, in supporting frames, and one piece gasketed removable cartridge.

.2 activated carbon media manufactured from coconut shell, to CAN/CGSB-115.16,

.3 600 mm wide x 600 mm high x 300 mm deep (24 in wide x 24 in high x 12 in deep) cartridges,

.4 arranged for [upstream][downstream][side access] servicing.

.2 Performance:

.1 nominal capacity of 1000 l/s (2000 cfm) per filter,

.2 sufficient carbon to achieve cartridge sorbent capacity measured in accordance with DIN 71460 of 1450 grams of toluene at 80% penetration.

.3 maximum initial resistance: 200 Pa (0.8 in wg) when operating at rated capacity of 1.0 m^3/s (2000 cfm).

Standard of Acceptance
- Camfil Farr - Camsorb V-Cell
- Airguard Vari-Pure

2.14 Air filter gauges

.1 0-250 Pa (0-1 in wg) range for [panel filters,][grease filters,][35% efficient filters,][and roll filters],

.2 0-750 Pa (0-3 in wg) range for other filter banks,

.3 installation kit with static pressure tips and isolation valves.

Standard of Acceptance
- Dwyer 250AF Series inclined solid acrylic plastic manometer
- Dwyer Minihelic II or Magnehelic 2 -5000 Series diaphragm actuated direct reading dial type with A609 Filter Kit

3 EXECUTION

3.1 Filter banks

.1 Install in plenums, ducts, and air intakes as shown.

.2 Made up using one size of cell throughout. Mixed cells are not permitted.

3.2 Filter gauges

.1 Install for each bank of filters over 1900 l/s (4000 cfm) capacity and for each bank of "absolute" filters regardless of capacity.

.2 Provide separate gauges for “prefilter” and “final filter” where roll filters or 35% cartridge filters are located ahead of other filter banks.

.3 Install and pipe static pressure tips and isolating valves to allow calibration.

3.3 Filter protection and replacement

.1 Provide temporary roughing filters ahead of filter banks during initial operation of air handling systems.

.2 When building is turned over to Owner;

.1 remove temporary filters and ensure that filter banks are fitted with full sets of cartridges and media.

.2 install new, full sets of cartridges and media for any air filter banks used during construction and loaded to more than 125% of initial clean pressure drop.

END OF SECTION

CUSTOM AIR HANDLING UNITS
23 73 23

1 GENERAL

1.1 Scope

.1 Provide custom factory fabricated air handling units as shown.

1.2 Component Standards

.1 Unit components to comply with relevant sections of this Division.

1.3 Shop drawings

.1 Submit integrated shop drawing package with;

.1 unit layouts drawn to scale showing

(a) gauges and finishes of materials
(b) support and connection details,
(c) equipment weight
(d) component identification using numbering and type designations taken from contract drawings, specifications, and schedules, and
(e) component locations identified in plan and section.

.2 component shop drawings and manufacturer's data sheets in accordance with requirements set out in Specification Sections identified above showing;

(a) component identification,
(b) manufacturer’s equipment model numbers,
(c) component performance and design data,
(d) fan discharge and radiated sound power level,
(e) component outline dimensions, and
(f) power requirements,

.3 control and power wiring schematics.

.2 Incomplete package submissions will be returned for correction, without review.

1.4 Factory inspection

.1 After shop drawings have been reviewed and returned, arrange for factory inspection of [][first] unit being manufactured.

.2 Schedule inspection to allow shop floor review of;

.1 support base and drain pan construction

.2 unit framing,

.3 access door construction and mounting,

.4 internal and external casing panel attachment details,

.5 coil, humidifier and filter mounting details, and

.6 power and control wiring standards

.3 Make corrections and/or revisions identified in Inspection Report issued following factory inspection of unit before factory test and release for shipment to site.

.4 Transfer record of revisions to shop drawings and resubmit shop drawings for final review.

.5 Manufacture subsequent units in accordance with revised and reviewed final shop drawings.

1.5 Factory testing

.1 Conduct factory pressure test and flow test of assembled unit.

.2 Factory pressure test procedure;

.1 For centrifugal fan in blow through configuration and plenum type fans;

(a) temporarily seal off fan suction and supply duct connections and test downstream section under positive pressure;
(b) seal off fresh air and recirculation dampers on fan suction side and test upstream section under negative pressure.

.2 For centrifugal type fans in draw-through units;

(a) seal off fan discharge and fresh air and recirculation dampers and test unit under negative pressure.

.3 Use a calibrated orifice plate and blower unit to measure air leakage rate at test pressure.

.4 Pressure test air leakage to be not more than 1½ % of unit airflow capacity at 1.25 kPa (5 in) static test pressure.

.3 Factory flow test procedure;

.1 Connect supply discharge ductwork including minimum of two turning fittings and at least 3 m (10 ft) of straight ductwork with airflow measuring station in ductwork and balancing damper at end of ductwork to emulate system characteristics.

.2 Conduct tests for at least five points between shut-off and run-out at rated motor kW with fan speed appropriate for specified Point of Rating; Measure and record test data as follows;

(a) pressure drops across coils and filters
(b) fan inlet and discharge static pressure relative to test chamber,
(c) fan input kW
(d) fan supply air volume
(e) fan speed.

.4 Submit test report and plot of pressure flow characteristic on catalogue fan curve for review as shop drawing.

.5 Correct problems identified during factory performance testing prior to shipping.

2 PRODUCTS

2.1 General

.1 Factory assembled, from base, frame, casings, access doors, components such as fans, coils, filters, dampers, humidifiers, motors, belt and variable frequency drives, drip pans, eliminators, vibration isolation, silencers, inlet cowls, louvres, and accessories as shown and specified.

Standard of Acceptance
° Haakon

- MAFNA
- Ventrol

2.2 Materials

.1 Galvanized steel:

.1 ASTM A-527 lock-former quality

.2 ASTM A525-75 designation G90 class for unpainted surfaces,

.3 satin coat steel for painted surfaces.

.2 Stainless Steel:

.1 type 304/304L to ASTM A480 Specification for General Requirements for Flat Rolled Plate, Sheet and Strip

.3 Aluminum:

.1 Type 3003-H-14,

.4 Insulation:

.1 50mm (2") thick Mansville “Permacoate Linacoustic R-300" or AP/Armaflex SA Black acoustic duct liner

2.3 Unit construction

.1 Base frame:

.1 150 mm (6 in) welded structural steel or formed channels in ladder configuration with cross members at ends and under major equipment loads,

.2 fitted with lifting lugs, and

.3 designed to evenly distribute unit weight.

.2 Floor:

.1 reinforced, minimum 3mm (0.125 in) aluminum

.2 50 mm (2 in) insulation, with 0.8 mm (22 ga) bottom panel caulked and sealed.

.3 40 mm (1½ in) watertight collars around inside of perimeter of unit and around floor openings.

.3 Wall and roof construction:

.1 Exterior wall and roof constructed from insulated sandwich panels,

.2 50 mm (2 in) thick with tongue and groove or 'C' type jointing,

.3 maximum panel width 660 mm (26 in) in direction of air flow,

.4 fastened at 300 mm (12 in) centres to intermediate ribs and structural framing, reinforced and braced for rigidity,

.5 outer skin: 1.6 mm (16 ga), galvanized steel

.6 inner skin: 0.8 mm (22 ga), galvanized steel,

(a) perforated sheet, 22% open, in mixing plenums, filter sections and fan casings.
(b) solid sheet in sections with cooling coils, humidifiers or condensing heat recovery devices and for at least 900 mm (36 in) downstream of each of these sections.

.4 Interior partitions:

.1 1.6 mm (16 ga) thick single wall panel, reinforced for differential pressure across wall of 2.5 times pressure drop of component mounted in partition.

.2 joints mechanically fastened and sealed with caulking or gaskets.

.5 Blanking Plates:

.1 fitted around coils, dampers, filters and other components,

.2 secured between supporting frames for equipment and casing of air handling unit,

.3 gasketted or caulked and secured to components with stove bolts on 12" centres,

.4 fabricated from 0.8 mm (22 ga) stainless steel for cooling coils and condensing heat recovery units and from 0.8 mm (22 ga) galvanized steel in other locations.

.6 Drain Pans:

.1 1.6 mm (16 ga) 304 stainless steel, cross broken and double sloped to recessed bottom drain with drain pipe extended from side of floor pan, above top of base rail,

.2 50 mm (2 in) insulation, with 0.8 mm (22 ga) bottom panel caulked and sealed,

.3 drain size: 32 mm (1¼ in) NPT minimum size, FPT connection,

.4 locations: at fresh air intakes, in mixed air plenums, and as shown.

.7 Cooling coil drain pans:

.1 as above for drain pans and,

.2 75mm (3 in) sump, located above base rail

.3 located under cooling coil rack and extending 100 mm (4 in) upstream of coil entering side and minimum 100 mm (4 in) downstream of coil on leaving air side, and not less than 100 mm (4 in) from face of eliminators on leaving air side.

.4 locations: at cooling coils, condensing heat recovery units, and in humidification sections.

.8 Intermediate cooling coil drain pans:

.1 fitted under upper coils in a bank where coils are stacked,

.2 equipped with vertical stainless steel drain piping at each side of coil, discharging directly to bottom drain pan.

.3 extended at least 50 mm (2 in) upstream of coils on entering air side, 100 mm (4 in) downstream of coils on leaving air side, and not less than 100 mm (4 in) from face of eliminators on leaving air side.

.9 Supply duct connections:

.1 Plenum connections: radiused bellmouth type with radius equal to wall thickness.

.2 Centrifugal fan connections: internal flexible connection, and exterior companion flanges.

.10 Recirculation duct connections: exterior companion flange.

.11 Access doors:

.1 double wall construction, as described for wall panel [][but with solid inner liner,] fabricated with:

.2 1.6 mm (16 ga) formed channel trim with welded corners,

.3 mounted in matching 1.6 mm (16 ga) welded casing channel frame with continuous angle stop

.4 250 mm (10 in) round or 250 mm x 250 mm (10 in x 10 in) square, wired or tempered glass window, double glazed in sections subject to temperatures below 4.5°C (40°F).

.5 two Ventlok latches installed with handles on inside and outside of door.

.6 continuous stainless steel piano hinge or two butt hinges, welded to door and casing frame.

.7 continuous 13 mm closed cell hollow gasket with metal encapsulated, reinforced backing, mechanically fastened to door opening perimeter.

.8 Doors to open against pressure differential.

.9 Door height to be smaller of 1500 mm (60 in) or 200 mm (8 in) less than inside height of unit.

.10 Door width to be not less than [600 mm (24 in)][450 mm (18 in)], and fan section doors to be sized to permit motor removal.

.12 Casing finish

.1 Paint external galvanized surfaces with one coat of phosphate vinyl wash primer, finished with two part blend of bond primer and alkyd enamel paint. Finish colour to be selected from standard range of products submitted with shop drawings.

.2 Paint un-galvanized steel parts with corrosion resistant paint to CGSB 1-GP-181M + Amdt-Mar-78.

.3 Outdoor units to be primed with etch bond epoxy and painted with two coats of polyurethane paint, minimum 3 mils.

.4 Paint finish on outdoor units to be capable of withstanding US Federal Test Standard No. 141 (Method 6061) 500 hour salt spray test.

2.4 Unit sections

.1 Mixing box:

.1 integral part of unit

.2 fresh air and recirculation dampers mounted exterior to unit.

.3 parallel blade dampers: to Section 23 33 13 - Dampers - Operating;

(a) damper actuators provided under Section 25 35 01 - B.A.S. Instrumentation and Actuators.

.2 Stratification eliminator:

.1 Air blending devices to produce constant air temperature as measured across upstream face of chilled water coil with temperature variation not exceeding ±3°C (±5.4°F) from average face temperature.

.3 Filter sections:

.1 Filters arranged for upstream access for replacement.

.2 Mount filter gauges on side of unit, with sensing probes and shut off valves.

.3 Filter banks to be made up using 600 mm x 600 mm (24 in x 24 in) filter modules. Mixing of filter module sizes is not acceptable.

.4 Coils:

.1 Extend pipe connections for supply, return, vent and drain clear of unit side casing. Install sheet metal sleeve with grommets between at inner and outer casing walls to accommodate pipe and insulation.

.2 Casing panel sections to be removable and coil racks to be configured to permit individual slide-out withdrawal of each coil in bank.

.3 Coil support racks, welded;

(a) for cooling coils; type 304 stainless steel.
(b) for heating coils; galvanized steel.

.5 Moisture eliminators:

.1 Capped 3-bend, 2-hook style spaced on 30 mm (1¼ in) centres in sections not more than 315 mm x 610 mm (3 ft x 2 ft).

.2 Factory fabricated from 0.6 mm (24 ga) stainless steel with supporting frames and clips to permit removal.

.6 Humidifiers:

.1 locate and connect in accordance with humidifier manufacturer's instructions.

.2 minimum plenum length: 1500 mm (60 in).

.3 extend piping to exterior of unit. Install sheet metal sleeves with grommets between at inner and outer casing walls to accommodate pipes and insulation.

.4 install humidifier control panel and control components and pipe to humidifier manifold.

.7 Fan section:

.1 suction plenum braced to withstand negative static pressure, to be of sufficient width to provide ¾ fan wheel diameter clearance at centrifugal fan intakes, and of sufficient length to locate fan motor at least 610 mm (24 in) from leaving side of cooling coil drip pan.

.2 flexible connection to be mechanically fastened to fan casing/frame and unit walls with double plate fastenings and gaskets/sealant on both sides of flex connection.

.3 The overall vibration level on any of the bearing housings on the fans and motors taken in horizontal , vertical or axial direction shall not exceed 0.10 in/sec peak to peak . Any discreet frequency shall not have an amplitude exceed 0.03 in/sec peak to peak. Any discreet frequency above 15 times the rotating speed shall not exceed 0.098 in /sec. All vibration spectra to be taken with a maximum frequency of 120,000 cycle/sec.

.4 The Unit supplier is to provide an `On Site' fan vibration test, balance and report for all unit fans. The test, balancing, and report are to be by `Vibtech Analysis Ltd.' or `Fan Dynamics Ltd.'. Fans are to be balanced so that the tested fan vibration is less than that listed in paragraph a) above

.8 Plenums:

.1 plenums with access doors as shown.

2.5 Marine lights

.1 Installed In each section of unit provided with access door.

2.6 Fan starter

.1 Factory mount fan combination starter in recessed enclosure in fan section, with access door (without window) and ventilating louvres at top and bottom of enclosure.

.2 Provide a 50mm (2 in) threaded conduit fitting through wall adjacent to lower louvre for field power wiring.

2.7 Variable frequency drives

.1 Select drive, motor, electrical filters and accessories to match duty specified and installation configuration. Furnish written 3 year extended warranty to cover labour and materials for repair/replacement in case of motor burnout or drive failure.

.2 Factory mount variable speed drives in recessed enclosure in fan section, with access door (without window) and ventilating louvres at top and bottom of enclosure.

.3 Size enclosure to permit routing of field power wiring around unit.

.4 Provide a 50 mm (2 in) threaded conduit fitting through wall adjacent to lower louvre for field power wiring.

2.8 Factory wiring

.1 Provide factory wiring, and empty conduit as follows:

.1 wire and conduit between fan motor and junction box located on exterior of unit adjacent to fan plenum access door,

.2 wire and conduit between fan motor and variable frequency drive,

.3 wire and conduit for marine lights, wired to a single switch mounted on exterior of unit adjacent to fan plenum access door,

.4 32 mm (1¼ in) empty EMT conduit for control wiring, full length inside of unit with one (1) 100 mm x 100 mm (4 in x 4 in) junction box in each unit section, terminating in a NEMA 1 junction box outside of unit adjacent to fan plenum access door.

.5 conduit and wiring for control system, with minimum of one (1) 100 mm x 100 mm (4 in x 4 in) junction box in each section.

2.9 Factory DDC Control System

.1 Provide factory installed, wired and programmed Direct Digital Control (DDC) system, including instrumentation, in accordance with Division 25.

.2 Mount DDC controllers in Local Equipment Panels.

.1 where panel width is more than 600 mm (24 in) wide, provide double doors,

.3 Provide rough-in conduit to termination point on side of unit casing for network wiring connection to main Building Automation System.

.4 Factory test controls and provide test report with delivery of equipment, including instrument calibration reports.

2.10 Multi-section units

.1 Arrange with installation trades for multi-section units where limited site access or other restrictions prevent installation and/or shipping of units factory assembled. Confirm travel path and ensure unit sections fits through all openings.

.2 Prepare manufacturing and assembly drawings and identify sub-assemblies, parts shipped loose and assembly materials including insulation, sealants, fasteners and hardware.

.3 Prepare sequence of assembly showing hoisting, placing and fastening procedures.

.4 Obtain agreement from installing trades before proceeding to manufacture.

.5 Factory assemble, insulated and painted unit base sections with joining flanges where possible.

.6 For testing factory assemble base sections with fan, motor, and drive, protective screening, belt guards and isolation base and disassemble components and ship in pieces once satisfactory leakage and flow testing is complete.

.7 Pre-assemble and pretest electrical components, conduit, and wiring in each section at the factory.

.8 Conduit, power and control wiring, to interconnect sections, to be installed in field, after assembly is completed.

3 EXECUTION

3.1 Installation

.1 Place unit on structural supports, shim level, anchor base frame, and flash between unit base and roof curb.

.2 Connect piped services and ductwork as shown.

.3 Align fan shafts, belt drives and motors, adjust belt tension, remove shipping bolts, and check motor rotation before start-up.

.4 Protect motors and fans during construction and rotate fans, by hand, every month between delivery and acceptance of building.

.5 Adjust variable pitch fan/motor sheaves during balancing to achieve specified air quantities.

.6 Install deep seal P-traps on drain lines.

3.2 Field Wiring

.1 Wire final 300 mm (12 in) of motor power supply to exterior junction boxes in flexible conduit.

.1 Power supply to junction box provided under Division 26.

.2 Wire between 120 V junction box (provided under Division 26), and marine light switch/duplex outlet and humidifier control panel.

.3 Obtain electrical inspection permits and approval of the final assembly.

3.3 Additional installation requirements for Multi-section units

.1 Arrange for manufacturer's representative to supervise on-site unit assembly.

.2 Field assemble unit sections.

.3 Assemble the components as directed.

.4 Spot prime and refinish paint coat after assembly.

.5 Complete field wiring between sections for motors, lights and controls.

END OF SECTION

DUCTLESS SPLIT AIR CONDITIONERS
23 81 26

1 GENERAL

1.1 Scope

.1 Provide ductless split air conditioning units and heat pump units as shown.

1.2 Shop drawings

.1 Submit shop drawings for each condensing unit and evaporator with;

.1 equipment model number,

.2 outline dimensions,

.3 enclosure details,

.4 space requirements for service and maintenance,

.5 support arrangements.

.2 Provide rating information showing capacity and power input requirements for heating and cooling at full load.

.3 Provide diagrams showing;

.1 requirements for field assembly with air flows, connection pipe sizes and rated air flow,

.2 unit internal and external electrical power and control wiring with motors, starters, relays and interlocks identified, and with terminal and wire numbers marked.

1.3 Warranty

.1 Compressors to be warranted against failure for five (5) and warranty to include for labour and materials used in replacing compressors, and in cleaning, dehydrating and charging refrigeration system.

2 PRODUCTS

2.1 General

.1 Package system, factory assembled and tested with pre-charged refrigeration piping, refrigerant and oil charge.

.2 Ready for connection of electric power at evaporator unit and condensing unit and control wiring between units.

Standard of Acceptance

- Daikin
- Mitsubishi

2.2 Evaporator Unit

.1 Indoor evaporator unit;

.1 pre-charged direct expansion type cooling coil, arranged with counter flow between air and refrigerant,

.2 three speed fans statically and dynamically balanced,

.3 disposable filters for particulate and odour control,

.4 condensate pan draining to 20 mm (¾ in) side outlet connection.

.5 exposed: plastic enclosure with removable panels for servicing,

.6 conceaned: enamel sheet metal enclosure with access doors and concealed fasteners,

.7 concealed suspension brackets

.8 operating sound level less than 45dB(A)

2.3 Condensing unit

.1 Outdoor, air cooled, hermetic compressor;

.1 mounted on vibration isolators,

.2 air cooled condensing coil,

.3 condenser fans, motor starters, and controls,

.4 sheet metal enclosure with mounting lugs and fan safety grille primed and enameled to withstand 1000 hr salt spray test.

.5 low ambient operation to -22°C (-7°F)

.6 operating sound level less than 55dB(A)

2.4 Refrigerant circuit

.1 Piping, valves, fittings and related parts to CSA B52.

.2 Pipe insulation: 19 mm (¾ in) thick flexible elastomeric insulation on suction line.

2.5 Temperature control system

.1 Hard wired wireless battery operated electronic thermostat and control module to operate heating, and cooling in sequence in response to thermostat sensed temperature, with indication for;

.1 operating mode (heat/cool)

.2 compressor operation,

.3 no heat,

.4 touch sensitive key pad to allow hour/day operating program and adjustment of thermostat set point.

3 EXECUTION

3.1 Installation

.1 Install evaporator unit in space, route drain piping as shown.

.2 Install condensing unit with adequate clearance for service and maintenance.

.3 Run refrigeration suction and liquid piping as shown in accordance with manufacturer's instructions with respect to horizontal and vertical length limitations

.4 Charge systems and leak test in accordance with manufacturer's instructions

.5 Provide un-fused weatherproof disconnect on or adjacent condenser and evaporator units and run electric power and control wiring.

.6 As required, depending on manufacturer, sub-feed electrical power for evaporator unit from condenser unit.

.7 Provide sheet-metal wind-baffle shield on condenser as required by manufacturer's instructions for low ambient operation.

3.2 Start-up service

.1 Arrange for manufacturers' field representative to supervise installation, start-up system and instruct Owners operations and maintenance personnel.

END OF SECTION

COILS
23 82 16

1 GENERAL

1.1 Scope

.1 Provide coils and accessories as shown.

1.2 Shop drawings and product data

.1 Submit shop drawings for;

.1 drip pans and coil supports.

.2 Submit manufacturers product sheets with performance and installation data for;

.1 coils,

.2 moisture eliminators.

.3 Coil data to show;

.1 size (face area, tube length, and tube face),

.2 construction (tube material and size, fin material and spacing, header material and connection sizes, casing and tube support material),

.3 cooling or heating fluid performance (working pressure, fluid flow rate water, glycol or steam), circuiting, tube velocity, pressure drop, and entering and leaving fluid temperature water and glycol), and condensing pressure and condensate system back-pressure steam)),

.4 air side performance (air quantity, entering wet and dry bulb temperatures, leaving wet and dry bulb temperatures, air side pressure loss).

1.3 Quality and equivalence

.1 Coil selections are in general identified by model designations taken from manufacturers catalogues to indicate physical properties and quality standards not otherwise described.

.2 Companies, and/or trade names listed below are acceptable for various coil types, where products offered are essentially similar to those shown or identified by manufacturer or model number.

Standard of Acceptance

- Aerofin
- Trane
- McQuay
- York
- Carrier
- Heatcraft
- Engineered Air
- USA Coil & Air
- Coil Company[][
- RAE Corporation]
- Ventrol
- Marlo

1.4 Applicable codes and standards

.1 Pressure components:

.1 CRN registered as a pressure vessel or fitting as applicable to the province of installation, for coils installed in registered pressure piping systems.

2 PRODUCTS

2.1 Water and glycol coils in condensing and cooling service

.1 Tubes and fins:

.1 copper tubes with aluminum fins and complete coil dipped and baked for corrosion resistance.

.2 fin density: not more than 320 fins/m (8 fins/in),

.3 minimum fin thickness 0.19mm (0.0075”)

.4 maximum tube length: 3 m (10 ft).

.5 fitted with turbulators where water velocity in tube is less than 1.2 m/s (3.85 fps),

.6 tube supports of same material as casing.

.2 Headers:

.1 non-ferrous headers, with brazed tube connections,

.2 vent connection on inlet header and drain connection on outlet header.

.3 Casings:

.1 1.6 mm (16 ga) 304 stainless steel

.2 designed for bolting to other sections.

.4 Design criteria:

.1 minimum design pressure: 1340 kPa (200 psig) unless otherwise shown.

.2 factory tested with air under water at between 120 and 150% of design pressure.

.3 ratings certified by manufacturer to ARI Standard.

.4 selected for not more than 2.5 m/s (500 fpm) airside face velocity,

.5 fluid side pressure drop: maximum [][30 kPa (10 ft) for glycol coils and] 60 kPa (20 ft) for chilled water coils, unless otherwise shown.

.6 maximum tube velocity: 2.5 m/s (8 fps).

2.2 Water and glycol coils in heating service

.1 Tubes:

.1 copper tubes with aluminum fins

.2 fin density: not more than 640 fins/m (16 fins/in),

.3 maximum tube length: 3 m (10 ft).

.4 tube supports of same material as casing.

.5 fitted with turbulators where water velocity in coils is less than 1.2 m/s (3.85 fps)

.2 Headers:

.1 steel headers with brazed joints,

.2 vent connection on inlet header and drain connection on outlet header,

.3 Casings:

.1 [1.6 mm (16 ga) thick galvanized sheet steel][1.6 mm (16 ga) 304 stainless steel],

.2 designed for bolting to other sections.

.4 Design criteria:

.1 minimum design pressure: 1340 kPa (200 psig) unless otherwise shown.

.2 factory tested with air under water at between 120 and 150% of design pressure.

.3 selected for not more than 3.5 m/s (700 fpm) airside face velocity.

.4 fluid side pressure drop: maximum 30 kPa (10 ft) for glycol coils and 30 kPa (10 ft) for water heating coils, unless otherwise shown.

.5 maximum tube velocity: 2.5 m/s (8 fps).

.6 ratings certified by manufacturer to ARI.

2.3 Water Reheat/Booster coils for duct or terminal unit mounting

.1 Tubes:

.1 copper tubes with aluminum fins connected in serpentine fashion.

.2 fin density: not more than 640 fins/m (16 fins/in),

.3 maximum tube length: 750 mm (2 ft-6in).

.2 Casings:

.1 1.6 mm (16 ga) thick galvanized sheet steel designed for bolting to other sections.

.3 Design criteria:

.1 minimum design pressure: 1720 kPa (250 psig) at minimum 104°C (220°F).

.2 factory tested with air under water at between 120 and 150% of design pressure.

.3 selected for not more than 3.5 m/s (700 fpm) face velocity.

.4 fluid side pressure drop: maximum 9 kPa (3 ft) for glycol coils and 15 kPa (5 ft) for water heating coils.

.5 ARI ratings certified by manufacturer.

2.4 Non-freeze steam coils

.1 Tubes:

.1 tube-in-tube steam distributing type with aluminum fins,

.2 tubes mounted in tube supports with positive slope draining condensate into header at steam inlet end,

.3 horizontal coils, maximum tube length: 1.5 m (5 ft),

.4 vertical coils, same end, bottom connections, maximum tube length: 3 m (10 ft),

.5 fin density: not more than 120 fins/m (3 fins/in) for vertical snow-coil applications.

.2 Headers:

.1 steel, or cast brass headers,

.3 Casings:

.1 casings and tube supports of 1.6 mm (16 ga) thick galvanized sheet steel,

.4 Design criteria:

.1 minimum design pressure: 860 kPa (125 psig) saturated steam

.2 factory tested with air under water at 4.1 MPa (600 psi)

.3 ratings certified by manufacturer,

2.5 Moisture eliminators for coils in condensing and cooling service

.1 Construction:

.1 capped 3-bend, 2-hook style spaced on 30 mm (1 in) centres in sections not more than 315 mm x 610 mm (3 ft x 2 ft),

.2 factory fabricated from 0.6 mm (24 ga) stainless steel

.3 supporting frames and clips to permit removal of individual sections.

2.6 Drip pans for coils in condensing and cooling service

.1 Construction:

.1 1 mm (18 ga) stainless steel

.2 mounted under each coil where coils are mounted one above each other,

.3 continuous under each coil bank

.4 extend downstream of the coil to a distance at least one-half the height of the coil

2.7 Coil supports

.1 Construction:

.1 welded angle racks arranged and stiffened to allow withdrawal of individual coils,

.2 manufactured from 304 stainless steel for cooling (condensing) coils and structural steel for other coils.

.3 fitted with removable coil access panels insulated with 25 mm (1 in) of flexible elastomeric sheet.

2.8 Blanking plates

.1 Fabricated from 0.8 mm (22 ga) stainless

3 EXECUTION

3.1 Eliminators

.1 Provide eliminators on downstream side of cooling coils where velocity exceeds 2.5m/s (500 fpm).

3.2 Coil support frames

.1 In stacked coil arrangements, mount coils in coil support frames.

3.3 Drip pans

.1 Provide drip pan under each cooling[][, glycol exhaust][, heat pipe exhaust] coil section and install with positive slope to drain connection at low point.

.2 In stacked coil arrangements pipe upper drain pans into pan below with 40 mm (1½ in) copper pipe.

.3 Trap lowest coil drain pan in each coil bank and pipe to floor or hub drain with 40 mm (1½ in) copper pipe.

3.4 Blanking plates and casing connections

.1 Install blanking plates at entering or leaving air side of each coil and on both entering and leaving sides of cooling coils, to close bypass openings between coils, coil supporting frames and casings of air handling equipment.

.2 Provide gaskets for, or apply sealer or caulking to, connections between coils, blanking plates, coil supporting frames, and casings.

.3 Flange and bolt casings to single coils, coils support frames [][and spray sections] with 6 mm (¼ in) stove bolts at approximately 75 mm (3 in) centres or as determined by holes in flanges of equipment.

3.5 Drain and vent provisions

.1 Install water and glycol coils pitched toward connection end.

.2 Fit each vent and drain outlet with hose end packless valve with pipe cap.

END OF SECTION

HUMIDIFIERS
23 84 13

1 GENERAL

1.1 Scope

.1 Provide humidifiers as shown.

1.2 Shop drawings and product data

.1 Submit manufacturer's piping and wiring diagrams, and data sheets showing:

.1 capacities,

.2 absorption distances,

.3 recommended installation methods.

.2 Submit manufacturers data substantiating absorption distances with air leaving humidifier at 13°C (55°F) and 65%RH.

2 PRODUCTS

2.1 Steam injection humidifiers

.1 Single or multiple steam jacketed duct distribution manifolds across width of duct or plenum;

.1 normally closed modulating steam control valve,

.2 centrifugal type steam/water separator,

.3 factory installed [pneumatic][electric] valve actuator,

.4 number as follows:

Duct height mm (inches)	Number of Manifolds
0 to 950 (0 to 36)	1
950 to 1450 (36 to 60)	2
1450 to 2050 (60 to 80)	3
2050 to 2550 (80 to 100)	4
2550 to 3000 (100 to 120)	5
greater than 3000 (120)	Add additional humidifier

Standard of Acceptance

- Armstrong
- Dri-Steem
- Spirax Sarco - PMD
- Nortec
- Pure

2.2 Rapid absorption steam humidifiers

.1 Distribution panels with closely spaced steam dispersion tubes spanning between headers and mounted in galvanized steel casing;

.1 normally closed modulating steam control valve,

.2 centrifugal type steam/water separator,

.3 factory installed electric valve actuator,

Standard of Acceptance
- Dri-Steem - Ultra-Sorb
-

2.3 Reverse osmosis system

.1 Packaged, skid mounted system, consisting of:

.1 reverse osmosis unit,

.2 RO booster pump,

.3 activated carbon filter,

.4 pre-filter,

.5 RO storage tank,

.6 RO circulation pump,

.7 water quality meter,

.8 ultra-violet sterilizer,

.9 water softener,

.10 "clean-in-place" tank.

.2 Power requirements:

.1 single point power supply connection [120 VAC, single , 60 Hz][575VAC, 3ö, 60Hz],

.2 CSA Standard C22.2 No. 94.1 Type 2 enclosure containing starters, fused disconnects for each piece of electrical equipment not requiring a starter, and interlocked panel disconnect switch.

.3 Pre-filter:

.1 5 micron pre-filter in polypropylene housing, with removable, replaceable cartridge media.

3 EXECUTION

3.1 Installation

.1 Mount and fit units in accordance with manufacturer's instructions.

.2 Provide [hot][cold] water supply, minimum {6 mm (¼ in} size type K soft temper copper tubing with shut-off valve.

.3 Provide air gap or backflow preventer in inlet water line and air gap in drain line to each humidifier

.4 Connect overflow with drain line sloped 1 in 25, terminating over open drain.

.5 Install steam trap assembly, strainers, isolating valves, and connect up steam supply and condensate return.

.6 Locate steam generator close to and below distributors.

3.2 Supervision and Start-up

.1 Arrange and pay for services of trained representative of equipment manufacturer to supervise installation, wiring, set up, and testing of humidifier systems.

.2 At completion, manufacturers' representative is to instruct Owners operating personnel in operation and maintenance of humidifier systems.

END OF SECTION

BUILDING AUTOMATION SYSTEMS GENERAL
25 05 01

1 GENERAL

1.1 Scope

.1 Extend existing hospital Building Automation System (BAS) with Direct Digital Control (DDC), and Energy Management for new mechanical systems and interface with other microprocessor based building subsystems.

.1 During the tender period, the contractor must perform a site inspection of the place of work and surroundings as well as, areas where access would be considered reasonable and make a thorough investigation of as-built conditions to determine the scope of work required relating to existing controls equipment and main trunk locations, prior to submitting their tender price.

.2 Controls contractor is to include for all upgrades required to the existing system (including software/hardware/controllers/licenses/etc) as required to interface all new points and controllers into BAS.

.2 Provide programming and decommissioning for demolition of existing BAS headend including graphics, trends, and schedules.

.3 Include software and hardware, wiring, computing equipment in compliance with this specification.

.4 Products (including control devices, controllers, instrumentation, thermostats, etc...), controls strategies, and labeling scheme shall match base building standards.

.5 Interface with other microprocessor based building subsystems.

.6 Sequence of operations are documented on drawings.

1.2 Related Sections

.1 Building Automation System includes Sections:

.1 25 14 01 B.A.S. Equipment Controllers

.2 25 35 01 B.A.S. Instrumentation and Actuators

.3 25 90 01 B.A.S. Sequence of Operations

1.3 Equipment Supplied for installation under Other Sections

.1 Supply the following equipment for installation under other Sections of Division 20;

.1 automatic control valves,

.2 temperature wells for controllers and sensors provided under this Section,

.3 terminal unit controllers, actuators for volume dampers and velocity pressure sensors including transformers. Arrange and pay for shipping to terminal unit manufacturer's facility for factory installation.

.4 motorized dampers and actuators for motorized dampers and smoke dampers including associated end switches and relays.

1.4 Equipment Provided under Other Sections

.1 The following equipment is provided under other Sections of Division 20;

.1 liquid flow measuring devices

.2 steam humidifiers with automatic control valves

.3 unit heater and cabinet unit heater line voltage thermostats

.4 manual dampers, fire dampers, gravity dampers, and smoke dampers

.5 motorized dampers

1.5 Applicable standards

.1 ANSI/ASHRAE standard 135-2001 BACnet

.2 ANSI 709.1 Lonworks

.3 Interfacing Standard:

.1 Input/output devices to use ASCII (American Standard for Communication and Information Interchange) code and standard EI (Electronic Industry Association) interfaces.

.2 CSA T530: Building Facilities, Design Guidelines for Telecommunications (same as EIA/TIA 569).

.3 IEEE 802.3 Ethernet 10Base-T LAN.

1.6 Abbreviations and definitions

.1 The following definitions, abbreviations, and acronyms apply:

.1	AI	Analog Input: continuously variable value, usually a sensor, referenced to a controller
.2	AO	Analog Output: continuously variable value, usually a control signal to an actuator device, referenced to a controller.
.3	BI	Binary (digital) Input: a two-state (On-Off) value, usually associated with a switch or state, referenced to a controller.
.4	BO	Binary (digital) Output: a two-state (On-Off) value, usually associated with starting or stopping equipment or generating an alarm, referenced to a controller.
.5	BCU	Building Control Unit
.6	ECU	Equipment Control Unit
.7	FAS	Fire Alarm System
.8	GUI	Graphic User Interface: an LED, LCD or monitor display
.9	I/O	Input/Output
.10	LAN	Local Area Network
.11	NC	Normally Closed: position of device in a de-energized state.
.12	NO	Normally Open: position of device in a de-energized state.
.13	OWS	Operator workstation: a PC based server or computer
.14	Tier 1	High level network providing communication between BCU’s and workstations.
.15	Tier 2	Lower level network providing communications between ECU’s and BCU’s
.16	WAN	Wide Area Network

1.7 Manufacturers and Installers

.1 Provide BAS with DDC and Energy management for mechanical and electrical systems by an organization:

.1 specializing in design, installation, commissioning and service of [open protocol] DDC systems,

.2 having completed five (5) projects of similar size and complexity within the preceding five (5) years,

.3 employing certified journeymen experienced in this type of work.

Standard of Acceptance

- Johnson Controls *(Metasys)*

1.8 Continuity of Staff and Subcontractors

.1 Project Manager is to be nominated at time of shop drawing submission and is to remain involved with project, from shop drawing preparation through to Acceptance, unless request for change is submitted and approved.

.2 Subcontractors listed in preliminary design submission are to execute work defined as sublet in preliminary design document, unless request for change is submitted and approved.

.3 Requests for changes in staff, subcontractors, or extent of work subcontracted are to be submitted for approval and such approval is not to be unreasonably withheld.

1.9 Identification of non-conforming materials and equipment.

.1 Submit documentation at time of bid, identifying nature and extent of non-conformance and variances from specifications or referenced standards.

.2 Failure to submit this documentation at time of bid will be interpreted as confirmation that materials, workmanship, hardware and software will be in strict accordance with specifications and standards.

1.10 Licences and Ownership

.1 Ownership of, and licences for, hardware and software supplied or used for this project or for ongoing system operation, maintenance and modification to be registered, without restrictions, in Owner's name.

.2 This is applicable to System Software, Workstation Application Editors, and Controller Software.

.1 Licensing to permit an unlimited number of users to access system without additional fees.

.2 As of last day of warranty period, software is to be upgraded to current version or release.

.3 Project-developed software and resulting documentation to be treated as part of system and subject to these same requirements for ownership and licensing. This material includes;

(a) Project graphic images
(b) CAD generated record drawings
(c) Project database
(d) Project-specific application programming code and documentation.

1.11 Shop Drawings

.1 Submit one completely engineered and coordinated shop drawing package. Partial or incomplete submission of data and/or drawings will be returned without review.

.2 Submit shop drawings for designed elements;

.1 list of materials of equipment to be used indicating manufacturer, model number, and other relevant technical data.

.2 BAS riser diagram showing system controllers, operator workstations, network repeaters, and network wiring.

.3 single-line schematics and system flow diagrams showing location of control devices.

.4 detailed analysis of each Sequence of Operation from design documents, ready for development of actual programming code.

.5 Sequence of Operations to cover normal operation and operation under various alarm conditions applicable to that system.

.3 Submit shop drawings schedules for;

.1 control damper; spreadsheet type, to include separate line for each damper and columns for damper attributes.

.2 control valve; spreadsheet type, to include separate line for each valve and separate columns for valve attributes.

.4 Submit catalogue cut-sheets for;

.1 manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for equipment and hardware items as follows;

(a) Controllers (BCU's and ECU'S)
(b) Transducers/Transmitters and Sensors with
- accuracy data, range and scale information,
- one sheet for each device marked with applicable options. (Where several devices of same type are to be used, submit one sheet for each device, individually marked.)

(c) Actuators
(d) Valves
(e) Relays/Switches
(f) Panels
(g) Power Supplies
(h) Batteries
(i) Operator Interface
(j) Wiring and wiring accessories

.2 hardware data sheets for Operator Interfaces, local panels, and portable operator terminals.

.5 Submit supporting documentation:

.1 examples of graphics for Operator Interface [][to include;

(a) BAS network schematics
(b) typical terminal unit floor plan graphic that shows conditions on occupied floor
(c) typical equipment room floor plan graphic
(d) typical graphics for each system and terminal unitat least one sample graphic for each type of equipment,
(e) one sample graphic for chilled water system
(f) one sample graphic for hot water system
(g) description of techniques used for animation of information displayed on graphics].

.2 Software manuals for applications programs for Operator Interface, portable operator terminals, and programming devices.

.3 Protocol Implementation Conformance (PIC) statement for BACnet devices.

.4 Evidence that LonWork devices are LonMark approved and bear LonMark Logo.

.5 Where interfaces occur with control or wiring diagrams of other sections, obtain reproducible copies of these diagrams and revise to show terminal numbers at interface and include diagrams as part of interconnection schematic shop drawings.

1.12 Project schedules

.1 At time of shop drawing submission provide Gantt type Schedule of Work with;

.1 project broken down into discrete work items

.2 start date of each work item

.3 duration of each work item

.4 relationships between work items and showing constraints on work flow.

.5 planned delivery dates for ordered material and equipment with expected lead times.

.6 procedures.

.2 During design, installation and start-up of installation provide monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated Schedule of Work with each report.

1.13 Warranty

.1 At completion of Work, submit written guarantee undertaking to remedy defects in work for period of two (2) years from date of acceptance, which includes:

.1 rectification of control system failures attributable to defects in workmanship, materials, hardware, and software,

.2 Service Technician to arrive on site within 24 hours of warranty service request, to install and de-bug software patches, to replace defective parts, materials or equipment, and to provide incidental supplies, and labour for remedial work,

.3 Technician to remain in attendance until system is returned to operating condition.

.2 Submit similar guarantee for any part of work accepted by Owner, before completion of whole work.

2 PRODUCTS

2.1 General

.1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:

.1 Temperature - 0° to 32.2°C (32° to 90°F)

.2 Relative Humidity 10% to 90% non -condensing

.3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal.

.2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 Equipment standard

.1 Products and software: manufacturer/developer/supplier's catalogued current stock.

.2 This installation is not to be used as test site for newly developed product or software, without explicit written approval.

.3 Equipment and systems installed under this Contract to meet;

.1 performance specifications when subjected to VHF, UHF, FM, AM or background RFI as generated by commercial or private, portable or fixed transmitters that meet regulatory codes.

.2 Federal Communication Commission (FCC) Rules and Regulations, Part 15, Subpart J for computing devices.

2.3 General BAS architecture

.1 To match existing

2.4 General functional requirements

.1 To match existing

2.5 Performance

.1 To match existing.

3 EXECUTION

3.1 Examination

.1 Inspect site and thoroughly examine documents to establish locations for control devices and equipment and report discrepancies, conflicts, or omissions for resolution before starting rough-in work.

.2 Be responsible for correction of defects caused through neglect of inspections and examinations or failure to report and resolve discrepancies.

3.2 Existing equipment

.1 Existing equipment is not to be re-used. Cut back and remove all existing control wiring for all equipment being demolished. Remove all redundant points from B.A.S.

.2 Demolition and removals:

.1 Unless specifically noted or shown otherwise, remove existing control components made redundant:

(a) room thermostats, controllers, auxiliary electronic devices, pneumatic controllers and relays, control valves, electronic sensors, and transmitters, to be removed and placed in storage as directed by Owner.
(b) local control panels; removed and placed in storage as directed by Owner.

.2 remove and dispose of existing conduits, wiring and tubing in exposed areas as they become redundant,

.3 remove existing control compressed air systems and connect to new control air system;

(a) existing hardwired interlocks to remain installed in systems.

.3 in existing areas not otherwise involved in renovations, arrange and pay for holes and marks left by decommissioning and removal of control components, wiring, conduit, and tubing to be patched and refinished to match existing

3.3 Existing System Operation.

.1 Mechanical systems to remain in operation and to maintain space conditions between hours of 6 a.m. and 9 p.m., Monday through Friday.

.2 In these periods mechanical control system shut downs of up to 15 minutes may be permitted, after obtaining written agreement from Owner.

.3 When time required for cut-over of controls will not meet these constraints, perform work outside of operating hours after making application; outlining areas affected; and likely length of interruption, and obtain written agreement from Owner. .

.4 Maintain fan scheduling using existing or temporary time clocks or control systems throughout period of control system installation.

.5 Modify existing starter control circuits to incorporate hand-off-auto control of existing starters for motors to be controlled through BAS system.

3.4 Protection

.1 Protect work and material against damage during construction and be responsible for work and equipment until inspected, tested, and accepted.

.2 Protect material not immediately installed and close open ends with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

.3 Protect electronic equipment from elements during construction.

3.5 Coordination

.1 Coordinate and schedule control work with other work in same area to ensure orderly progress.

.2 Testing and balancing:

.1 Supply set of tools for Testing and Balancing Technicians to interface to control system, train these technicians in use of tools and provide qualified Control Technician to assist with testing and balancing first 10 terminal units.

.2 Tools to be turned over to Owners on completion of testing and balancing.

.3 Controls work by others:

.1 Integrate and coordinate this control work with controls and control devices provided or installed by others.

.2 Each supplier of control product to configure, program, start up, and test that product to satisfy requirements of Sequence of Operation regardless of where within contract documents product is specified or described.

.3 Resolve compatibility issues between control products provided under this section and those provided under other sections or divisions of this specification.

3.6 General Workmanship

.1 Installation to be performed by skilled and certified technicians.

.2 Install equipment, piping, and wiring or raceways horizontally, vertically, and parallel to building lines.

.3 Provide sufficient slack and flexibility in connections to allow for vibration isolation between conduit, raceways, piping and equipment.

.4 Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

.5 Install instrumentation and devices in locations providing adequate ambient conditions.

.6 Protect components placed in areas of potentially high humidity.

3.7 Cleaning

.1 Clean up debris, remove packaging material, collect waste and place in designated location, on a daily basis.

.2 Keep work areas free from dust, dirt, and debris.

.3 On completion of work, check finish of equipment provided under this section for damage and repair damaged factory-finished paint, replace deformed cabinets and enclosures with new material, and repaint to match original.

3.8 Field Quality Control

.1 Ensure work, materials, and equipment comply with this specification and approved shop drawings.

.2 Monitor field installation for code compliance and workmanship quality.

.3 Arrange and pay for inspections by local or provincial authorities having jurisdiction.

3.9 Wiring

.1 Electrical materials, equipment and installation procedures under to conform to Ontario Electrical Safety Code as amended to date and standards established in Division 26.

.2 Conduit:

.1 thin wall (EMT) conduit up to and including 32mm (1/1/4 in) size for exposed wiring up to 3 m (10 ft) above floor level,

.2 rigid galvanized steel conduit in locations accessible to public, subject to mechanical injury, or outdoors; and for conduit 40mm (1 ½ in) size and larger,

.3 watertight compression fittings in exterior locations.

.3 Run conduit and raceways parallel to building lines and be secured to building structure.

.4 Wiring not to be installed in conduit to be installed parallel to building lines and be secured to building structure with clips at minimum 3m (6 ft) centres. Where possible, wiring to run above corridors and in service spaces.

.5 Wiring in return air ceiling spaces to be plenum rated.

.6 Where conduit leaves heated areas and enters unheated areas, seal conduit.

.7 Provide interposing and motor control relays at local item of equipment or at associated MCC as applicable.

.8 Provide 120 VAC wiring as needed to support operation of system networking hardware, field panels, and controllers. Refer to Section 20 05 13 for description of division of work and responsibility.

.9 Provide control transformers for system components requiring power supply that do not have integral control transformers.

.10 Where point schematics and specifications indicate auxiliary contact provision, provide instrumentation, wiring, conduit, power supplies and services as to integrate these points into BAS.

.11 Mount transformers in enclosures. [

3.10 Identification of Equipment

.1 Identify discrete items of equipment with plastic nameplates, identifying equipment and function.

.2 Identification plates are in addition to manufacturers plates.

.3 Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.

.4 Identification plates:

.1 provided for equipment identified with number designations in schedules and equipment shop drawings.

.2 marked with equipment type, number and service following wording and numbering used in contract documents and shop drawings

.3 laminated plastic

.4 white face and black centre

.5 minimum size 75 mm x 40 mm x 3 mm (3 in x 1½ in x c in),

.6 engraved with 6.5 mm (1/4 in) high lettering.

.7 securely attached to equipment.

.5 Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 50 mm (2 in) of termination.

.6 Permanently label or code each point of field terminal strips to show instrument or item served.

.7 Label each control component with permanent label. Label plug-in components so that label remains stationary during component replacement.

.8 Label room sensors related to terminal boxes or valves with nameplates. Place labels on back of sensors.

.9 Identify starters that are interfaced to BAS system with self adhesive labels, white letters on red background as follows;

W AR N I N G

THIS EQUIPMENT IS OPERATING UNDER AUTOMATIC CONTROL AND MAY START OR STOP AT ANY TIME WITHOUT WARNING. SWITCH DISCONNECT TO "OFF" POSITION BEFORE SERVICING.

.10 Submit samples of labels and nameplates for review prior to installation.

3.11 Acceptance

.1 After tests described in this specification are performed satisfactorily and checklists and reports are submitted and approved, certify acceptance of control system including:

- .1 Control system checkout and testing
- .2 Control system demonstration
- .3 Training
- .4 As-built documentation

.2 Certification document may identify tests that cannot be performed due to extenuating circumstances such as weather conditions. Append program to certification document for rectification and completing these tests during warranty period.

3.12 Control System Checkout and Testing

.1 Provide schedule for start-up testing.

.2 Calibrate and prepare for service; equipment, instruments, controls, and accessories.

.3 Start-up testing to verify substantial completion of control system before system demonstrations begin.

- .1 Verify that control wiring is connected and free of shorts and ground faults. Verify that terminations are tight.
- .2 Enable control systems and verify input device calibration.
- .3 Verify that binary output devices operate and that normal positions are correct.
- .4 Check control valves and automatic dampers for proper action and closure and adjust valve stem and damper blade travel.
- .5 Verify that analog output devices are functional, that start and span are correct, and that direction and normal positions are correct.
- .6 Verify that system operates according to Sequences of Operation. Simulate changes in variables by overriding and varying inputs and schedules and observe and record each operational mode response.
- .7 Tune PID loops and control routines.
- .8 Check each alarm with an appropriate signal at value that will trip alarm.
- .9 Trip interlocks using field contacts to check logic and to ensure that actuators fail in proper direction.

.10 Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

.4 Prepare and submit log documenting start-up testing of each input and output device and each control routine, with technician's initials certifying each device and each routine is functioning correctly and sensors have been calibrated. Include list of deficiencies, if any, and schedule setting out rectification program with time lines.

3.13 Control System Demonstration

.1 Obtain approval of start-up testing log and rectification program before scheduling demonstrations.

.2 Provide notification not less than 10 days before system demonstration begins.

.3 Demonstration to follow previously submitted and approved procedures;

.1 submit checklists and report forms for each system as part of demonstration,

.2 lists and forms to have initials of technicians conducting demonstrations,

.3 date of each demonstration and signatures of Owner's representatives witnessing each demonstration section.

.4 Prior to acceptance, perform following tests to demonstrate system operation and compliance with specification after and in addition to tests specified above in Control System Checkout and Testing.

.5 Show field operation of;

.1 each Sequence of Operation.

.2 Operator Interface

.3 DDC loop response with graphical trend data output showing

(a) Each DDC loop response to set point change producing an actuator position change of at least 25% of full range.
(b) Trend sampling rate to be from 10 seconds to 3 minutes, depending on loop speed.
(c) Loop trend data to show set point, actuator position, and controlled variable values.
(d) Documentation of further tuning of any loop that displays significantly under- or over-damped control

.4 Demand limiting routine with trend data output showing demand-limiting algorithm action;

(a) trend data to document action sampled each minute over at least 30-minute period and to show building kW, demand-limiting set point, and status of set-points and other affected equipment parameters.

.5 Building fire alarm system interface.

.6 Trend logs for each system point with;

(a) trend data to indicate set-points, operating points, valve positions, and other data as specified in points list provided with each Sequence of Operation,
(b) each log to cover three 48-hour periods and to have sample frequency not less than 10 minutes,
(c) show that Logs are accessible through operator interface and can be retrieved for use in other software programs.

.7 Substantiate calibration and response of any input and output points requested.

.8 Provide at least two technicians equipped with two-way communication.

.9 Provide and operate test equipment to establish calibration and prove system operation.

.6 Tests that fail to demonstrate system operation to be repeated after repairs and/or revisions to hardware or software is completed.

.7 Project record Submittals.

.1 Submit three copies of project record documents and obtain approval during acceptance procedures.

.2 Submit inspection certificates.

.3 Certificate of Acceptance to be withheld until Submittals are approved.

3.14 Training

.1 Materials:

.1 Provide course outline and materials for each class at least six weeks before first class.

.2 Provide training through instructor-led sessions, with computer-based, or web-based techniques.

.3 Instructors to be factory-trained and experienced in presenting this material.

.4 Perform classroom training using network of working controllers representative of installed hardware

.2 Operating staff training:

.1 Provide training for Owners operating staff using abovementioned training materials in self-paced mode, web-based or computer-based mode, classroom mode, or combination of these methods.

.2 Allow for 3 repeat sessions for each category to cover operator shift rotation.

.3 Training to enable students to accomplish following objectives.

.1 Group 1:

(a) Proficiently operate system
(b) Understand control system architecture and configuration
(c) Understand BAS system components
(d) Understand system operation, including BAS system control and optimizing routines (algorithms)
(e) Operate workstation and peripherals
(f) Log on and off system
(g) Access graphics, point reports, and logs
(h) Adjust and change system set-points, time schedules, and holiday schedules
(i) Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
(j) Understand system drawings and Operation and Maintenance manual
(k) Understand project layout and location of control components
(l) Access data from BAS controllers
(m) Operate portable operator's terminals

.2 Group 2:

(a) Create and change system graphics
(b) Create, delete, and modify alarms, including configuring alarm reactions
(c) Create, delete, and modify point trend logs (graphs) and multi-point trend graphs
(d) Configure and run reports
(e) Add, remove, and modify system's physical points
(f) Create, modify, and delete application programming

(g) Add operator interface stations
(h) Add new controller to system
(i) Download firmware and advanced applications programming to controller
(j) Configure and calibrate I/O points

.3 Group 3:

(a) Maintain software and prepare backups
(b) Interface with job-specific, third-party operator software
(c) Add new users and understand password security procedures

.4 Divide presentation of objectives into three sessions:

.1 Group 1: Day-to-day Operators.

.2 Group 2: Advanced Operators

.3 Group 3: System Managers and Administrator

.4 Participants will attend one or more of sessions, depending on knowledge and expertise level required.

.5 Provide each student with one copy of training material.

3.15 Submittals for Acceptance

.1 Provide system documentation at time of acceptance.

.2 As-built drawings;

.1 As-built interconnection wiring diagrams, or wire lists of field installed system with identified, ordering number of each system component and service.

.2 Floor plans with accurate depiction of location of system devices, controllers, and trunk wiring. Drawings to be constructed using Architectural backgrounds provided .

.3 Provide 2 copies on CD-ROM of above drawings in AutoCAD Release 2000 format without compression.

.4 Provide 5 full size hard copies of floor plan drawings.

.3 Operation and Maintenance (O&M) Manuals:

.1 Provide two paper copies of material and five copies on CD-ROM in Adobe PDF format.

.2 Describe operation, maintenance and servicing requirements of system and associated equipment.

.3 Provide following information in separate sections, each with an index.

(a) Service and parts;
- Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
- List of recommended spare parts with part numbers and suppliers.

(b) System description;
- English language outline of BAS system and system architecture
- As-built versions of shop drawing product data.
- Reduced size (11 in x 17 in) copies of record drawings
- Graphic files, programs, and database on magnetic or optical media.
- Licenses, guarantees, and warranty documents for equipment and systems.

(c) Technical literature for equipment, including;
- catalogue sheets,

- calibration, adjustments and operation instructions,
- installation instructions,
- hardware and software manuals, with information supplied by original product developer, on application programs and on computers and controllers supplied
- Operator's manual with procedures for operating control systems; logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set-points and variables.
- Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
- Original-issue documentation with installation and maintenance information for third-party hardware including computer equipment and sensors.
- Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- Programming manual or set of manuals with description of programming language and syntax, explanation of statements for algorithms and calculations used, procedures for point database creation and modification, documentation of techniques for program creation and modification, and instructions for use of editor.
- Documentation of programs created using custom programming language including set-points, tuning parameters, and object database. Electronic copies of programs to modify and create control logic, set-points, tuning parameters, and objects that can be viewed using programming tools.

.4 Original Software:

.1 Furnish one original set of application and system software on original media. Disks to bear manufacturer's label. Field copies are not acceptable.

.2 Original-issue copies of software to include operating systems, custom programming language, application generation, graphic support, maintenance support, operator workstation or web server software, and other utilities provided in support of installed system.

3.16 Correction After Completion

.1 After start-up, testing, and commissioning phase when satisfactory and reliable operation of equipment and systems has been demonstrated, acceptance to be certified. Guarantee period to begin on date established on certificate of acceptance.

.2 Provide (supply, install, de-bug and commission) updates and patches to resolve software deficiencies in operator workstation or web server software, project-specific software, graphic software, database software, and firmware during guarantee period.

.3 Provide (supply, install, de-bug and commission) upgrades that improve routines and procedures of operator workstation software, web server software, project-specific software, graphic software, or database software, free of charge, during guarantee period .

.4 Provide details of proposed changes and obtain written authorization before installation of updates, patches, or upgrades.

.5 Include preventative maintenance, with allowance for spare parts, labour, and emergency (24 hour) service for system and equipment during guarantee period.

.6 Equipment manufacturers to submit written undertakings to make circuit board repairs and provide spare parts, software support and patches, and technical assistance for at least five years after acceptance is certified.

END OF SECTION

B.A.S. EQUIPMENT CONTROLLERS
24 14 01

1 GENERAL

1.1 Scope

.1 Provide Equipment Controllers (“ECU”) for Building Automation System.

2 PRODUCTS

2.1 General

.1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:

.1 Temperature - 0E to 32.2EC (32E to 90EF)

.2 Relative Humidity 10% to 90% non -condensing

.3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal,

.4 Operating voltage: operate at 90% to 110% of nominal voltage rating and to perform an orderly shutdown below 80% nominal voltage,

.5 Operation to be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

.2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 Equipment Controllers - General

.1 ECU’s separated into two types: Programmable, and Configurable.

.2 General:

.1 stand-alone, multi-tasking, multi-user, real time digital processors with hardware, software, and communications interfaces, power supplies, and input/output modular devices.

.2 removable (hot swapable) without disconnection of terminals and wiring,

.3 have access to data within network to accomplish global control strategies.

.4 support firmware upgrades without need to replace hardware and to have spare capacity for I/O.

.5 continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.

.6 monitor status of overrides and inform operator if automatic control has been inhibited, and allow operator to manually override automatic or centrally executed inhibit command.

.3 Input/Output points:

.1 hardwired inputs and outputs to tie into system through various Equipment Control Units (ECU’s).

.2 protected such that shorting of point to itself, shorting of point to another point, or shorting of point to ground will not damage controller.

.3 protected such that voltage spikes of up to 24 V, of any duration, and any polarity will not damage controller.

.4 Analog input: compatible with, and field configurable to commonly available sensing devices using low voltage signals (0 -10 VDC), current signals (4 -20 ma), or resistance signals from thermistors or RTD.

.5 Analog output: in form of modulating electronic signal, either voltage mode (0 -10VDC) or current mode (4 -20mA).

.6 Digital inputs: allow monitoring of on/off signals from remote devices. Digital inputs to provide wetting current of at least 12 ma and to be compatible with commonly available control devices.

.7 Digital outputs: provide on/off operation, or pulsed low voltage signal for pulse width modulation control. Digital outputs to be relays, 24 Volts AC or DC maximum, having 3 Amp maximum current. Each relay to be configured as normally open or normally closed, and either dry contact or bussed.

.8 Universal inputs: Thermistor Precon Type II, dry contacts, or 0 -5VDC with 0 -10K Ohm input impedance.

.4 Spare I/O capacity, each ECU:

.1 minimum of 15% spare I/O point capacity for each point type found at each location.

.2 15% of each type if input points are not universal,

.3 15% of each type if outputs are not universal,

.4 Minimum of one spare is for each type of point used.

.5 Future use of spare capacity to involve provision of field device, field wiring, point database definition, and custom software. These spare points to be configurable without additional controller boards or point modules. Wiring connections to be made to field-removable, through modular terminal strips or termination cards connected by ribbon cable.

.5 Time Clock:

.1 Controllers that perform scheduling operations to have on board real-time clock.

.2 In network application, time clock synced to associated BCU.

.6 Communications:

.1 communication port (RS-232 DB-9, RJ-11 or RJ-45) for connection to laptop computer or operator interface device to allow memory downloads and other commissioning and troubleshooting operations.

.2 communication services over BAS networks to support operator interface performance, and value passing as follows;

(a) connection of an operator interface device to any one controller on network to allow operator to interface with other controllers as if that interface were directly connected to those other controllers.
(b) data, status information, control algorithms, inputs, outputs, etc., from any controller on network is to be available for viewing and editing through operator interface device that is connected to any controller on network.
(c) links to execute control strategies to be programmed and tested so that an operator with appropriate password privileges is able to edit these links either by typing in standard object addresses, or by using simple point and click commands.
(d) daily routine automatically synchronize time clocks in controllers. An operator initiated change to master time clock setting to be automatically broadcast to other controllers on network.
(e) minimum baud rate for peer-to-peer communication between controllers in system LAN to be at 10 Mbps and communication with low level controllers, to be at 76 Kbps.

.7 Power interruption:

.1 continue to provide control functions in event of network communication failures.

.2 incorporate sufficient non-volatile memory to store critical configuration data in event of loss of normal power, and sufficient battery backup to support real time clock and volatile memory for minimum of 72 hours.

.8 Memory:

.1 sufficient memory to support its own operating system, including data sharing.

.9 GUI:

.1 face mounted LED type annunciation to display operational mode, and power and communication status.

.10 Tier 2 LAN:

.1 ECU's reside on either ARCNET or MS/TP physical data link layer protocol to provide BACnet internetworking, or reside on LonTalk FTT -10 network and provide data using LonMark standard network variable types and configuration properties.

.11 BACNet devices, Tier 2 Network;

.1 Conformance Class 3,

.2 support the BACnet functional groups for

(a) Change-of-Value (COV) Event Initiation,
(b) Change-of-Value (COV) Event Response,
(c) Event Initiation,
(d) Event Response,

.3 support the BACnet standard application services of;

(a) Read Property,
(b) Write Property.

.4 support the standard BACnet object types of;

(a) Device,
(b) Analog Input,
(c) Analog Output,
(d) Analog Value,
(e) Binary Input,
(f) Binary Output and Binary Value,
(g) Loop,
(h) Multi-State Input,
(i) Multi-State Output,
(j) Notification Class at a minimum.

.5 The described functionality provides reading and writing of all analog or digital inputs and outputs between BACnet devices on the network and provides for change-of-value initiation and reporting.

.12 LonMark/LonWorks devices, Tier 2 Network:

.1 LonMark or LonWorks devices must be networked from LonTalk to an Ethernet Datalink and IP data structure.

.2 Binding of LON devices including Domain, Subnet, Node ID, and SNVT's (Standard Network Variables Types) structure and Standard Objects and Functionality Profiles.

.3 Configuration of network variables for IP tunneling to be responsibility of LON device supplier.

.4 Supplier of LON devices to arrange and pay for inclusion of Echelon's proprietary LNS Services and LON Manager in software packages.

2.3 Equipment Control Unit (ECU) - Programmable

.1 General:

.1 capable of stand-alone, microprocessor-based operation.

.2 fully programmable controller for larger equipment and small systems such as hydronic air handling system, simple chiller or boiler plants, cooling towers and pumps.

.3 support firmware upgrades without need to replace hardware and to have minimum of 15 percent spare capacity of I/O functions.

(a) type of spares to be in same proportion as implemented functions on controller, but in no case there to be less than one point of each implemented I/O type.

.4 continuously perform self-diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.

2.4 Equipment Control Units (ECU) - Configurable

.1 General:

.1 capable of stand-alone, microprocessor-based operation.

.2 purpose-built for specific application to which they are applied, including;

(a) terminal unit (VAV, CAV, FPVAV) box,
(b) unit heaters,
(c) fan coils,
(d) rooftop unit
(e) local reheat zones
(f) free-standing fans

.3 Optically isolated from other controllers on communication loop.

.4 Memory: maintain all BIOS and programming information in the event of a power loss for at least 90 days.

.2 Air terminal units (VAV, CAV and FPVAV boxes):

.1 integral damper electronic actuator on terminal unit controllers.

.2 auxiliary universal I/O points for control of reheat coil hot water control valve or SCR electric reheat coil, and a second zone (perimeter) heating control valve or SCR electric baseboard heater.

(a) 0-10 VDC, or 4-20 mA outputs

.3 factory calibrated velocity pressure sensor,

.4 calibration data stored in EEPROM memory for at least 15 velocity/pressure points within terminal unit range,

.5 terminal units ECU delivered to terminal unit manufacturer's factory for installation.

.3 Local zone control:

.1 wired to wall mounted temperature sensor with jack-style communications wiring.

2.5 Equipment Controller Software

.1 General:

.1 applications software for building systems operation and monitoring and energy management to reside and operate in system controllers (ECU's),

.2 using and editing of applications to be available to an operator with appropriate authorization, through operator workstation/browser interface or at other engineering workstations,

.3 software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:

(a) BACnet
(b) LonTalk
(c) MODBUS
(d) OPC
(e) SNMP

.4 Memory resident and available to the programs a full library of DDC algorithms, intrinsic control operators, arithmetic, logic, and relational operators for implementation of control sequences.

.5 Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self learning).

.6 Adaptive Control algorithm used on control loops, as indicated in the I/O summary, where the controlled medium flow rate is variable (such as VAV units and variable flow pumping loops).

.7 Adaptive control algorithm monitor the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm operates in a continuous self learning manner and retains in memory a stored record of the system dynamics so that on system shutdown and restart, the learning process starts from where it left off and not from ground zero.

.8 Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.

.9 Make available DDC setpoints, gains and time constants associated with DDC programs to the operator for display and modification via the central operator interface and portable operators terminal.

.10 Adjustable execution interval of each DDC loop from two to 120 seconds in one second increments.

.11 Assignment of initialization values to all outputs to assure that controlled devices assume a fail safe position on initial system start up.

.2 Configurable ECU programming:

.1 Series of user selectable and configurable pre-programmed control functions.

.2 Control parameters field adjustable during balancing to compensate for variations in terminal unit installation, type and size.

.3 Software application programs:

.1 Scheduling

(a) capable of scheduling each object or group of objects.
(b) separate schedules for each day of week with up to five start/stop pairs. (10 events)
(c) exception schedules defined up to year in advance and once events on exception schedule day have been executed, definition of the exception schedule day will be discarded and replaced by standard schedule for that day of week.
(d) up to 24 holiday schedules may be placed on scheduling calendar and will be repeated each year.

(e) ability to override programmed start/stop based on outside temperature reaching or exceeding an adjustable value, operator initiated, individual for each system

.2 Optimal Start/Stop

(a) Delay startup of each HVAC system to latest possible time which will allow building space to reach target conditions occupancy time
(b) Also advance shutdown of each system to earliest possible time.
(c) Include modeling techniques using building mass temperature and outdoor air temperature to predict building warm up and cool down times under different outdoor and indoor conditions.
(d) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.3 Temperature based load control

(a) Provide temperature setback or set up according to programmed occupancy schedules with capability to assign separate schedules to each control zone.
(b) Control of setback or set up achieved through setpoint adjustment, cycling of systems or cooling plant temperature conditions occupancy time
(c) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.4 Supply air reset

(a) Monitor heating and cooling loads in building spaces and adjust HVAC discharge sensors to most energy efficient levels which will still satisfy measured load. zone.
(b) Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.

.5 Enthalpy Economizer:

(a) Program to control outside and return and exhaust air dampers during the cooling season based on inside and outside enthalpy comparisons.
(b) modulate dampers to mix outside and return air for free cooling whenever outside temperature is less than the supply air temperature setpoint
(c) Use either return or outdoor air to effect smallest enthalpy change across the cooling coil whenever outside temperature is above the supply air setpoint.

.6 Grouping of objects

(a) able to group together objects associated with equipment based on function and location so that group may be used for scheduling, logging, assigning global commands and other applications.
(b) at a minimum, assemble the following groups;
- each air handling unit and objects from all terminal units controllers associated with the specific air handling unit

(c) assemble other groups as directed by the Consultant, Commissioning Agent and Client

.7 Alarms

(a) each binary input and binary value object capable of generating an alarm based on an operator-specified state and to have capability to enable or disable this alarm.
(b) each analog object capable of generating an alarm based on an operator-specified high and low alarm limit and to have capability to enable or disable this alarm.
(c) delivered with alarms enabled as listed in Sequences of Operation.

.8 Electrical demand management

(a) capable of managing electrical demand by monitoring power consumption from signals received from pulse generator provided by others mounted at building power meter or from watt transducer or current transformers attached to building electrical feeder lines.

(b) If power consumption exceeds operator definable levels, system to be capable of automatically adjusting set-points, de-energizing low priority equipment, and taking other pre-programmed actions as described in Sequences of Operation to reduce demand.
(c) If demand drops below operator defined levels, action will be taken to restore loads in predetermined order.

.9 Maintenance Management.

(a) able to monitor equipment status and generate maintenance alarms based upon user-designated run-time, starts, or performance limits.
(b) configured to deliver maintenance alarms based upon Sequences of Operation.

.10 Sequencing.

(a) able to sequence chillers, boilers, and pumps with lead, lag, standby, priority assignment based upon run time,
(b) configured as specified in Sequences of Operation.

.11 PID Control.

(a) PID (proportional-integral-derivative) algorithm with direct or reverse action, controlled variable, set point, and PID gains user-selectable.
(b) this algorithm to calculate time-varying analog value that is used to position an output object or stage series of output objects.
(c) integral windup protection as a fundamental part of PID algorithm.

.12 Staggered Start.

(a) able to prevent controlled equipment from restarting simultaneously on power restoration after power outage.
(b) user-selectable sequence to establish order in which equipment (or groups of equipment) is started, and time delay between starts.

.13 Energy Calculations.

(a) calculation routines to establish and accumulate instantaneous power demand in kW, flow rates in L/s temperature differences in CE and convert information to energy usage data.
(b) two algorithms;
- first one calculates sliding window average with operator specified window intervals.
- second one calculates fixed-window average with digital input signal to define start of window period and synchronize fixed-window average calculation with start time used by utility.

.14 Anti-Short Cycling.

(a) routines to protect binary output objects from short cycling with operator selected on-time and off-time minimums.

.15 On/Off Control with Differential.

(a) direct-acting or reverse-acting algorithm that cycles binary output object based on operator selected controlled variable, set point and differential.

.16 Run-Time Totalization.

(a) calculation routine that totalizes run-times for any binary input or object with operator selected high runtime alarms.
(b) delivered with run time totalization and alarms configured as specified in Sequences of Operation.

3 EXECUTION

3.1 General

.1 Provide ECU's for control and instrumentation strategies as detailed in sequence of operation, and as shown.

.2 Provide custom programming to meet the control strategies as called for in the sequence of operation sections.

.3 Install equipment in accordance with manufacturer's recommendations.

.4 Mount units on modular channel frames (Unistrut or equivalent) adjacent to equipment being controlled.

.1 for free-standing frames, provide cross bracing and spread footing to withstand a horizontal seismic force equal to 150% of weight of ECU and support frame.

.2 ECU's may be mounted directly to fixed building elements, including columns and walls.

.3 Do not mount or attach ECU or mounting frames to any equipment subject to vibration.

.5 Install piping securely anchored to structure or equipment.

.6 Make power connections to controller units and sensors.

3.2 Tier 2 LAN device density

.1 Total number of devices on each Tier 2 LAN not to exceed 80% of maximum device limitations (with the use of repeater devices).

3.3 ECU database

.1 Configure each ECU and provide database to include:

.1 Terminal unit box type,

.2 Terminal unit box size,

.3 minimum and maximum air flows,

.4 reheat air flow: minimum turndown air flow prior to use of reheat,

.5 current air flow,

.6 calibration factor: for field calibration determines by air balancing,

.7 room temperature setpoint,

.8 maximum room temperature setpoint: occupant selectable,

.9 minimum room temperature setpoint: occupant selectable,

.10 cooling setpoint,

.11 heating setpoint,

.12 unoccupied cooling setpoint,

.13 unoccupied heating setpoint,

.14 afterhours maximum Timer: maximum time occupant may override unoccupied cycle,

.15 internal cooling Signal: used to reset supply air temperature if more cooling is required,

.16 internal Heating Signal: used to reset supply air temperature is less cooling is required

END OF SECTION

B.A.S. INSTRUMENTATION AND ACTUATORS
25 35 01

1 GENERAL

1.1 Scope

.1 Provide Instrumentation, dampers, control valves, and Actuators for Building Automation System.

.2 Provide actuators for operating dampers provided as part of factory built air handling units.

1.2 Related Sections

.1 Operating dampers provided as part of factory built air handling equipment;

.1 23 73 23: Custom Air Handling Units.

2 PRODUCTS

2.1 General

.1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:

.1 Temperature - 0°C to 32.2°C (32°F to 90°F)

.2 Relative Humidity 10% to 90% non -condensing

.3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal.

.2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 Power Supplies and Line Filtering

.1 Power Supplies:

.1 control transformers to be UL listed,

.2 line voltage units to be CSA listed,

.3 provide over-current protection in primary and secondary circuits,

.4 limit connected loads to 80% of rated capacity.

.2 DC power supplies:

.1 output to match equipment current and voltage requirements,

.2 units to be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation to be 1.0% line and load combined, with 100-microsecond response time for 50% load changes,

.3 units to have built-in over-voltage and over-current protection and to be able to withstand 150% current overload for at least three seconds without trip-out or failure,

.4 units to operate between 0°C and 50°C (32°F and 120°F). EM/RF to meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.

.3 Power Line Filtering:

.1 provide internal or external transient voltage and surge suppression for workstations and control modules,

.2 surge protection:

(a) dielectric strength of 1000 V minimum,
(b) response time of 10 nanoseconds or less,
(c) transverse mode noise attenuation of 65 dB or greater,
(d) common mode noise attenuation of 150 dB or greater at 40-100 Hz.

2.3 Motorized Control Dampers

.1 Construction:

.1 in accordance with section 23 33 14 - Dampers - Operating.

2.4 Electric/electronic actuators – air dampers

.1 Actuators for Air Handling Units dampers and general purpose plenum/duct mounted dampers:

.1 electric/electronic type for two position or proportional operation as shown,

.2 enclosure:

(a) general purpose, drip proof enclosure for indoor applications,
(b) NEMA 4 enclosure for outdoor use and where dampers are exposed to the airstream inside an air intake plenum.

.3 gear type mechanism with spring-return to failed position as shown,

.4 mounted over damper shaft or with connecting linkage and with fastening clamp assembly,

.5 sized and selected in accordance with manufacturer's instructions,

.6 electronic overload or digital rotation sensing circuitry to protect damper operator through entire range of rotation,

.7 angle of rotation adjustable between 0° to 90°,

.8 control signals:

(a) 0 - 10VDC or 0 - 20ma for proportional control,
(b) power On-Off for two position service,

.9 feedback signals:

(a) proportional service: 2 - 10 VDC position feedback signal.
(b) two position service: two SPDT auxiliary switches for end stop position indication.

.10 suitable for operation down to -35°C when installed outdoors.

.2 Actuators for dampers serving fuel-fired appliances and stationary engines – equipment and rooms:

.1 as above for general purpose duct mounted dampers and as follows.

.2 spring return to fail position on loss of power supply:

(a) combustion air dampers : fail-to-open
(b) ventilation inlet air dampers: fail-to-open
(c) recirculation air dampers: fail-to-close
(d) exhaust air dampers: fail-to-open.

.3 spring operating cycle time: <20 seconds at -20°C to 50°C (-4°F to 122°F)

.4 operating control:

(a) combustion air dampers: two position open/closed
(b) all other dampers: modulating with 0-10VDC or 4-20 mA input signal

Standard of Acceptance

- Belimo – EFB24-S N4/EFB120-S N4 series for two position dampers
- Belimo – EFB24-SR-S N4 series for modulating dampers

.3 Actuators for Terminal unit dampers:

.1 integrated DDC controller and damper actuator,

.2 sized and selected in accordance with terminal box damper manufacturer's specifications,

.3 gear drive, direct coupled type operators mounted to shaft with universal V-bolt clamp,

.4 proportional type control,

.5 selectable / reversible rotation direction,

.6 input type and range as suitable for interfacing to output of terminal unit controller,

.7 angle of rotation adjustable between 30 to 90° with mechanical limit stops,

.8 damper position indication visible without cover removal,

.9 manual override to set damper position without power applied to actuator,

.10 electronic stall protection,

.11 general purpose dust proof enclosure,

.12 actuator running time of not more than 100 seconds,

.13 delivered to terminal unit manufacturer's factory for installation.

2.5 Control Valves

.1 General:

.1 Body and trim materials selected in accordance with specification for globe valves, ball valves, or high performance butterfly valves, and in accordance with manufacturer's recommendations for design conditions and service.[

.2 Size control valves for pressure drops and heating and cooling loads as scheduled with same pressure rating as globe valves under same service and pressure conditions.

.3 Size valves for two port and three port, two position service;

(a) line size,
(b) ball valves, sizes NPS 1 ½ and smaller,
(c) butterfly valves, sizes NPS 2 and larger.

.4 For two port and three port modulating service;

(a) use globe valves for CV rating 160 and smaller,
(b) use butterfly valves for CV rating above 160.

.5 Select butterfly valves based on CV rating at 70° rotation

.2 Water and glycol valves:

.1 two position service;

(a) straight through two port type, single seated, with replaceable disc or ball,
(b) quick opening linear or equal percentage flow characteristics.

.2 modulating service;

(a) straight through two port type, single seated,
(b) equal percentage flow characteristics.

.3 modulating diverting service; three port mixing valves,

(a) linear for each port to give constant total flow or,

(b) equal percentage flow characteristics with 25% valve authority (valve pressure drop equal to 33% pressure drop through load at full flow).

.4 actuator and trim selected for close-off pressure ratings as follows;

(a) two-way modulating or two position service; 150% of pump shut off head.
(b) three-way modulating service; 300% of pressure differential between ports A and B at design flow or 100% of pump shut off head.
(c) shut off head to be based on maximum rpm when pump is fitted with VFD

.5 sized as follows;

(a) for two-position service; line size.
(b) for two-way modulating service unless otherwise shown; pressure drop at design flow equal to greatest of;
- 200% of pressure drop through heat exchanger,
- 100% of pressure drop through coil,
- 50% of pressure difference between supply and return mains, or
- 35 kPa (5 psi).

(c) for three-way modulating service; pressure drop equal to smaller of;
- twice pressure drop through coil or heat exchanger, or
- 35 kPa (5 psi).

(d) for valves for radiation, terminal units and reheat coils;
- pressure drop of 7kPa (1 psig)

.6 failed position on isolation from control signal as follows;_

(a) Heating water and glycol zone valves; normally open.
(b) Heating coil valves in AHU; normally open.
(c) Chilled water control valves; normally closed.
(d) Chilled water differential pressure by-pass control valves; normally open.
(e) Hot water and glycol differential pressure by-pass control valves; normally closed.

.3 Steam valves:

.1 globe type, with equal percentage flow characteristics.

.2 actuator and trim selected for close-off pressure rating equal to 150% of operating (inlet) pressure.

.3 sized as follows;

(a) two-position service;
- pressure drop at design flow equal to 10%-20% of inlet steam gauge pressure.

(b) modulating service at inlet steam gauge pressure of 100 kPa (15 psig) or less;
- pressure drop at design flow equal to 80% of inlet steam gauge pressure.

(c) modulating service at inlet steam gauge pressure of 101-350 kPa (16-50 psig);
- pressure drop at design flow equal to critical pressure drop (45% of absolute inlet pressure).

(d) modulating service with inlet steam gauge pressure over 350 kP(50 psig);
- pressure drop as scheduled.

(e) modulating steam loads greater than 570 kW (2000 lbs./hr) at all pressures;
- provide two valves, connected in parallel and controlled in sequence, with first valve in opening sequence sized for a and second for b of steam load.

2.6 Electric/electronic actuators - valves

.1 Valve actuators for service other than radiation, radiant panel and reheat coil valve applications:

.1 sized and selected in accordance with manufacturer's specifications,

.2 electric/electronic for two position, or proportional control action, coupled to valves with linkage,

.3 electronic interface control board, solid state drive, reversible motor, oil immersed gear train,

.4 electronic overload or digital rotation sensing circuitry to protect damper operator through entire range of rotation,

.5 span and zero travel adjustment,

.6 position feedback signal on actuators used for proportional control,

.7 provision for manual positioning of valve when actuator is not powered,

.8 spring return mechanism to return valve to "normal" position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)),

.9 control signals:

(a) 0 to 10VDC or 0 to 20ma,
(b) modulate damper position with 2 to 10VDC or 4 to 20ma input signal operating range when in proportional service.
(c) input type and range as suitable for interfacing to output of BAS controller

.10 feedback signals:

(a) two independent adjustable travel limit switches and wiring to BAS for indication of valve position.

.11 general purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use,

.12 electric actuators suitable for operation down to -35°C where installed outdoors.

.2 Valve actuators for service on radiation, radiant panel, and reheat coil valve applications:

.1 output shaft driven by gear train mechanism.

.2 reversible motor with automatic load limit,

.3 input type and range as suitable for interfacing to output of BAS controllers,

.4 adjustable span and offset travel ,

.5 position feedback signal on actuators used for proportional control,

.6 general purpose, dustproof, die-cast aluminum housing,

.7 actuator rotation limit.

2.7 Air flow measuring devices

.1 Multiple head pitot tube type stations:

.1 diamond shape cross-section Annubar sensor with multiple tube structure, averaging chambers and bidirectional flow sensing capability

.2 sheet metal duct collars

.3 selected for operating flow range, duct size and air temperature

.4 integral differential pressure sensor with analog output signal proportional to differential pressure across sensor, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.5 accuracy; ±1% of actual value

.6 repeatability; ±0.1% of actual value

.7 flow turndown; greater than 10:1

.8 differential pressure range;0 to 1250 Pa (0 to 5 in wg)

.9 operating pressure; up to 34.3 kPa (5 psig)

.10 operating temperature rating;-4°C to 95°C (-20°F to 200°F)

.11 operating pressure rating;1725 kPa (250 psig)][

.2 Thermal anemometer probe type airflow measuring stations:

.1 sensors mounted in sheet metal duct collars of [aluminum][stainless steel],

.2 each thermistor mounted in solid thermoplastic housing

.3 probe length equal to greater of two inside dimensions of rectangular and oval ducts and equal to duct diameter for round ducts

.4 minimum two sensing points per probe

.5 independent averaging of multiple sensing points

.6 averaging amplifier with adjustable offset and span for multiple probe applications

.7 temperature compensated linear analog output signal indicating average velocity at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.8 velocity accuracy; ±2% of reading

.9 temperature accuracy; 0.10°C (0.18°F)

.10 resolution; 0.4% of scale

.11 repeatability; ±0.2% of reading

.12 velocity range;0 to 25m/s (0 to 5000 fpm)

.13 maximum allowable pressure drop; 1.2 Pa at 10m/s (0.005 in wg at 2000 fpm)

.14 flow station operating temperature range; [0°C to 70°C (30°F to 160°F)][-29°C to 71°C (-20°F to 160°F)]

.15 electronic operating temperature range; 0°C to 70°C (30°F to 160°F)

.16 flow station operating humidity range; 0 to 99% RH non-condensing

.17 dedicated electronic, solid state digital processing control panel with general purpose dustproof enclosure

.18 provided with upstream and/or downstream flow conditioning.

.3 Thermal anemometer type airflow measuring stations for installation at fan inlets:

.1 fan inlet bell mouth mounted with adjustable steel strut and mounting feet

.2 minimum of two flow sensing thermistors and temperature sensors per station, two stations for DWDI fans

.3 sensors mounted in aluminum casing and recessed within strut

.4 independent averaging of multiple sensing points

.5 temperature compensated linear analog output signal indicating average velocity at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.6 velocity accuracy; ±2% of reading

.7 temperature accuracy 0.2°C (0.36°F)

.8 resolution; 0.4% of scale

.9 repeatability; ±0.2% of reading

.10 velocity range; 0 to 25m/s (0 to 5000 fpm)

.11 maximum allowable pressure drop;1.2 Pat 10m/s (0.005 in w.g. at 2000 fpm)

.12 flow station operating temperature range; 0°C to 71°C (30°F to 160°F)

.13 electronic operating temperature range; 0°C to 71°C (30°F to 160°F)

.14 flow station operating humidity range; 0 to 99% RH non-condensing

.15 dedicated electronic, solid state digital processing control panel with general purpose dustproof enclosure

.4 Provide mounting hardware for installation of airflow measuring stations by sheet metal contractor.

2.8 Temperature switches

.1 Low temperature limit thermostat (freezestat):

.1 6m (20 ft) of sensing capillary sensitive to freezing air over any 400mm (15 in) section,

.2 [automatic reset with fixed differential temperature][manual reset switch]

.3 installed in multiples with one unit serving not more than 5 m^2 (40 sq ft) of duct area.

.4 single pole single throw (SPST) contacts or single pole double throw (SPDT) contacts where used as digital input to BAS

.5 1.7°C to 7.2°C (35°F to 45°F) operating temperature range

.6 adjustable set point within specified range

.7 protective enclosure.

.2 Temperature switches:

.1 sensing element of liquid, vapour or bimetallic type,

.2 adjustable set-point and differential of at least 0.22°C to 1.7°C (0.4°F to 3.0°F),

.3 snap action type rated at 120 volts, 15 amps or 24 volts DC,

.4 automatic in operation and automatically reset when condition returns to normal.

.5 suitable for wall mounting on standard electrical box with protective guard, or suitable for insertion into air ducts with insertion length of 450 mm (18 in), or

.6 thermowell type with compression fitting for 20 mm (0.8 in) NPT well, mounting length of 100 mm (4 in), and immersion wells of type 316 stainless steel, or

.7 Strap-on-type with helical screw stainless steel clamps.

.8 23°C to 57°C (75°F to 138°F) [38°C to 71°C (100°F to 160°F)] operating temperature range

.9 adjustable set point within specified range

.10 single pole single throw (SPST) contacts or single pole double throw (SPDT) contacts where used as digital input to BAS

.11 protective enclosure.

2.9 Temperature sensors/transmitters

.1 Sensor alternative technologies:

.1 Resistance temperature device (RTD) of precision thin film platinum element type;

(a) linear characteristics over sensor range,
(b) 1000 ohm, [±20 ohms (2%)][±2 ohms (0.2%)] reference resistance at 0°C (32°F),

(c) 0/.0385ohms/ohm/°C (0.0212 ohms/ohm/°F) temperature coefficient of resistance and
(d) ±0.36°C at 21°C (±0.65°F at 70°F) accuracy [][to Din IEC 751]

.2 Resistance temperature device (RTD) of precision thin film nickel element type, with

(a) linear characteristics over sensor range,
(b) 1000 ohm, [±20 ohms (2%)][±2 ohms (0.2%)] reference resistance at 21°C (70°F),
(c) 5.4 ohm/°C (3.0 ohm/°F) temperature coefficient of resistance and
(d) ±0.18°C at 21°C (±0.34°F at 70°F) accuracy

.3 Thermistor with

(a) non-linear negative temperature coefficient of resistance,
(b) 10,000 ohms reference resistance at 25°C (77°F),
(c) curve matched to±0.2°C (±0.36°F) temperature accuracy over 0°C to 70°C (32°F to 158°F), and
(d) long term stability of 0.025°C (0.045°F) drift per year

.2 Each sensor:

.1 2 integral anchored lead wires

.2 waterproof sensor to sheath seal

.3 strain minimizing construction

.4 standard conduit box termination with cover

.5 pig-tail wire leads with wire nuts or screwed terminal connector block

.6 factory calibrated and capable of end to end (sensing element to BAS) accuracy of±0.25°C (±0.5°F) over full range of measured variable.

.7 transducing circuit to convert output to signal compatible with equipment controller

.8 concealed USB or serial communications port for portable PC or hand held commissioning equipment.

.3 Averaging element type temperature sensors:

.1 average style element for ducts of greater cross section than 0.4 m^2 (4 sq ft).

.2 sensor operating temperature range from –40°C to 121°C (-40°F to 250°F)

.3 copper sheathed construction

.4 non-condensing 5 to 95% RH

.5 minimum immersion length of 4000 mm (13 feet)

.6 probe field formable to minimum radius of 100mm (4 in) at any point along probe length, other than with 200 mm (8 in) of connector box, without degradation of specified performance

.7 provided as multiple sensors where single averaging element cannot be located to provide proper duct or plenum temperature sampling.

.4 Duct mount probe type temperature sensors:

.1 provided for ducts of cross section less than 0.4 m^2 (4 sq ft)

.2 sensor operating temperature range from –40°C to 121°C (-40°F to 250°F)

.3 copper or brass or stainless steel sheathed construction

.4 non-condensing 5 to 95% RH

.5 metal mounting plate

.6 length such that sensing element is no less than a of duct width or diameter from duct wall greater

.7 provided as multiple sensors where single element cannot be located to provide proper duct or plenum temperature sampling.

.5 Thermowell mount type temperature sensors:

.1 insertion elements for measurement of fluid temperatures with stainless steel sheath

.2 sensor operating temperature range from –40°C to 121°C (-40°F to 250°F)

.3 spring loaded construction with compression fitting for 20mm (NPS ¾) well mounting

.4 length suitable for application

.5 stainless steel or chrome plated brass thermowells of size and material to suit relevant sensor, pipe and service

.6 Outside air temperature sensors:

.1 insertion type for through-the-wall installation with stainless steel sheath

.2 sensor operating temperature range from –25°C to 60°C (-13°F to 140°F)

.3 waterproof seal at wall

.4 non-condensing 5 to 95% RH

.5 total active probe length of 100 mm to 150 mm (4 in to 6 in)

.6 with non-corroding outdoor shield to minimize solar heating effect and

.7 inert section passing through wall to allow precise measurement of outdoor temperature.

.7 Space temperature sensors, Type 1:

.1 for measurement of space temperatures throughout facility

.2 sensor operating temperature range from 4°C to 60°C (40°F to 140°F)

.3 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors.

.4 guard secured to mounting plate by screws.

.8 Adjustable space temperature sensors with display, Type 2:

.1 for measurement and adjustment of space temperatures in rooms at designated location as shown on plans or described in Sequences of Operation.

.2 digital key pad or slider control for temperature adjustment, 20°C to 25°C (68°F to 78°F)

.3 On/Off button to allow occupant override feature.

.4 three digit LED digital temperature display with 0.2° display resolution

.5 5 to 95% RH non condensing

.6 set point operating temperature range from 4°C to 60°C (40°F to 140°F)

.7 minimum/maximum limit set point values adjustable from BAS operator interface and controller

.8 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors.

.9 guard secured to mounting plate by screws.

.9 Space temperature sensors - Secure Areas:

.1 for measurement of space temperatures at locations subject to vandalism as shown on plans or described in Sequences of Operation.

.2 sensor operating temperature range from 4°C to 60°C (40°F to 140°F)

.3 stainless steel flat plate surface type with sensor epoxy-bonded to back of cover plate.

.4 tamperproof / secure concealed fasteners.

2.10 Humidity sensors - electronic

.1 Each humidity sensor:

.1 suitable for operating ranges of 10 to 100% R.H.

.2 sensor operating temperature range from –40°C to 121°C (-40°F to 250°F)

.3 solid state sensing element,

.4 accuracy of ± 3% over range of 5 to 95% R.H.

.5 independent, non-interactive span and zero adjustments

.6 0-100% linear proportional output signal indicating relative humidity, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.7 strain minimizing construction

.8 dust proof enclosure

.9 screwed terminal connector block.

.2 Duct mount probe type humidity sensors:

.1 metal mounting plate

.2 constructed with 304 stainless steel element enclosure

.3 length such that sensing element is not less than a of duct width or diameter from duct wall.

.3 Outside air type humidity sensors:

.1 weatherproof enclosure with cover

.2 waterproof seal.

.4 Space humidity sensors:

.1 surface mounted plastic guard with surface mounting plate and wall anchors

.2 guard secured to mounting plate by screws

.3 analogue LCD humidity display.

2.11 Duct type combination temperature and humidity sensors

.1 Where both temperature and humidity are shown to be measured at same location or in same airstream, use of single measuring unit is permitted provided that features and performance of both temperature sensor and humidity sensor are in accordance with requirements of this specification.

2.12 Pressure sensors/transmitters and pressure switches

.1 General:

.1 Rating of chilled and condenser water units: 1000 kPa (125 psi).

.2 Rating of hot water units: 1000 kPa (125 psi).

.3 Rating of steam units: 1200 kPa (150 psi).

.4 Rating of high temperature water units: 2700 kPa (400 psi)

.5 Pressure sensors monitoring fan operation to have set point adjustable from 0 to 3600 Pa (0 to 10 in wg.) and adjustable differential between 10 to 300 Pa (0.03 to 1 in wg).

.2 Static pressure and differential pressure sensors for air or inert gas - electronic:

.1 diaphragm driven, capacitance change type, 0-100% linear proportional output signal indicating static pressure or differential pressure at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.2 field adjustable zero and span

.3 selected with span of not greater than twice maximum static pressure and not less than twice differential pressure at shut-off.

.4 accuracy, including non-linearity, hysteresis and non-repeatability; ±1% full scale

.5 operating temperature range; -18°C to 80°C (0°F to 175°F)

.6 operating humidity range; 10 to 90% non-condensing

.7 high and low pressure ports, brass hose barbed pressure fittings suitable for 8 mm (¼ in) tubing

.8 mounting bracket, suitable for duct mounting

.9 dust proof enclosure, and

.10 screw terminal connector block.

.3 Pressure transducers - electronic:

.1 suitable for use in water, glycol, steam, ammonia and non-corrosive refrigerants,

.2 series 300 stainless steel construction, stainless steel diaphragm

.3 sealed electronics

.4 0-100% linear proportional output signal indicating pressure at station, 4-20 mA, 0-5 Vdc or 0-10 Vdc

.5 designed for 3 times rated range over pressure without damage

.6 low pressure range 1 to 700 kPa (0 to 100 psig)

.7 high pressure range 1 to 3400 kPa (0 to 500 psig)

.8 accuracy including non-linearity, hysteresis, and non-repeatability; ±1% full range span

.9 operating temperature range; -40°C to 100°C (-40°F to 212°F)

.10 operating humidity range; 10 to 90% non-condensing

.11 suitable for direct mounting to pressure port

.12 dust proof enclosure, and

.13 screw terminal connector block.

.4 Differential pressure transmitters for terminal units:

.1 suitable for use in air with pressure independent terminal units (constant volume, variable volume or fan powered)

.2 capacitive sensor technology

.3 pressure range 0 Pa to 373 Pa (0 to 15 in.w.g.)

.4 linear output proportional to velocity pressure of unit inlet air stream, and suitable as analog input to terminal unit controller

.5 accuracy including non-linearity, hysteresis, and non-repeatability; ±1% full scale

.6 operating temperature range; 0°C to 50°C (32°F to 122°F)

.7 operating humidity range; 10 to 90%non-condensing

.8 high and low pressure ports, barbed pressure fittings suitable for 8 mm (¼ in) tubing for connection to air flow pick up device provided with terminal box

.9 mounting kit, suitable for installation within terminal unit controller enclosure

.10 coded screw terminals

.5 Differential pressure switches:

.1 spring loaded diaphragm type

.2 suitable for use with air or inert gas,

.3 adjustable set-point and differential,

.4 snap acting SPDT contacts suitable for use as digital input to BAS

.5 switch mounted with diaphragm in vertical plane

.6 automatic in operation and automatically reset when condition returns to normal.

.7 operating temperature range; 0°C to 60°C (35°F to 140°F)

.8 operating humidity; 10 to 90% RH non-condensing

.9 high and low pressure ports, brass hose barbed pressure fittings suitable for 8 mm (¼ in) tubing

.10 mounting bracket suitable for duct mounting,

.11 dust proof enclosure, and

.12 screw terminal block

.6 Pressure switches:

.1 bourdon tube, bellows or diaphragm type,

.2 suitable for use with air, inert gas, water, glycol, steam, ammonia or non-corrosive refrigerants,

.3 selected with span of not greater than twice maximum pressure

.4 adjustable set-point and differential,

.5 snap action type

.6 rated at 120 volts, 15 amps AC or 24 volts DC,

.7 automatic in operation and automatically reset when condition returns to normal.

.8 dust proof enclosure, and

.9 screw terminal block

.7 Pressure electric switches:

.1 used to create electric switching from pneumatic control signals

.2 diaphragm operated SPDT. snap acting contacts with electrical rating suitable for application.

.3 designed to withstand up to 170 kPa (25 psi) input pressure,

.4 adjustable cut-in and cut-out settings between 25 and 140 kPa ([3 and 20 psi).

2.13 Occupancy sensors

.1 General:

.1 passive infrared sensor with temperature compensated pyro-electric dual active element,

.2 red LED for occupancy indication

.3 digital time delay adjustable from 15 seconds to 30 minutes

.4 integrated light level directional

.5 isolated output relay suitable as digital input to BAS.

Standard of Acceptance
- Watt Stopper Model CX-100

2.14 Operating Room Monitor

.1 General:

.1 Provide one control panel per operating Room.

.2 Capable of measuring and displaying up to three (3) specific values at a time.

.3 Minimum dual screen to display: temperature, humidity and relative pressure. Secondary screen to display supply CFM, air changes per hour, and HEPA Filter pressure drop based on air flow measuring station.

.4 Stand-alone operating with fully programmable microprocessor based controller with fully colour TFT touch screen interface. Panels to be capable of both visual and audible alarms.

.5 Controller to have a minimum of the following inputs and outputs: 4AI, 4AO, 4DI and 4 digital contacts suitable for BAS interfacing.

.2 Screen set-up:

.1 Main Screen:

(a) Temperature
(b) Humidity
(c) Relative Pressure from corridor

.2 Secondary Screen:

(a) Air Changes Per Hour
(b) Supply air quantity (CFM)
(c) Occupied
(d) HEPA Filter status

.3 Provide site representative (specialist) from manufacturer for install, custom programming and testing. Room monitors to be set-up and demonstrated to owner and their representatives for their review during commissioning.

Standard of Acceptance
- Phoenix Controls – Advanced Pressure Monitor II
- Square M

2.15 Air flow switches

.1 General:

.1 for indication of air flow within duct.

.2 stainless steel flow paddle of suitable length and width for duct area and air flow

.3 snap-action SPDT switch

.4 field adjustable set point

.5 maximum air velocity; 10.2 m/s (2000 fpm)

.6 switch mounted with paddle shaft in horizontal position

.7 operating ambient temperature range; 0°C to 40°C (32°F to 104°F)

.8 dustproof enclosure with mounting plate and gasket seal.

2.16 Electrical devices

.1 Current sensing relays:

.1 metering transformer ranged to match load being metered,

.2 plug in base and shorting shunt to protect current transformer when relay is removed from socket,

.3 current transformer for single or three phase metering connected into single relay,

.4 adjustable latch level, adjustable delay on latch and minimum differential of 10% of latch setting between latch level and release level,

.5 discrimination between phases in three phase applications to allow worst case selection,

.6 mounted in motor starter enclosure and fed from starter control transformer,

.7 relay contacts capable of handling 10 amps at 240 volts.

.2 Current transducer:

.1 output signal proportional to measured line current,

.2 output signal in one of following ranges; 4-20 mA, 0-5 Vdc or 0-10 Vdc

.3 Control Relays:

.1 plug-in type, UL listed, with dust cover and LED "energized" indicator.

.2 contact rating, configuration, and coil voltage suitable for application.

.3 NEMA 1 enclosure for relays not installed in local control panels.

.4 Time Delay Relays:

.1 solid-state plug-in type, UL listed, with adjustable time delay adjustable ±100% from set point shown.

.2 contact rating, configuration, and coil voltage suitable for application.

.3 NEMA 1 enclosure for relays not installed in local control panels.

.5 Override Timers:

.1 spring-wound line voltage, UL Listed, with contact rating and configuration by application unless implemented in control software.

.2 0-6 hour calibrated dial.

.3 flush mounted on local control panel face.

.6 AC Current Transmitters:

.1 self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output.

.2 full-scale unit ranges of 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment.

.3 ±1% full-scale accuracy at 500 ohm maximum burden.

.4 UL/CSA listed and meet or exceed ANSI/ISSA 50.1 requirements.

.7 AC Current Transformers:

.1 UL/CSA listed

.2 completely encased (except for terminals) in approved plastic material.

.3 selected for appropriate current ratios with ±1% accuracy at full-scale output.

.4 fixed-core transformers for new wiring installation

.8 AC Voltage Transmitters:

.1 self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

.2 adjustable full-scale unit ranges; 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac.

.3 ±1% full-scale accuracy at 500 ohm maximum burden.

.4 UL/CSA listed, 600 Vac rated and conforming to ANSI/ISSA 50.1.

.9 AC Voltage Transformers:

.1 UL/CSA listed, 600 Vac rated with built-in fuse protection.

.2 suitable for ambient temperatures of 4°C to 55°C (40°F to 130°F) and

.3 ±0.5% accuracy at 24 Vac and 5 Vac load.

.4 windings (except for terminals) enclosed with metal or plastic.

.10 Power Monitors:

.1 three-phase type with three-phase disconnect and shorting switch assembly,

.2 UL listed voltage transformers, and

.3 UL listed split-core current transformers.

.4 selectable output either rate pulse for kWh reading or 4-20 mA for kW reading.

.5 maximum error of ±2% at 1.0 power factor or ±2.5% at 0.5 power factor.

.11 Current Switches:

.1 self-powered, solid-state type with adjustable trip current

.2 integral current transformers and relays to indicate motor status

.3 SPDT output relay suitable for use as digital input

.4 field adjustable output relay trip setting, over 0-100% of range. Deadband adjustment to maximum of 10% of range

.5 integral zero-leakage LED's indicating sensor power and switch status

.6 long term setting drift of current transformer and relay combination not more than 5% full range over 6 months

.7 over current and over voltage protection for current transformer and relay

.8 operating temperature range; -10°C to 50°C (14°F to 122°F)

.9 operating humidity range; 5% to 90% RH non condensing

.12 Electronic signal isolation transducers:

.1 provided whenever;

(a) an analog output signal from BAS is connected to an external control system as an input (such as chiller control panel) or

(b) BAS is to receive an analog input signal from an external remote system.

.2 designed for ground plane isolation between systems.

2.17 Electro-Pneumatic (E/P) Transducers

.1 General:

.1 provided to convert 4-20 mA, 0-5 Vdc, or 0-10 Vdc analog control input to 20-100 kPa (3-15 psig) output signal.

.2 separate span and zero adjustments.

.3 manual output adjustments.

.4 pressure gauge assembly.

.5 feedback loop control.

.6 mid-range air consumption of 0.05 L/s (0.1 scfm).

2.18 Local equipment panels

.1 General:

.1 NEMA 2 sheet metal cubicles with vertically hinged lockable doors,

.2 sensors, transducers, BAS controllers, and relays mounted on backing board and/or DIN rails within inner section,

.3 enclosures sized to house controllers and associated transformers, control relays, wiring, conduits and other auxiliary equipment.

.4 engraved lamacoid labels with white lettering indicating function of each sensor, transducer, controller, gauge and instrument.

.5 wiring terminations labelled

.6 EMT conduit openings and adapters in sufficient quantities and sizes to accommodate wiring terminating within enclosure

.7 wiring within enclosure installed in neat and protected manner, enclosed in wireways or plastic conduit.

.8 inside each panel, one set of as built, plasticized control Shop Drawings for equipment served by that panel permanently affixed to cabinet frame.

2.19 Wiring and Raceways

.1 Wiring, conduit, and raceways to Section 20 05 13.

.2 Wire used for power and control:

.1 insulated copper conductors,

.2 UL listed for minimum 90°C (200°F) service.

.3 Power wiring minimum 12 gauge.

.4 Control wiring for digital functions: 18 AWG minimum with 300 Volt insulation.

.5 Control wiring for analog functions: 18 AWG minimum with 300 Volt insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.6 Transformer current wiring: 16 AWG minimum.

.7 Sensor wiring: 22 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware. Provide additional conductors as to support supplemental features of sensor (i.e. set-point adjustment, override, etc.)

3 EXECUTION

3.1 Installation of Sensors

.1 General:

.1 Mount sensor assemblies and elements;

(a) in clean areas wherever possible,
(b) accessible to allow for replacement and servicing without interfering with access for adjacent equipment and personnel traffic in surrounding space,
(c) provide access doors where assemblies and elements are concealed.

.2 Install transmitters, transducers, controllers, solenoid air valves and relays in NEMA2 enclosures;

(a) install wiring and tubing within enclosures in trays or individually clipped to back of panel with identification tags and terminal numbers visible.

.3 Rigidly support field mounted transmitters, transducers, and sensors on pipe stands or channel brackets.

.4 Orient sensing elements to correctly sense measured variable and to be isolated from vibrations and environmental conditions that could affect measurement or calibration.

.5 Identify each cable and wire at every termination point.

.6 Air seal wires attached to sensors at entry into junction box.

.2 Temperature sensors:

.1 Install room temperature sensors on concealed junction boxes supported by wall framing.

.2 Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in serpentine manner vertically across duct. Support each bend with capillary clip.

.3 Install mixing plenum low-limit sensors in serpentine manner horizontally across duct. Support each bend with capillary clip. Provide sensor element length to coil area ratio of 3 m per 1 m^2 (1 ft per 1 sq ft).

.4 Install pipe-mounted liquid temperature sensors in wells with heat-conducting material. Where thermowell installation necessitates shutting down of pumps or draining of pumps, coordinate with Consultant and Owner.

.5 Cut and recover piping insulation to one foot either way for installation of strap-on temperature sensors. Provide removable insulation box over sensor and patch insulation to match existing.

.6 Install outdoor air temperature sensors on north facing wall with sun shield.

.7 Mount space temperature and humidity sensors 1200 mm (4 ft) above finished floor.

.3 Pressure sensors:

.1 Mount gauge tees adjacent to water differential pressure taps. Install shut-off valves before tee for water gauges.

.4 Differential air static pressure sensor installations:

.1 Supply duct static pressure;

(a) pipe high-pressure tap to duct using pitot tube,
(b) make pressure tap connections according to manufacturer's recommendations.

.2 Return duct static pressure;

(a) pipe high-pressure tap to duct using pitot tube,
(b) make pressure tap connections according to manufacturer's recommendations.

.3 Building static pressure;

(a) pipe pressure sensor's low-pressure port to static pressure port located on outside of building through high-volume accumulator,
(b) pipe high-pressure port to location behind thermostat cover.

.4 Piping to air pressure transducer pressure taps to contain capped test port adjacent to transducer.

.5 Locate air pressure transducers, except those controlling terminal unit boxes;

(a) in control panels, not on monitored equipment or on ductwork,
(b) mount transducers in vibration-free location accessible for service without use of ladders or special equipment.

.5 Airflow measuring stations:

.1 Provide transducers, relays, and interconnection wiring to perform Sequences of Operations as detailed and Monitoring in accordance with Controls Schematics.

.6 Fluid pressure measuring stations:

.1 Isolation valve and snubber to be installed between pressure sensor and pressure source.

.2 Sensors and switches on steam lines and high temperature water to be protected by pigtail siphon installed between sensor and fluid line.

.3 provide two pressure transducers with software calculation at controller for differential pressure measurements in fluid piping systems.

.7 Safety controls:

.1 Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches and controls to be hard-wired to de-energize equipment as described in Sequence of Operation.

(a) unless otherwise shown.

.2 Safety switches and controls to require Operator intervention to activate local manual reset.

.3 Provide contacts that allow BAS software to monitor safety control status.

.8 Flow Switch Installation

.1 Fit correct length paddle for diameter of pipe.

.2 Adjust switch for specified flow condition in accordance with manufacturer's instructions

3.2 Actuators

.1 General:

.1 Mount actuators and adapters according to manufacturer's recommendations.

.2 Electric and Electronic Damper Actuators:

.1 Mount damper actuators directly on damper shaft or jackshaft

.2 Mount valve actuator directly on shaft or with linkages according to manufacturer's recommendations.

.3 For low-leakage dampers with seals, mount actuator with minimum 5° travel available for damper seal tightening.

.4 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close damper, then tighten linkage.

.5 Provide mounting hardware and linkages for actuator installation.

.3 Valve Actuators:

.1 Connect actuators to valves with adapters approved by actuator manufacturer.

3.3 Operating Room Monitors

.1 Install operating room monitors shown on drawings.

.2 Standard 50 mm x 100 mm (2 in x 4 in) junction box and 120 VAC power supply to operating room monitors provided by Division 26.

.3 Provide services of qualified technician to supervise installation of operating room monitors.

.4 Include start up services including verification of proper installation and wiring and proper operation of each operating room monitor system.

.5 Provide owner training on use and maintenance or operating room monitors. Provide training to two groups: users / health care workers, and facility operators.

END OF SECTION

B.A.S. SEQUENCE OF OPERATIONS
25 90 01

1 GENERAL

1.1 Definitions

.1 System Start: actions required at system start-up under schedule control or on re-start after power failure.

.2 Normal Operation: normal control sequence after initial start-up requirements are satisfied.

.3 Demand Limiting: special operation parameters during normal utility power outages (emergency generator operation)

.4 System Stop: shut-down of system under schedule control and fail-safe position of system in event of loss of normal power.

.5 Fire Alarm: action required in the event of a signal from the fire alarm system (FA).

.6 Schedule: scheduled operation of system

.7 Alarm: minimum alarm points required.

.8 Emergency Power: control system elements to be fed from emergency power, refer to electrical drawings.

2 EXECUTION

2.1 Sequence of operation and control drawings

.1 Control sequences that follow describe and detail suggested method of control of systems.

.2 Control drawings listed for each control sequence illustrate required inputs and outputs for the control and monitoring of systems.

.3 Review sequence of operation described for each system and allow for additional input and output points to achieve method of control described. Review documents to determine quantity of each piece of equipment or system.

.4 Sequences of Operation

.1	CS 100	Terminal Re-heat Unit
.2	CS 101	Recirculating AHU
.3	CS 200	Equipment and Electrical Room Monitoring

END OF SECTION

B.A.S. SEQUENCE OF OPERATIONS
25 90 01

CS200

Equipment and Electrical Room Monitoring (typical)

Reference: Electrical drawings for equipment location.

Applicable

System: Electrical Equipment – through new NAE panel, location as shown on mechanical drawings

Alarm/Monitoring:

- UPS status monitoring and alarm notifications in 3rd floor UPS room
    - UPS System
        - UPS System Normal operation, Load on maintenance bypass, Load on UPS, Load on static bypass, System shutdown & UPS on battery
        - UPS Room High Temperature
        - UPS Room Water Leak Detection System

END OF SECTION

CS100 - Terminal Unit with Reheat (where applicable)

Reference: Heating Drawings

Applicable Systems: Terminal unit with reheat (typical)

System Start: Boxes are enabled when associated AHU system is operating. Reheat coil valve V1 is enabled with OAT > 5°C. Reheat Coil valve V1

Normal Operation: ***Space Temperature Control***

Boxes designated as “constant volume”:

Heating Priority Control

Reheat coil has priority. At designed air flow reheat valve V1 modulates to maintain space setpoint temperature.

Unoccupied Mode: Boxes designated as “constant volume” continue to operate as per normal operation mode.

System Stop: On shutdown of associated AHU system, supply air damper of terminal unit boxes goes to preset (adjustable) position. Hot water valve V1 on reheat coil shall modulate to maintain room temperature.

Fire Alarm: N/A

Schedule: As per associated fan schedule.

Alarm:	F1	Abnormal terminal unit air flow +/- 20-25%
	T1	Space temperature out of range – high: 3°C > setpoint; low: 2°C < setpoint (only when window is closed)

CS101 – Recirculating AHU Operation

Reference:	Mechanical Drawings and Schematics
Applicable Systems:	F-01 and RF-01

System Start:

System start is by operator locally or at B.A.S.

During normal operation (i.e. existing AHU is also in operation), close damper D14.

Heating Valve V2, and Cooling Coil Valve V4 are enabled whenever system fans are operating. Humidifier Valve V3A/B are enabled when outdoor air temperature <= 10°C.

Outdoor Air Damper D1, Exhaust Air Damper D4, Return Air Damper D5 and Supply air damper D2 are enabled.

Return fan ESS2 is enabled. Damper open limit switch on each damper is monitored by BAS. When exhaust (or mixed) air dampers D3/D4 are proved 80% open, return fan is allowed to run.

Supply fan ESS1 is enabled and allowed to run once Return Fan is proved operating EST2 for 15 seconds.

Normal Operation:

Fan Operation

Fans are to maintain system static pressure as determined on-site. Outdoor air damper is to maintain 33% fresh air minimum in all modes of operation (except for catastrophic event mode of operation).

Supply Air Temperature Control

Heating Mode:

When Outdoor Air Temperature T0 is below Supply Air Temperature setpoint T3 of 12.7°C (adjustable), Outdoor Air Damper D1, Exhaust Air Damper D4 and Mixed Air Damper D3 modulate to maintain Mixed Air Temperature T1 at setpoint of 12.7°C (adjustable). On further decrease in Outdoor Air Temperature T0, Heating Valve V2 modulates to maintain the Supply Air Temperature T3 setpoint.

Free Cooling Mode:

When Outdoor Air Temperature T0 is equal to Supply Air Temperature setpoint T3 of 12.7°C (adjustable), Mixed Air Damper D3 fully closes. Outdoor Air damper D1 fully opens. All heating and cooling coil valves close and humidifier valve V2 modulates to maintain return air humidity setpoint H2, noted below.

Cooling Mode:

When Outdoor Air Temperature T0 is above Return Air Temperature T5, Outdoor Air Damper D1 modulates to meet system mini-mum outdoor air requirement. Mixed Air Damper D3 modulates to provide make up air as required; Cooling Coil Valve V3 modulates to maintain Supply Air Temperature T3 setpoint.

Supply Air Temperature Reset:

Continually reset Supply Air Temperature setpoint T3 higher until the first occurrence of an associated reheat coil valve position at 10% or less open (all other valves more than 10% open, or Return Air Humidity H2 exceeds 60%.

Hold current value setpoint until the first associated reheat coil valve fully closes, then begin resetting Supply Air Temperature T3 setpoint lower. Continually reset Supply Air Temperature T3 setpoint lower until all associated reheat coil valves are open at least 20%.

Maximum rate of Supply Air Temperature T3 setpoint change is 0.5°C /15 minutes (adjustable) increase or decrease.

Humidifier Control:

Humidifier Valve V3 modulates to maintain Return Air Humidity H2 setpoint. Return Air Humidity H2 setpoint to be scheduled in accordance with Outdoor Air Temperature T0 as follows:

	Outdoor Air Temp -23°C	Outdoor Air Temperature +10°C
Maximum Return Air Humidity H2 Setpoint % RH	30	40

Supply Air Humidity H1 sensor overrides Return Air Humidity H2 signal to limit Humidifier Valve V3 to limit Supply Air Humidity H1 of 80% RH. When Outdoor Air Temperature T0 is above 10°C (adjustable), Humidifier Valve V3 is disabled.

Pressure and Flow Control:

Supply air static pressure P1 modulates supply fan adjustable frequency drive maintain constant system pressure and demand air volume.

P2 overrides control of EV1 to maintain pressure below the limit setpoint.

Return air static pressure P3 modulates return fan adjustable frequency drive maintain constant system pressure and demand air volume.

Freeze Protection Trip:

Automatic-resetting low temperature alarms TLA1 trip on plenum temperature below +2°C. Provide 30 second (adjustable) debounce timer. Automatic reset will occur based on rise above fixed temperature differential

On first trip, BAS to restart system and record alarm event. Bypass FZ TLA1 for 30 seconds to allow airflow to increase temperature at sensor

On second trip, BAS to initiate a second restart

On third trip, BAS to lock out unit and generate a priority alarm.

System Stop:

System shut down is initiated by schedule or operator command at BAS.

Upon signal to stop system, Return Fan ESS2 and Supply Fan ESS1 stop. All isolation dampers close.

System Failure:

Failure of new AHU:

On failure of new AHU implement system stop protocols and alarm at B.A.S. Open damper D14 and close damper D9 and D15

Failure of existing AHU:

On failure of existing AHU, close all motorized dampers to/from OR 15 (D7 and D10) and main return dampers (D12 and D13). Speed up VFD to maintain the minimum airflow to both OR14 and 16.

Fire Alarm: System remains in operation at 100% outdoor air mode

Smoke Control: If unit is running, smoke control sequence to match existing units' operation

Catastrophic Events: Interior Catastrophic Event: unit runs in 100% outdoor air mode. Confirm recirculation damper D3 is closed and exhaust and outdoor air dampers D1 and D2 are fully open. Heating/Coiling coil valves and humidifier valves modulate to main setpoints.

Exterior Catastrophic Event: unit runs at 100% recirculation mode. Recirculation damper D3 opens, once proven 50% open, fresh air and exhaust air dampers D1 and D2 close

Schedule: Continuous 24/7

Monitor: All points shown on schematic

Alarms:

EST1 Supply fan status from AFD fault
EST2 Return fan status from AFD fault
F1 Supply Fan smoke detection

F2 Exhaust Fan smoke detection

F3 Exhaust air temperature high (fire stat protection F3) above 152°F to shut-down fan system (hardwired to supply and exhaust fan VFDs)

T3 Supply Air Temperature out of range - Low: 10.5°C, High: 18.5°C

H1 Supply Air Humidity high at 80% RH

P1 Supply Pressure high at 4 in.wg. (adjustable), shut down fan system (hard-wired to supply fan and exhaust VFDs)

P3 Return Pressure high at 3 in.wg. (adjustable), shut down fan system (hard-wired to supply fan and exhaust VFDs)

PDHA1 Supply Pre-Filters dirty at 250 Pa Pressure Drop

PDHA2 Final Filters dirty at 375 Pa Pressure Drop

TLA1 Low plenum air temperature (freeze protection – FZ) below 2°C to shut-down fan system

AFD Fault Reset:

Loss of Power

On loss of power detection through AFD under-voltage trip, on resumption of line power the adjustable frequency drives will automatically attempt after a 60 second delay one (1) re-start in a 30 second period. If the drive fails to reset the fault, the operator will manually initiate an external reset through the BAS or locally at the drive control panel.

Any Other Fault Condition

For any other fault condition, the drive will not automatically reset. The operator will manually initiated an external reset through the BAS or locally at the drive control panels.

Emergency Power: Yes

Electrical Specifications

FOR

M Wing, Second Floor, Hybrid Operating Room

Sunnybrook Health Sciences Centre

2075 Bayview Avenue
Toronto, Ont.
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LIST OF SECTIONS
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DIVISION 26

DIVISION 27

DIVISION 28

END OF SECTION

ELECTRICAL GENERAL REQUIREMENTS
26 05 01

PART - 1 GENERAL REQUIREMENTS

1.1 SCOPE

.1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 1.

.2 Comply with General Conditions of Contract, Supplementary Conditions and Division 01 - General Requirements.

.3 Where conflict occurs between Codes, Specification and Drawings, plan and riser, the maximum condition to govern, and the Tender to be based on whichever indicates the greater cost.

1.2 WORK INCLUDED

.1 Work to be done under this section to include furnishing of labour, materials and equipment required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

1.3 DOCUMENT ORGANIZATION

.1 Applicable Divisions for Electrical Work:

.1 Division 26 - Electrical
.2 Division 27 - Communications
.3 Division 28 - Electronic Safety and Security

.2 For clarity, any reference in the Contract Documents to Division 26 includes Division 27 and 28.

.3 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.

.4 Contractor is responsible for completion of work whether or not portions are sublet.

1.4 DIVISION 26, AS IT APPLIES TO DIVISION 27 AND 28

.1 Articles that are of a general nature, applicable to each Section of these Divisions.

.2 Articles specifying materials, equipment, installation techniques and workmanship that are applicable to more than one Section of these Divisions.

.3 Articles that are to be read in context with and form part of relavent Sections of these Divisions.

1.5 DEFINITIONS

.1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in this Specification, mean that material or item referred to is "indicated", "shown", "listed" or "noted" on Drawings.

.2 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases used in this Specification, mean that material or item referred to is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by", Consultant.

.3 Instructions using any form of word "provide" involves Contractor in furnishing labour, materials and services to supply and install referenced item.

1.6 **LANGUAGE**

.1 Specification is written as series of instructions addressed to Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where list follows semi-colon (;) punctuation is for clarity, where list follows colon (:) punctuation is to be read as short-hand form of verb “to be” or “to have” as context requires.

.2 It is not intended to debate with Contractor reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

1.7 **EXAMINATION**

.1 Examine any existing buildings and services, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of work.

.2 Examine work of other Divisions before commencing this work, and report any defect or interference.

.3 No allowance will be made for any expense incurred through failure to make these examinations of site and documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender.

1.8 **DESIGN SERVICES**

.1 Provide design services for elements of the Work where specified in other sections of Division 20, sealed by a professional engineer licensed in the applicable jurisdiction.

1.9 **STANDARD OF MATERIAL AND EQUIPMENT**

.1 Provide materials and equipment in accordance with Section 01 61 00 - Material and Equipment.

.2 Materials and equipment:

.1 new and of uniform pattern throughout work,
.2 of Canadian manufacture where obtainable,
.3 labelled or listed as by Code and/or Inspection Authorities CSA certified and CMB listed. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority.,
.4 standard products of approved manufacture.
.5 in compliance with Standards and Regulations with respect to;
(a) chemical and physical properties of materials,
(b) design,
(c) performance characteristics, and
(d) methods of construction and installation.
.6 identical units of equipment to be of same manufacture.
.7 In any unit of equipment, identical component parts to be of same manufacture, but various component parts comprising unit need not be from one manufacturer.

.3 Materials and equipment are described to establish standards of construction and workmanship.

.1 Where manufacturers or manufacturers products are identified in lists with phrase "Standard of Acceptance", these are manufacturers and/or products which meet standards with regard to performance, quality of material and workmanship.
.2 Manufacturers and or products used are to be chosen from these lists.

.4 Include items of material and equipment not specifically noted on Drawings or mentioned in Specifications but which are required to make an operating system.

.5 Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Sections, before such items are purchased.

.6 Factory fabricate control panels and component assemblies.

.7 Select materials and equipment in accordance with manufacturer's recommendations and install in accordance with manufacturer's instructions.

.8 Materials and equipment not satisfying these selection criteria will be condemned.

.1 Remove condemned materials from job site and provide properly selected and approved materials.

1.10 **SUBSTITUTIONS**

.1 The use of a substitute article or material which the Contractor represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions:

.1 a substitution will not be considered for reasons of meeting the construction schedule unless the Contractor can demonstrate to the satisfaction of the Consultant they made all reasonable efforts to procure the specified product or material in a timely fashion,

.2 the Contractor must advise the Consultant of this intention to use an alternative article or material before doing so,

.3 the burden of proof as to the quality and suitability of alternatives to be upon the Contractor and they shall supply all information necessary as required by the Consultant at no additional costs to the Contract,

.4 the Consultant to be the sole judge as to the quality and suitability of alternative materials and their decision to be final,

.5 where use of an alternative material involves redesign or changes to other parts of the work, the costs and the time required to effect such redesign or changes will be considered in evaluating the suitability of the alternative materials,

.6 no test or action relating to the approval of substitute materials to be made until the request for substitution has been made in writing by the Contractor and has been accompanied by complete data as to the quality of the materials proposed. Such request to be made in ample time to permit appropriate review without delaying the work, taking into consideration that such a substitution request may be rejected and require providing the product or material as originally specified,

.7 Whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials to be accompanied by reports from the equivalent body indicating compliance with the requirements of the specifications,

.8 The costs of all testing required to prove equality of the material proposed to be borne by the Contractor.

PART - 2 SUBMITTALS

2.1 **SHOP DRAWINGS AND PRODUCT DATA**

.1 Submit shop drawings, manufacturers and product data and samples in accordance with Section 01 33 05;

.1 Submit for each item of equipment such as Panelboards, Luminaire cuts and Special Systems.

.2 Submit shop drawings in the same unit of measure as are used on the drawings. Both metric and imperial measures may be included.

.3 Submit shop drawings by email to: shopdrawings@hhangus.com

.2 Include a H.H. Angus shop drawing cover sheet form prepared for this project, for each shop drawing (sample included at the end of this section), or, include the same information on the contractors submittal cover sheet:

.1 Information required on each submission:
- (a) Client/Architect name
- (b) Project Name
- (c) H.H. Angus project number
- (d) Date
- (e) Contractor name
- (f) Contractor reference No.
- (g) Manufacturer name
- (h) Product type
- (i) Specification section number
- (j) Contractor trade: mechanical, electrical, elevators, or general trades
- (k) If a re-submission, the previous submission H.H. Angus reference number.

.3 Submit shop drawings in PDF format;

.1 If submitted in hardcopy format, submit in 11 x 17, black and white originals of graphic quality suitable for photocopying. Allow one additional week for processing of shop drawings submitted in hardcopy format.

.4 Manufacturers printed product data sheets for standard items are acceptable in place of shop drawings providing physical characteristics are identified and are related to specification references.

.5 Submit manufacturers data sheets with typed schedules listing manufacturers and suppliers name and catalogue model number for such items as fire alarm system components, etc.

.6 For luminaires, submit luminaire cuts with manufacturer’s names and catalogue numbers for all luminaires to be used on the job. Identify and arrange the luminaire cuts and catalogue numbers in the same sequence as the Specification Luminaire list.

.7 Shop drawings and product data to show:

.1 CSA or equivalent approval.
.2 Dimensioned outlines of equipment.
.3 Dimensioned details showing service connection points.

.8 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.9 Where applicable, include wiring, single line and schematic diagrams.

.10 Include wiring drawings or diagrams showing interconnection with work of other Sections.

.11 Each shop drawing to be checked and stamped as being correct, by trade purchasing item, before drawing is submitted. If above requirements are not complied with, shop drawings will be rejected and returned forthwith.

.12 Before manufacture or assembly of the equipment, submit only the shop drawings showing dimensioned outlines of equipment and elevations illustrating locations of visible equipment such as breakers and their trip settings, windows, meters, and description of operation as well as single line diagrams. Submit drawings showing construction details, component assemblies or interior wiring diagrams which may be necessary for the correct functioning of the equipment.

.13 For manufacturer's data and lighting fixtures, submit for approval, bound sets showing the fixture cuts, manufacturer's name and catalogue numbers. Each folder or binder to be

complete with all fixtures used on the job. Arrange the fixture cuts and catalogue numbers and identify in the same sequence as the specified fixture list.

2.2 **FIELD, FABRICATION, OR INSTALLATION DRAWINGS**

.1 Contractor field, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal only will be returned identifying the submitted drawings have not been reviewed.

.2 Maintain a copy on site of such drawings for reference by the Consultant.

.3 Provide a copy of such drawings to the Consultant for general information purpose only, upon request.

2.3 **OPERATING AND MAINTENANCE DATA**

.1 Provide operation and maintenance data bound in 210 mm x 300 mm x 50mm thick (8½ in x 11 in x 2 in thick) size, vinyl covered, hard back, three-ring covers.

.1 Organize material in volumes generally grouped by Division Section; Site services, Power, Lighting, Low Voltage Systems, Fire Alarm and Security.
.2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear Project Name, Project Number, Date, Trade Section, and List of Contents.
.3 Provide three hard-copies to Owner.

.2 In addition,provide Adobe PDF files for each document, produced from original direct-to-digital file creations.

.1 Organize documents into separate PDF files for each Division Section identified above, and apply Adobe Bookmarks to create Table of Contents.

.3 Include in operations and maintenance data:

.1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
.2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
.3 Wiring and schematic diagrams and performance curves.
.4 Names and addresses of local suppliers for items included in maintenance manuals.
.5 Copy of reviewed shop drawings.
.6 The operating characteristics of the equipment supplied such as calibration curves and coordination data to allow proper co-ordination with owner’s equipment.
.7 Description of operation of the controls and protective devices used.
.8 Maintenance and adjustment procedures, and lifting and jacking instructions.
.9 Fault locating guide.
.10 Spare parts list and an itemized cost.
.11 Name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.

2.4 **OPERATING AND MAINTENANCE INSTRUCTIONS**

.1 Supply the services of a skilled tradesman for a minimum of two consecutive full days to start each system in its proper sequence, and test and calibrate controls and set-up systems.

.2 During this procedure thoroughly explain the operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other sections in this Division.

.3 Arrange suitable time for instructions with Owner's operating and maintenance personnel.

.4 Keep a record of date and duration of each instruction period together with the names of persons attending. Submit signed records at completion of instruction.

2.5 **CARE, OPERATION AND START-UP**

.1 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with every aspect of the operation, care and maintenance thereof.

2.6 **RECORD DRAWINGS**

.1 Provide record drawings in accordance with Section 01 78 05.

.2 A set of design drawings in AutoCad 2016 on CD or DVD ROM will be provided by the Consultant. Make sets of white prints for each phase of Work, and as Work progresses and changes occur mark white prints in coloured inks to show revisions. Dimension locations of drains, pipes, ductwork, conduit, manholes, foundations and similar buried items within the building, with respect to building column centres. Mark level with respect to an elevation which will be provided.

.3 Survey information from excavation and backfill of site services to be held on site, after approval, and to be similarly transferred to white prints.

.4 Retain these drawings and make available to Consultant for periodic review.

.5 On a weekly basis, scan marked-up drawings to Adobe .pdf format. Where a project has a FTP site, post these files on a weekly basis.

2.7 **AS-BUILT DRAWINGS**

.1 Prior to testing, balancing and adjusting, transfer site record drawing information to AutoCad 2016 (CAD) files, to record final as-built condition. Obtain a current set of CAD files from the Consultant.

.1 Drawings are to remain set to and follow Consultants AutoCad Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.

.2 The Consultant's CAD files may not reflect all or any construction changes.

.2 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the CAD files to record these changes. “Bubble” these revisions, and place these annotations on a separate and easily identified drawing layer.

.3 As-built drawings to show the final as-built condition.

.4 Show on electrical as-built drawings final location of conduit, outlets, panels, branch wiring, system wiring, pull boxes, bus ducts, and equipment.

.5 Show on site services as-built drawings survey information provided by Ontario Land Surveyor (OLS) monitoring services installation.

.6 Identify each drawing in lower right hand corner in letters at least 12 mm (½") high as follows "AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed" (Signature of Contractor) (Date). The site services drawings are to include (Signature and Stamp of OLS) attached to note.

.7 The site services drawings are to include (Signature and Stamp of OLS) attached to note.

.8 Once “AS BUILT DRAWINGS” white prints are reviewed, transfer Consultant's comments to the CAD files. Return AutoCad drawings modified to “As Built” condition to Consultants on CD or DVD Rom.

.9 Submit three (3) sets of white prints and three (3) copies of CAD files with Operating and Maintenance Manuals.

PART - 3 REFERENCE CODES STANDARDS AND REGULATIONS

3.1 CODES AND STANDARDS

.1 Do complete installation in accordance with Ontario Electrical Safety Code (OESC) except where specified otherwise.

.2 Do underground systems in accordance with CSA C22.3 No.7-M86 except where specified otherwise.

.3 Abbreviations for electrical terms: to CSA Z85-1983.

.4 Comply with CSA Certification Standards and Ontario Electrical Safety Code Bulletins in force at time of Tender submission.

Where requirements of this specification exceed those of the above mentioned standards, this specification to govern.

3.2 CONFINED SPACES

.1 Unless otherwise proscribed by the Constructor’s / Owner’s workplace safety program, treat spaces not designed and constructed for continuous human occupancy as “confined spaces”, including but not limited to:

.1 horizontal and vertical service spaces, shafts, and tunnels,
.2 inside of equipment which permits entry of the head and/or whole body, and
.3 ceiling spaces which are identified as containing a hazardous substance.

3.3 PERMITS, FEES AND INSPECTIONS

.1 Submit to Electrical Safety Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Consultant will provide drawings and specifications required by Electrical Safety Authority at no cost.

.4 Notify Consultant of changes required by Electrical Safety Authority prior to making changes.

.5 Furnish Certificates of Acceptance from Electrical Safety Authority and authorities having jurisdiction on completion of work to Consultant.

PART - 4 FIELD QUALITY CONTROL

4.1 TESTING

.1 Conduct and pay for following tests:

.1 Power distribution system including phasing, voltage, grounding and load balancing.
.2 Circuits originating from branch distribution panels.
.3 Lighting and its control.
.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system, communications.

.2 Arrange and pay for services of applicable manufacturer's factory service engineer or certified independent testing organization to supervise initial start-up of specialized portions of installation and to check, adjust, balance and calibrate components including related wiring and controls. Provide these services for such periods, and for as many visits as may be necessary to put applicable portion of installation in complete working order. Provide a certificate indicating that the equipment is free and clear of deficiencies.

.3 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.4 Insulation resistance testing.

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
.3 Check resistance to ground before energizing.

.5 Carry out tests in presence of Consultant.

.6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.7 Submit test results for Consultant's review. Test electrical equipment to standards and function of specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

4.2 LOAD BALANCE

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, report listing phase and neutral current on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

4.3 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as per equipment manufacturers recommendations for each piece of equipment.

4.4 CLEANING

.1 Do final cleaning [in accordance with Section 01 74 23.

.2 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt, including the top surface, whether exposed or in the ceiling space.

.3 Clean switch, receptacle, and communications outlets, coverplates, and exposed surfaces.

.4 Clean all other electrical equipment and devices installed as part of this project.

.5 Electrical, UPS Equipment or Communication Closets:

.1 Thoroughly vacuum and clean interiors and all panels, cabinets and other electrical equipment of all construction debris and dust prior to energization using a HEPA vacuum cleaner. Final clean using clean lint free cloths with a cleaning liquid as recommended by the manufacturer for the purpose.

.2 HEPA vacuum the top of all panels, cabinets, cable trays and conduits, followed by a thorough HEPA vacuuming of the floors. Thoroughly wash floors with wet mop and clean water. Control access to the room after cleaning. Provide temporary filter media on air supply ducts to these rooms to prevent re-contamination from other areas of construction.

.3 Thoroughly re-clean as necessary prior to final turn over.

4.5 FINAL INSPECTION

.1 At project completion submit written request for a final inspection of electrical systems. Include with this submission written certification that:

.1 Deficiencies noted during job inspections have been completed.
.2 Systems have been balanced and tested and are ready for operation.
.3 Completed maintenance and operating data have been submitted and approved.
.4 Tags are in place and equipment identification is completed.
.5 The cleaning up is finished in every respect.
.6 All electrical panels, switchboards, cabinets, and equipment surfaces have been touched up with matching paint, or re-finished as required
.7 Spare parts and replacement parts specified have been provided and receipt acknowledged.
.8 As-built and Record drawings are completed and approved.
.9 Owner's operating personnel have been instructed in operation and maintenance of systems.
.10 Fire alarm verification is 100% completed and Verification Certificate has been submitted and accepted.

PART - 5 EQUIPMENT

5.1 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Safety Authority and Consultant.

.2 Porcelain enamel decal signs, minimum size 175 mm x 250 mm (7" x 10").

5.2 PROTECTION

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

5.3 SLEEVES AND CURBS

.1 Provide sleeves of galvanized steel for conduit and cable runs passing through concrete walls, beams, slabs and floor. Sleeves for bus ducts, wireways and cable trays to be minimum 3 mm (1/8") galvanized steel.

.2 Provide concrete curbs, minimum 100 mm (4") high above finished floor surrounding openings where bus ducts, wireways and cable trays rise through slabs above grade to prevent debris and water from falling to floor below. Concrete curb to have sufficient area to adequately carry bus duct support brackets.

.3 Provide concrete curbs, minimum 100 mm (4") high above finished floor for telephone cable risers and other openings intended for electrical use in slabs above grade.

.4 Extend galvanized sleeves for conduit rising through slabs 100 mm (4") minimum above finished floors. Provide sleeves, passing through floors having a waterproof membrane, with an integral flashing clamp.

.5 Where cables or conduits pass through floors and fire rated walls, pack space between wiring and sleeve full with Fireproofing, and seal with caulking compound conforming to CANZ-19.13.

5.4 **FIREPROOFING**

.1 The integrity of the fire resistance rating of the floors and walls to be maintained around electrical raceways and/or cables passing through such floors and/or walls.

.2 Materials used to maintain fire resistance ratings to have a minimum 2 hour ULC or cUL listed rating.

.3 Wiring may penetrate a fire resistance rated assembly provided it is enclosed in non-combustible conduit, and the passage of the conduit in turn is suitably sealed to the assembly with fire stop material.

.4 Wiring with a combustible covering and not enclosed in non-combustible conduit penetrating a fire resistance rated assembly shall be grouped into separate fire sealed penetrations to ensure the overall diameter of the combined wire(s) in each penetration does not exceed 25 mm, and that the integrity of the fire rated assembly is not compromised.

.5 Single conductor metal sheathed cables shall be arranged to individually penetrate the fire rated assembly and be individually fire stopped.

.6 Where wiring is installed in cable trays and must penetrate a fire rated assembly, stop and independently support the cable tray immediately on each side of the fire rated assembly while allowing sufficient working room to properly install and inspect the fire rating materials and penetration.

Standard of Acceptance

- Thomas & Betts - Flame-safe
- Nelson/Wieland (Electrovert) - Flameseal
- Double A/D Distributors Ltd. - Firebarrier Firestopping
- Canstrut - Elasta-Seal MBF-KBF sealbags (where open tray passes through floor slab)

5.5 **SPRINKLER PROTECTION**

.1 Equipment in sprinklered areas, except for weatherproof equipment, must be provided with hoods or shields and gasketted doors for protection against sprinkler discharge, and to comply with the requirements of OESC.

.2 Ventilation openings to be overhanging drip proof type

.3 Weatherproof equipment, where noted in the specifications and/or drawings to have EEMAC type 3 enclosures in accordance with the requirements of CSA C22.2 No. 94 Standard.

.4 Surface panelboards, switchboards and other electrical equipment in sprinklered areas to be fitted with watertight hubs with insulated throat for all conduit entrances.

Standard of Acceptance

- Thomas & Betts Ltd. - Series 401
- Efcor of Canada Ltd. - Series 40-50B

5.6 **ACCESS DOORS**

.1 **In all cases where electrical elements, requiring access, are concealed above ceilings or in walls this Division is responsible to review, in the presence of the Owner, the Architect, the Consultants and the General Contractor, the exact details, locations and types of proposed access.**

.2 Submit list of proposed access door locations and obtain approval thereof before commencing access door installation.

.3 Submit access door shop drawings for approval as soon as possible after Award of Contract, showing size, type and exact location of access doors.

.4 Access doors, unless otherwise specified or shown, to be at least 3 mm (12 gauge) steel, finished prime coat only, with concealed hinges, anchor straps, plaster lock, without screws.

.5 Access doors in ceilings, where acoustic tile is applied to plaster or gypsum board, to be dish type designed to receive the tile insert.

.6 Inside frame dimensions to be approximately 300 mm x 450 mm (12" x 18"). However, if it is necessary for personnel to enter through doors, they to be at least 600 mm x 450 mm (24" x 18").

.7 Access doors to be as manufactured by:

Standard of Acceptance

- Zurn Industries Canada Ltd. - Inspectors
- LeHage Industries Ltd.
- A. G. Baird Limited - ABCO
- Stelpro Limited - Type 700

.8 Provide access doors for locations where equipment requiring maintenance or adjustment is "built-in".

.9 These access doors will be installed under the Division in whose work they occur. Arrange for and pay cost of access door installation.

.10 Access doors are not required in removable acoustic panel type ceilings.

.11 Provide approved coloured marking devices after completion of such ceilings, at four corners of each panel below point requiring access.

.12 Size and locate access doors in applied tile, or in glazed or unglazed structural tile to suit tile patterns. Refer to Architectural Room Finish Schedule and details on Architectural Drawings in this regard.

PART - 6 COORDINATION

6.1 GENERAL

.1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductwork, piping, etc, and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as “double line”, they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

.2 Lay out and coordinate Work to avoid conflict with work under other Divisions. **Note: the Mechanical Contractor is responsible for preparing very detailed three-dimensional Co-ordination/ Interference Drawings (refer to Spec Section 20-01-03) and this Division must co-ordinate/ assist with the preparation of these Drawings ensuring Drawings show, in the three-dimension, all Lights, Power Elements, System Components AND CONDUITS (specifically important in the EP Suite areas)**

.3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.

.4 When equipment provided under other Sections connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

.5 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.

.6 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.

.7 Location of conduit, bus duct, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.8 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the work as an operating installation.

6.2 **FIELD, FABRICATION, AND INSTALLATION DRAWINGS**

.1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services, and to demonstrate coordination with works of other trades.

.1 Drawing scale: minimum 1:50 (1/4"=1'-0")

.2 Use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings.

.3 Layout equipment and services to provide access for repair and maintenance.

.4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;

.1 “This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants’ review”

6.3 **CUTTING AND REMEDIAL WORK**

.1 Cutting and patching of existing work in the areas being renovated under the scope of this project and to accommodate the Work, unless otherwise noted, will be done by the General Trades Contractor. Layout such work for approval before undertaking same.

.2 **However, there are areas where work is delineated for this Division but that does not require work by the General Contractor (specifically, routing of new electrical services through existing un-renovated spaces). In these areas, cutting and patching of existing of general trades work and temporary removal/reinstallation of ceilings to accommodate work of this Division must be arranged and paid for under this Division.**

.3 Assume responsibility for prompt installation of work in advance of concrete pouring or similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade, whose work is involved, to do such cutting and patching. Pay for any resulting costs. Layout such work for approval before undertaking same.

.4 Holes required in existing construction to accommodate cable, raceways, bus duct or cabletray to be cut neatly or drilled.

.5 Division 26 contractor to be responsible for arranging and paying for all cutting and patching as required. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Consultant’s approval of location and methods in writing. Employ original installer or expert in the finishing of material required to perform cutting or patching for weather exposed or moisture resistant elements or sight exposed surfaces.

.6 All core drilling through floor slabs to be X-rayed and verified with Owner's representative prior to coring. Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Reroute any circuits damaged by core drilling.

6.4 **WORK IN EXISTING BUILDING**

.1 Refer to Division 01 - General Requirements.

.2 During the tender period, the Contractor shall perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of As Built conditions to determine scope of renovation or demolition work required prior to submitting tender.

.3 Work includes changes to existing building and changes at junction of old and new construction. Route cabling, ducts, conduits and other services to avoid interference with existing installation.

.4 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services required for the proper installation of new work.

.5 Maintain or relocate existing services which pass through the area of renovation or demolition, but which feed items located outside of these areas. Rewire devices to the original circuits.

.6 Remove existing lighting fixtures, wiring, devices and equipment to suit new construction. Cut back and cap conduits and electrical outlets, not being used, so that finished work presents a neat and clean appearance. Disconnect at point of electrical supply, remove obsolete wiring and conduits, and make existing systems safe. Blank off openings in panels or boxes from removed conduits or ducts.

.7 Unless noted to be reused, removed conduit, wiring and devices become the property of the Contractor and are to be taken from the site and disposed of appropriately.

.8 Removed lighting fixtures and equipment shall be reviewed at site with the Owner's representative, and if the Owner instructs they wish to keep any items, they shall be moved to a designated location on the site. Lighting fixtures and equipment that the Owner does not want shall be taken from the site and disposed of appropriately.

.9 Provide junctions boxes, outlet boxes, wiring, plates, etc..., as necessary for complete relocation of devices, fixtures and equipment.

.10 Revise panelboard directories accordingly if affected by work.

.11 Clean and re-lamp relocated lighting fixtures and replace any faulty ballasts.

.12 On completion of relocations, confirm relocated devices and lighting fixtures are in proper working order.

.13 Co-ordinate work affecting fire alarm system, fire safety, and detection systems with Consultant, Fire Alarm System Manufacturer, and authorities having jurisdiction prior to commencing work. Retain original fire alarm system manufacturer to verify all relocated fire alarm devices and all revised wiring. Provide temporary fire protection and/or a fire watch as required by authorities having jurisdiction in all areas affected by the demolition.

.14 Where Owner wishes to take over renovated areas ahead of project completion date and these areas are intended to be fed from distribution systems in new building, make temporary connections to existing services in these areas. Reconnect to permanent services, at a later date, when new distribution systems are available.

6.5 **CONTINUITY OF SERVICES**

.1 Refer to Division 01 - General Requirements.

.2 Connections to existing systems to be made at approved times. Obtain written approval recording times when connections can be made. Arrange work so that physical access to existing buildings is not unduly interrupted.

.3 Be responsible for any damages caused to existing systems when making connections.

.4 Keep existing buildings in operation with minimum length of shutdown periods. Include overtime work to tie-in piping or wiring at night or on weekends. Provide temporary feeders and connections as required to maintain systems in operation where shutdown periods will exceed 8 hours, or extend beyond the allowable time frame determined by the Owner.

6.6 **VOLTAGE RATINGS**

.1 Operating voltages: to CAN3-C235-83.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

6.7 **FINISHES**

.1 Primary and final painting for Work, other than items specified as factory primed or finished, to be done under Finish Division 9.

.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.4 Leave a quart can or a pressurized spray can of paint, as used with switchboards, with owner for touch-up purposes.

.5 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

.6 Store electrical materials and equipment such as switchboards, panels, transformers and luminaires in a dry, clean location and cover with polyethylene plastic to preserve factory finish.

.7 Protect exposed or free standing equipment with plastic to minimize entry of dust and dirt and marring of finished surfaces during progress of work

.8 Schedule luminaires, lamps and diffusers for installation as late as possible during construction in order to minimize accumulation of dust and/or dirt on them. Clean luminaires and diffusers, not acceptable because of dust and dirt, in an approved manner as specified by manufacturer. Wrap surface mounted and suspended luminaires, installed prior to painting and other dusty construction being completed in the area, in plastic to prevent dirt and paint from settling on them.

6.8 **EQUIPMENT IDENTIFICATION**

.1 Identify electrical equipment with nameplates and labels as follows:

.2 Nameplates:

.1 Nameplates for panels and equipment to be 3 mm (c") thick, black lettering on white background, with bevelled edges and mechanically attached with self-tapping stainless steel screws.

NAMEPLATE SIZES			
Size #	Size	Lines	Letter height
1	10 x 50 mm (½" x 2")	1 line	3 mm (⅛") high
2	12 x 70 mm (½" x 3")	1 line	5 mm (¼") high
3	12 x 70 mm (½" x 3")	2 lines	3 mm (⅛") high
4	20 x 90 mm (1" x 4")	1 line	8 mm (⅜") high
5	20 x 90 mm (1" x 4")	2 lines	5 mm (¼") high
6	25 x 100 mm (1" x 4")	1 line	12 mm (½") high
7	25 x 100 mm (1" x 4")	2 lines	6 mm (¼") high

.3 Labels: Embossed plastic labels with 6 mm (¼") high letters unless specified otherwise.

.4 Wording on nameplates and labels to be approved by [Consultant][Engineer] prior to manufacture.

.5 Allow for average of thirty-five (35) letters per nameplate and label.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

.10 Identify other cabinets for low voltage systems, such as signals and communications, as for panelboards with a directory showing circuit numbers and room locations plus a blank for "Remarks", as well as a lamicoid plate designating panel name.

.11 Typical Identification Standards

.1 Lighting, Receptacle an Power panels to each be identified with an engraved lamicoid plate secured to top interior trim as:
(a) LP-1A 12 mm (½") high lettering
(b) 120/208 volts 5 mm (¼") high lettering
(c) Fed from PP 'AA' 5 mm (¼") high lettering

.2 Supply each panel with a directory card holder welded to inside of door, complete with a neatly typewritten list showing information as follows:

Panelboard Name LP-1A	
Panel Voltage 120/208 Volts	
Circuit Number	Description
1	Lighting Room #34
2	Receptacles Room #34
3	Ice Machine Room #17

.3 Cover list with a 0.8mm (1/32") minimum thick clear plastic sheet to protect it.

.4 Identify equipment not listed above, such as incoming service cables, communicating cables, switchgear, transformers, disconnects, contactor motors, instruments, fire alarm, clock and program equipment and control panels, in a similar manner showing name and number of the equipment, voltage and load information.

.5 Labels for Emergency Lights shall consist of a glue on red dot in one corner of the light lens clearly visible from the floor.

.12 Identify feeder pull boxes and junction boxes with lettering stamped on brass or aluminum tags showing feeder or system concerned, voltage involved and data for both termination points whether equipment or panel. Tag to be held to boxes under lid screws using steel wire.

.13 Apply a small dab of paint to inside of each outlet box, pull box and panel as it is installed, using colour code as follows:

Red	Fire Alarm System and Emergency Voice Communication System
Dark Blue	Intercom and Public Address
Dark Green	Telephone and Data Systems
Black	Annunciator and Buzzer System
Grey	Clock System
White	Central Dictation
Orange	Nurse Call
Yellow	Alarm Systems
Pink	Computer Systems
Light Green	TV Systems
Light Blue	Miscellaneous

.14 Colour code is not required for regular lighting and power circuits.

.15 Junction boxes in furred ceilings to have colour identification on both inside and outside.

.16 Provide identification of emergency lights consisting of a glue-on red dot in one corner of the light unit.

.17 For lighting luminaires specified with both a normal and emergency power connection provide identification on luminaires internal barrier designating dual power feeds.

.18 Cubicles and/or cells to include main identifier nameplate on rear of cells

Standard of Acceptance

- W. M. Brady Co. of Canada Limited - B350
- IDI Electric (Canada) Ltd. - Style A

6.9 **WIRING IDENTIFICATION**

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1-1990.

.4 Use colour coded wires in communication cables, matched throughout system. Schedule and chart marker number or colour with corresponding equipment and include with record drawings or operation and maintenance data.

.5 Connections in equipment to be Phase A, B, C from left to right when viewing from front or accessible direction.

.6 Carry colour coding through from incoming utility supply down to and including panels as follows:

.1 Identify incoming utility service lines by Red - Phase "A", Black - Phase "B", Blue - Phase "C", with enamel paint.
.2 Band switchgear buswork in each switchboard and unit substation cubicle with tape identified in accordance with service lines colour-coding. In addition, where neutral bus is introduced, it to be banded white. Ground bus to be banded green.
.3 Band feeder and sub-feeder bus or conductors as above.
.4 Band main bus on lighting and power panels with tape as follows, to conform to the Electrical Safety Code.

Red	Phase A
Black	Phase B
Blue	Phase C
White	Neutral
Green	Ground
Orange	Control

.7 Identify control conductors for motors and equipment by pressure sensitive tape markers or permanent PVC sleeve markers at each main terminal point and wherever they are introduced into ducts or equipment. Schedule and chart marker numbers with corresponding machine numbers and locations and include with Record Drawings.

6.10 **CONDUIT AND CABLE IDENTIFICATION**

.1 Label feeder conduits.

.2 Locate labels as follows:

.1 At every end of every conduit, duct or cable run, adjacent to item of equipment serviced.
.2 On each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall partition or floor).
.3 At intervals of 15 m (50') along every exposed conduit, duct or cable run exceeding 15 m (50') in length.
.4 At every access point on concealed conduit duct or cable.

.3 Labels to be visible from 1.5 m (5') above adjacent floor or platform.

6.11 **WIRING TERMINATIONS**

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

.2 Manufacturers and CSA labels to be visible and legible after equipment is installed.

6.12 **LOCATION OF OUTLETS**

.1 Locate outlets in accordance with Division 01 - General Requirements.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm (6") horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10'), and information is given before installation.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

6.13 **MOUNTING HEIGHTS**

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

Description	General Area	Barrier Free
Local switches	1200 mm (47")	1200 mm (47")
Wall receptacles: General	600 mm (24")	600 mm (24")
Wall receptacles: above top of continuous baseboard heater	200 mm (8")	200 mm (8")
Wall receptacles: above top of counters or counter splash backs	175 mm (7")	175 mm (7")
Wall receptacles: In Mechanical rooms	1200 mm (47")	1200 mm (47")
Panelboards	As required by code or as indicated	
Telephone outlets	600 mm (24")	600 mm (24")
Wall mounted telephone outlets	1500 mm (60")	1200 mm (47")
Fire alarm pull stations	1500 mm (60")	1200 mm (47")
Fire alarm bells	2100 mm (83")	
Television outlets	300 mm (12")	450 mm (18")
Wall mounted speakers	2100 mm (83")	

Description	General Area	Barrier Free
Clocks	2100 mm (83")	

6.14 **CONDUIT AND CABLE INSTALLATION**

.1 Sleeves through concrete: galvanized steel, minimum 3 mm (c") sized for free passage of conduit, and protruding 50 mm (2").

.2 Arrange for holes through exterior walls and roof to be flashed and made weatherproof under Division 7.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.4 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions and assistance to locate and install inserts.

.5 Secure inserts firmly to form work before concrete is poured.

.6 Provide sleeve and insert drawings as required.

6.15 **PLYWOOD BACKBOARDS**

.1 Provide plywood backboards in electrical and telecommunications rooms and closets where indicated on drawings and where referenced under various sections of the specifications for mounting of equipment.

.2 Plywood to be securely fixed to the building structure.

.3 Plywood to be 19mm, void free, good one side, mounted with good side exposed

.4 Plywood to be Class A fire retardant, FSC certified, contain no added urea formaldehyde, and be suitable for compliance with LEED credits MR 5.1 + 5.2 (Manufactured and Extracted Regionally), MR 7.0 (Certified Wood), and EQ 4.4. (Low Emitting Materials). Provide necessary documentation to support LEED credit application process.

.5 Plywood to be treated as follows on all surfaces:

.1 Initially seal the plywood with one coat of Sherwin Williams part No. B49 W 2 wood primer
.2 Follow with one coat of Flame Control 10-10 Intumescent Fire Retardant Paint
.3 Finish with one coat of Flame Control 40-40 Fire Resistant Paint

6.16 **WIRING OF MECHANICAL TRADES MOTORS**

.1 To limit responsibility and to specifically define the Work under this Division, use the following procedure with regard to motors provided under Mechanical Division 20..

.2 The Contractor under Mechanical Division 20 will be responsible for installing equipment which he supplies including motors, starters, disconnect switch, Motor Control Centres and miscellaneous controls of the type specified. **For Refrigeration Equipment compressor and D/X Air Conditioning Equipment, Division 26 is to provide a weather-proof disconnect at the equipment, mounted independent of the A/C Equipment and complete final connection to the equipment using a minimum of 610mm (24") length of seal-tight flex conduit**

.3 In every instance whether pertaining to Plumbing, Air Conditioning, Refrigeration, Heating or Ventilating equipment, wire to line side of the Motor Control Centre, disconnect switch, or starter provided by these trades, in reasonable proximity to equipment being controlled.

.4 From this point, unless otherwise noted, the cost of electrical material and labour will be borne by the particular trade whose work is involved. That trade will mount starter and wire from it to motor being controlled, together with control wiring, remote switches, and pilot lights.

.5 Where individual starters and controls are grouped together, the Contractor under Mechanical Division 20 will provide a panel for mounting his equipment. Provide a feeder, main fused disconnect, a splitter of adequate size and capacity, [individual fused disconnect switches,] and wire to line side of the Division 20 starters.

.6 For Refrigeration Equipment compressor and D/X Air Conditioning Equipment, Division 26 is to provide a weather-proof disconnect at the equipment, mounted independent of the A/C Equipment and complete final connection to the equipment using a minimum of 610mm (24") length of seal-tight flex conduit.

.7 In the case of unit heaters, reheat coils, electrical control devices, and cabinet unit heaters, terminate wiring in an outlet immediately adjacent to motor or device being electrically powered. Wiring from this point to starter, thermostat, or other devices will be done under Mechanical Division 20.

.8 Provide branch circuit wiring and an outlet for each motorized damper or heating control.

.9 Ascertain exact locations of starters, Motor Control Centres and motors, from Mechanical Drawings.

.10 Motors up to and including 0.25 kW (¼ HP) to be 120 volt, 60 Hz, single phase.

.11 Motors.37 kW (½ HP) and above to be 3 phase, 60 Hz, voltage as noted

6.17 TEMPORARY AND TRIAL USAGE

.1 Temporary and trial usage by Owner of equipment or any other work or materials supplied before final completion and written acceptance is not to be construed as evidence of acceptance by Consultant.

.2 Consultant to have the privilege of such temporary and trial usage, as soon as supplier claims that said work is completed and in accordance with specifications, for such reasonable length of time as is deemed to be sufficient for making a complete and thorough test of same.

.3 Claims for damage not to be made by supplier for the damage to or breaking of any parts of such work which may be used, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

6.18 COMMISSIONING

.1 Equipment supplied on this project will be subject to detailed factory inspection and on-site testing and commissioning prior to being placed in service. The electrical contractor, their major system and equipment suppliers, and the Independent Testing Agent (ITA) will be required to participate in special commissioning meetings to review progress and status of the commissioning program.

.2 Include in Bid amount for licenced electricians to participate in the commissioning program, to undertake temporary power connections, operation of equipment, opening and closing of panel boards and switchboards, testing of power and control wiring, and assisting the ITA and the equipment suppliers' field personnel in the start up and testing of the equipment.

.3 The contractor and equipment suppliers to include in the Bid amount for all costs to accommodate and undertake factory and site testing.

6.19 **TRAINING**

.1 Include in the major equipment supply tender prices the services of a qualified technical representative to conduct "hands-on" training programs for the Owner's staff.

.2 The training to include an overview of equipment function and operation, basic inspection, housekeeping and logging procedures.

.3 Submit an outline of the training program for review, adjustment and approval by the Consultant. Training will occur in up to 3 separate sessions, at a time convenient to the Owner, to suit multiple shift maintenance staff schedules.

.4 Sessions may be videotaped by the Owner as an aid to ongoing training of Owners staff.

6.20 **PROTECTION DURING CONSTRUCTION**

.1 Provide protection required to enable existing building and equipment to remain in continuous and normal operation, and maintain construction schedule.

.2 Take the necessary precautions to protect equipment, existing building and service from damage during rearrangement. Accept responsibility for any damage which may occur and make good without cost to the Owner. Accept responsibility for damage to existing services and make good without cost to the Owner.

.3 It is of vital importance, during work of this Contract, that all existing surfaces and items, including walls, floors, ceilings, windows, doors and frames, piping, ductwork and light fixtures, are not damaged in any way whatsoever by the work of all trades. Take all precautions required or necessary to prevent any such damage, supplying all protection, hoarding, tarpaulins and dust sleeves. Any damage caused because of lack of such protection or lack of preventative measures to be made good at no cost to the Owner. Ensure that the work in the existing building, such as floors, finishes and trim, is protected as completely as possible to hold the replacing of damaged work by each sub-contractor to a minimum.

.4 Care to be taken when working above or around UPS modules, batteries and switchgear as this equipment must remain in service. Care to be taken to eliminate dust in these equipment areas.

.5 Switchgear fronts must be protected from accidental breaker trips when working around or above them. Provide a extended shield with 12 mm (½") plywood coated with fire retardant paint a minimum of 450 mm (18") from board front to allow access to board.

6.21 **HOUSEKEEPING**

.1 Scrap and refuse to be removed from the work area daily. Whenever possible, clean up immediately following completion of work. A high level of cleanliness must be maintained. Sweep and damp mop daily.

.2 Oily and waste solvent rags are a fire hazard and to be deposited in approved containers.

.3 Conduit, wires or cables, tools or equipment are not be left in such a way that they constitute a hazard.

.4 Openings in the roof or floor to be guarded to prevent to prevent stock or scrap from dropping down.

.5 Loose equipment and tools shall be cleaned off overhead areas before leaving each day.

.6 Boards with protruding nails shall not be left on the floor.

.7 Bolts shall be cut off at floor level to eliminate a possible tripping hazard.

6.22 **OWNER'S SPECIAL REQUIREMENTS**

.1 Contractor must provide a written list of names for employees and sub-trades entering the building, advising which areas they need access to at least 48 hours prior to expected time of arrival. This lead time is required to prearrange security passes.

.2 Security Passes must be visibly worn at all times by all employees.

.3 All trades people must strictly adhere to Building Security regulations or entrance into the building will be denied.

.4 All trades people are to enter the entrance identified by the Owner. Vehicles are to be parked in proper designated areas. Driveways are not to be blocked.

.5 Freight elevator must be used at all times to transport tools and material. Freight elevator door must be shut immediately after exiting the cab.

.6 Under no circumstances are any electrical or mechanical systems to be disabled or activated without prior knowledge and approval by the Owner's Project Manager. Prior to disabling or activation of any electrical or mechanical systems, Building Operations and Building Security must also provide approval.

.7 Prior notification must be forwarded to Building Security Staff before any construction activity can start which will result in heat, smoke, dust or fumes, such as sawcutting, soldering, spray painting, which can affect the sensitive fire protection equipment.

.8 Contractor responsible for scheduling and meeting the sub-trades daily on site, showing all trades people the work areas and work to be done.

.9 Trades-people are to supply and use their own tools. No tools, ladders or equipment, etc. will be loaned.

.10 Contractor is responsible for all associated environmental cleaning to the job site, daily during construction and upon completion. This includes both under raised floor and above ceiling. No materials or garbage will be permitted to be stored on the loading dock.

.11 Special care and attention must be adhered to at all times when transporting equipment and materials to prevent accidental damage to the fire protection equipment and all furnishings and fixtures.

.12 "No Smoking" - smoke free building. Violators will be denied entry. Smoking is not allowed on the roof.

.13 If Building Operations deems that work on a particular system requires security escort, the Contractor should allow 48 hours to make appropriate arrangements.

.14 For any fire system isolation requests, the Contractor should allow for 24 hours notification to Building Operations.

.15 For any open flame work, a fire extinguisher and security fire watch is required, and will be provided and paid for by Owner. Provide 24 hour notice prior to work to allow Owner to make necessary arrangements.

.16 Storage of materials on site must be cleared through the Building Manager.

.17 Contractors must perform a daily cleanup prior to leaving the site.

.18 Oxygen and acetylene cylinders are to be secured at all times and capped nightly.

.19 Work performed on operating and redundant systems must be restored to their normal condition at the end of each work day.

.20 At the conclusion of each work day, the Contractor's supervisor is to advise the Building Manager on the day's activities and plans for the next day's work. A security escort will be

required for any work being done in secured areas, e.g. raised floor, computer room and mechanical/electrical rooms.

6.23 **CONTRACTORS SITE OFFICE & LUNCHROOM**

.1 Contractor to provide site office and lunchroom facility.

.2 Contractor to provide and pay for temporary telephone/fax/ internet (email) service. Contractor will be responsible for all charges.

.3 Owner's cafeteria is off limits.

6.24 **CORE DRILLING**

.1 Wherever core drilling is required, provide temporary dust proof screens as specified.

.2 In areas where core drilling through existing slab is necessary, the areas to be drilled to be marked out clearly on the underside of slab. Owner's representative to be notified at least 1 week prior to core drilling operation. Tarping of equipment will be responsibility of Contractor supervised by the Owner.

.3 During all core drilling operations, ensure that a minimum of one person is stationed directly below the area of drilling with a large plastic container pressed to underside of slab to hold core and water upon completion of operations.

.4 A wet/dry commercial quality vacuum to be used continuously at location of drilling operation to remove all excess water from area.

.5 Prior to core drilling, approval shall be obtained in writing from the [Consultant][Engineer]. Hole locations are to be x-rayed prior to drilling. Costs for x-rays are to be carried by the Contractor. X-raying will typically be required to occur during premium time

6.25 **TEMPORARY DUST PROOF SCREENS**

.1 Provide temporary dust proof screens where required to separate areas of new work from existing areas and to prevent dust to settle on the Owner's plant and equipment. Dust proof material to be neoprene coated nylon tarpaulin or other types of fabric as approved by the [Consultant][Engineer].

.2 Extend dust proof screens from floor to underside of floor or roof above. Lap all sections of screen sheets 150 mm (6") minimum. Tape all lapped sheets.

.3 Provide all temporary framing required. Secure all screen sheets at top, bottom and ends. Tape perimeter of screen to ensure dust proof environment.

.4 Co-operate with Owners in the erection of temporary dust proof screens. Remove screens when and as directed by Consultant.

6.26 **PROTECTION OF FLOORS DURING EQUIPMENT INSTALLATION**

.1 Provide protection of existing floor finishes during installation or removal of equipment, and at any other time when moving or installing heavy equipment.

.2 Protect floors in rooms noted

.3 Install 19mm (¾") plywood over 5 mil plastic over finished floor areas when moving heavy equipment that could damage floor finish.

.4 Repaint or re-tile any floors or walls damaged or scratched during construction.

6.27 **CONSTRUCTION POWER AND TEMPORARY ELECTRICAL SERVICES**

.1 Provide temporary electrical power services during construction for temporary lighting and operating of power tools and other equipment. Provide necessary Revenue Canada approved kWHr metering unit.

.2 Arrange for connection with the Owner into existing switchboards as indicated. Pay all costs for installation, maintenance and removal.

.3 Provide and maintain temporary lighting throughout project. Level of illumination on all floors and stairs to not be less than 162 Lux.

.4 Temporary electrical power service are available at site in locations designated by Owner.

.5 Contractor and sub-contractors to provide transformers and suitable fused disconnect switches and wiring from locations as and where required and to maintain temporary services for use of light, tools, and apparatus, in order to facilitate completion of work, in accordance with applicable local by-laws.

.6 Notwithstanding the above, where a Contractor proposes to use electric welding, a portable motor generator set to be provided by Contractor to avoid undue disturbances on the building's electrical distribution system, located to the satisfaction of Owner.

.7 Electrical demand and consumption charges are to be metered

.1 Costs for this shall be paid by the General Contractor and all costs for the duration of the project shall be included in the Bid Amount.

.8 If, during installation phase of project, it becomes necessary to have a temporary interruption in the Owner's utilities, Owner will inform Contractor as soon as possible before any such interruption. Contractor and sub-contractors to then take such action as is necessary to accommodate said interruption in their installation schedule.

6.28 **PRICING OF CHANGE NOTICES**

.1 The value of a proposed change in the work shall be determined in one or more of the following methods:

.1 by time and material;
.2 by unit prices set out in the Contract or subsequently agreed upon:
.3 by labour and material costs submitted in a detailed quotation.

.2 In the case of changes in the Work to be paid for under the time and material or the unit price methods, the form of presentation of costs and methods of measurement shall be agreed to by the Consultant and Contractor before proceeding with the change. The Contractor shall keep accurate records, as agreed upon, of quantities or costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices where applicable.

.3 In the case of changes in the Work to be paid for under the time and material or the labour and material method, the material costs are to be less trade discounts. The discount to be provided from list price for items included in the Allpriser catalogue or Electrical Price Guide is 20%.

.4 The detailed quotation referenced under the labour and material method is to include a summary of charges made up of three components: labour charges, material costs and fees.

.1 Labour Charges
(a) The labour hour estimates are to be based on the current NECA Column 2 manual of labour units.
(b) Labour costs are to include burden on wages such as taxes, worker compensation charges, CPP, EI, project insurance, safety meetings, estimating, as-built drawings, supervision, small tools, site facilities, labour warranty and clean up.
(c) The all inclusive hourly labour rate applicable for quotations submitted for changes to the work is 1.90 times the BASE RATE of the current Collective Agreement (ie if current rate for a Journeyman Electrician is

$31.70 x 1.9 = $60.23 per hour per hour. The hourly labour rate for specialists not governed by union agreements (technicians or engineers) is 2.25 times the base rate for Electricians.

(d) The all inclusive hourly labour rate indicated above is to include:
- Collective Agreement relevant to the place of work (vacation pay, RRSP, Health & Welfare, RST of Health & Welfare, Pension, Union admin fund, ECA fund (or others), Secretariat.)
- Legislation as relevant to the place of work (Emp. Health Tax, E.I., CPP, WSIB, taxes)
- Project insurance, safety meetings, estimating, lay outs, site facilities, warranties, storage,
- clean up, office supervision and miscellaneous charges.

(e) Foreman Electrician, General Foreman, Superintendent rates shall be as for the calculated Journeyman rate above plus 15% of the base rate. A maximum of 10% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the Foreman rate.

(f) A maximum combined amount of 3% of the total calculated journeymen hours on a change may be charged as overhead supervision hours at the General Foreman / Supervisor rate.

(g) No other overhead supervision hours will be permitted.

.2 Material Charges

(a) Material costs are to be less trade discounts. The discount for items included in the Allpricer catalogue or Electrical Price Guide is 20%.

.3 Fees

(a) The overhead and profit fee is to include for the Contractor's head office and site office expenses, project manager, assistants, site office and storage facilities, utility charges, site security, telephone and facsimile transmission costs, As Builts, expendable small tools, financing costs, coffee breaks, site facilities, general clean up and disposal, security, storekeeper, and all other non-productive labour.

(b) Contractor is allowed a combined overhead and profit fee of 15% for work to be performed by his own forces.

(c) REFER ALSO TO SECTION 00 73 00, ARTICLE 6.1.6.1.6

PART - 7 CONSULTANT REVIEWS

7.1 GENERAL

.1 Consultant’s attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and the local authority have jurisdiction.

7.2 SITE REVIEWS

.1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances before the work is completed, deficiencies may be recorded where the item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date. Any such reported items, or lack thereof, shall not be relied on in any way as part of the Contractors quality assurance program nor relieve the Contractor in the performance of the Work.

.2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless otherwise shown.

.3 Milestone Reviews

.1 Specific milestone reviews are conducted at key stages by the Consultant, including:
- (a) Before backfilling of buried drainage,
- (b) Before closing of shafts
- (c) Before closing of ceilings
- (d) Before closing of walls
- (e) Equipment demonstration
- (f) Substantial Performance deficiency review
- (g) Total Performance deficiency review.

.4 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements in the construction schedule.

.5 Notify the Consultant in writing seven (7) calender days in advance of work to be concealed to arrange a site review prior to the Work being concealed. Any noted deficiencies are to be corrected and reviewed again by the Consultant before being concealed. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

PART - 8 CONTRACTOR DUTIES DURING INSPECTION

.1 Inspection from the Consultant's team will be provided in accordance with Regulation 941/90 of the Professional Engineers Act. Inspections will be performed on a periodic basis to ensure general compliance only. Unscheduled random inspections and scheduled pre-occupancy inspections will be conducted to ensure installation generally meets specified quality standards and intent of the design according to the Ontario Building Code. Not all work will be inspected as walls and ceilings are closed in and buried services covered to meet schedule deadlines. It is the Contractor's responsibility to ensure that work is complete and constructed to specified standards.

.2 The Division 26 Contractor shall each assign one person responsible for ensuring that work from all Division trades is complete prior to closing in wall, ceilings or burying services, and prior to Pre-occupancy Inspections. In conjunction with the Mechanical and Electrical Co-ordinator, the Contractor shall walk the site and thoroughly review that the work is complete, in good workmanship and installed according to the drawings and specifications. The Contractor shall then submit a "Statement of Completion" Report. In the case of pre-occupancy inspections, the Statement of Completion report will be submitted 24 hours prior to the scheduled Inspection.

.3 Services to be covered (behind drywall or buried) shall be photographed and assembled in a journal to form a comprehensive documentation of the completed services. The photos will be turned over to the Inspector for review prior to pre-occupancy inspection and will again be turned over to the Owner for his use at the end of the Project.

.4 In preparation for the pre-occupancy inspection of the area or phase being turned over to the Owner, the Division Contractor shall perform a comprehensive inspection of their own to ensure that their contractual obligations are met before requesting the pre-occupancy inspection. The written report or Statement of Completion shall consist of the following items:

- .1 date and time of the inspection, signed by the person who conducted the inspection
- .2 confirmation that previously noted deficiencies have been completed
- .3 confirmation that the work is 100% complete, tested, balanced and deficiency free or include a list of outstanding work with a reason why work has not been completed (ie another trade has to complete their work)
- .4 a plan of action to complete in-complete work with estimate of completion time.

.5 The format of the Statement of Completion will be agreed upon with the Consultant. The Consultant's Inspector shall sign off the Statement of Completion Report and return a copy

to the Contractor. The Contractor will retain on site a log of all signed off Statement of Completion reports.

.6 If Statement of Completion is not received, the Consultant reserves the right to withhold pre-occupancy inspection.

.7 If the Statement of Completion is received and the Inspector enters an area that is obviously not ready for inspection (ie the report was falsified), the Inspector shall immediately leave the site without completing the inspection. The Division Contractor shall request another inspection 72 hours in advance and shall resubmit the Statement of Completion 24 hours prior to the inspection.

PART - 9 CORRECTION AFTER COMPLETION

9.1 GENERAL

.1 At completion, submit written guarantee undertaking to remedy defects in work for a period of one year from date of substantial completion. This guarantee is not to supplant other guarantees of longer period called for on certain equipment or materials.

.2 Guarantee to encompass replacement of defective parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation work.

.3 Submit similar guarantee for one year from date of acceptance for any part of work accepted by Owner, before completion of whole work.

9.2 FINAL REVIEW

.1 At project completion submit written request for final review of mechanical and electrical systems.

.1 Refer to section 26 08 19 Project Close-Out.

H.H. Angus & Associates Limited Consulting Engineers

SHOP DRAWING COVER SHEET

1127 Leslie Street Toronto Ontario M3C 2J6 Canada

T: (1) 416 443 8200 F: (1) 416 443 8290

Include this cover page with each shop drawing submission.
Submissions without this form will be returned without review.

Client/Architect: **ABC Architects Ltd**

Project Name: **University Healthcare Wing**

HHA Project No: **2081001**

Contractor to complete the following for each submission.

Date: _____

Contractor Reference No: _____

Manufacturer Name: _____

Product Type: _____

Specification Section No: _____

Contractor Trade:

☐ Mechanical ☐ Electrical ☐ Elevators ☐ General Trades

If this is a resubmission, check here: ☐

Previous submission reference no.: _____
(HHA reference No. only)

HHA distribution - for internal use only:	
Mechanical review:	John Smith
Electrical review:	Joan Smith
Elevators review:	

END OF SECTION

FIRE STOPPING & SMOKE SEALS
26 05 10

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with the General Conditions of the Contract, Supplementary Conditions and other Sections of Division 1 and with Section 26 05 01, Electrical General Requirements.

1.2 SYSTEM DESCRIPTION

.1 Work of this Section comprises firestopping materials and/or systems to provide closures to fire at openings around penetrations, at un-penetrated openings, at projecting or recessed items, and at openings and joints within fire separations and assemblies having a fire-resistance rating, including openings and spaces at perimeter edge conditions.

.2 Work of this Section also comprises smoke sealants applied over firestopping materials or combination smoke seal/firestop seal material to form air tight barriers to retard the passage of gas and smoke.

.3 The installed firestopping/smoke sealant system shall provide and maintain a fire-resistance rating equivalent to the rating of the adjacent floor, wall or other fire separation assembly to the requirements of and as acceptable to the authorities having jurisdiction and to the Consultant.

.4 Firestopping and smoke seals within electrical assemblies (i.e. inside electrical cable ducts/ trays if applicable) shall be provided as part of the Work of Divisions 26. Refer to Section 26 05 01, Article 5.4 and include firestopping and smoke seals around the outside of such mechanical and electrical assemblies where they penetrate fire-rated separations shall be part of the Work of this Section unless otherwise indicated by the Contractor.

.5 Confirm locations of exposed/non-exposed fireproofed surfaces with consultant prior to application.

.6 Penetrations will have single or multiple conduits passing through and Work will consist of firestopping all penetrations with pre-approved ULC assemblies.

1.3 RELATED SECTIONS

.1 Sealing around service penetrations through rated floors and walls - under Division 26, Division 27 and Division 28.

1.4 QUALITY ASSURANCE

.1 Provide experienced and competent installers, trained by material or system manufacturer.

.2 Applicator Qualifications:

.1 Applicator shall have at least three years experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.

.2 Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.

.3 Applicator shall be approved for this Work by Product Manufacturer or listed below:

(a) Beverly F.S. (Tel: 905-659-3367)

(b) Dominion Caulking (Tel: 905-883-8355)

(c) Guild Electric (Tel 416-288-8222)

(d) Profirestop (Tel: 416-293-0993)

(e) RILI Firestopping (Tel: 905-349-3779)

(f) Single source responsibility for firestopping materials:

.4 Obtain firestop materials from single manufacturer for each different product required.

.5 Manufacturer shall instruct applicator in procedures for each material.

.6 Refer to notes on Drawings for additional information, instructions and clarifications.

1.5 **REGULATORY REQUIREMENTS:**

(a) Firestop System installation must meet requirements of CAN/ULC-S 115-11 tested assemblies that provide a fire rating equal to that of construction being penetrated.

(b) Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

1.6 Arrange a pre-job conference between Contractor, applicator, inspection and testing representative, manufacturer's representative and Consultant.

1.7 Fire Protection Consultant will test (Review) up to 2% of completed Work (Penetrations). Contractor to provide installer and enclosures at Consultant's discretion.

1.8 Consultant may or may not require destructive testing to be done. Contractor shall cover costs of repairing fire separation after destructive tests are performed.

1.9 **SUBMITTALS**

.1 Shop Drawings

.1 Submit drawings indicating the ULC or Warnock Hersey assembly number, the required temperature, hose stream, and flame rating, material thicknesses, installation methods and materials of firestopping and smoke seals, primer, supports, damming materials as applicable, reinforcements, anchorages, fastenings and methods of installation for each condition to be encountered.

.2 Designate on shop drawings both fixed and moving penetrants, relative positions, expansion and control joints in rated slabs and walls, firestopping details at receptacles and similar poke-through devices and surrounding permanent materials. Identify re-entry locations.

.3 Manufacturer's Product Data: Submit data for materials and prefabricated devices, providing descriptions sufficient for identification on Site.

.4 Certificates: Submit manufacturer's certification that installed firestopping and smoke seal material comply with specified requirements.

.5 ULC or Warnock Hersey Listings: Submit copies of Listing cards for review.

.2 Samples

.1 Submit only as requested various types of firestopping and smoke seal material.

.2 Mock-Up

1. Construct mock-up for each separation type prior to commencing Work at locations as designated by Consultant in accordance with Section 01 00 00

2. Mock-ups shall be reviewed and approved by manufacturer and Consultant.

3. Accepted mock-ups may remain as part of completed work.

4. Mock-ups shall be modified as many times as necessary to obtain acceptance.

.3 Delivery, Storage and Handling

.1 Deliver the materials to the job site in the manufacturer's unopened containers, containing the classification label, with labels intact and legible at time of use.

.2 Store material in accordance with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.

.3 Before handling, read product data sheets and material safety data sheets. Do not use damaged or expired materials.

.4 Identification

.1 Identify, through-penetration fire stopping and smoke seal systems with pressure sensitive, self adhesive, printed vinyl labels. Attach labels permanently to surfaces of penetration construction on both sides. Labels must be visible from 5'-0" above the floor. Labels must show the following information:

(a) the words "Warning: through-penetration firestopping system, Do not disturb"

(b) the applicators name, address and telephone number

(c) designation of applicable testing and inspection agency

(d) date of installation

(e) manufacturers name for materials

.5 Photography

.1 Provide digital photography of every fire separation penetration showing both the before and after installations. Picture must indicate day and time and be labelled to show exact location.

.2 Duplicate copies of digital photo records are to be submitted directly to the Hospital at the completion of the installation in each building/ wing.

PART - 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS / INSTALLATION SPECIALISTS

.1 General

.1 Manufacturers of firestopping products and installation specialist for this Work are limited to applicable assemblies as required for Project and having ULC or C-UL-US or Warnock Hersey labelled packaging.

.2 Approved manufacturers:

(a) 3M Canada

(b) A/D Fire Protection Systems Inc

(c) Grace

(d) Nuco Inc. (1-800-583-3984)

(e) Tremco Canada

2.2 **MATERIALS**

.1 Firestopping and smoke seals shall conform to the following:

.1 Asbestos free materials and systems.

.2 Provide a fire-resistance rating not less than the fire-resistance rating of the surrounding or adjacent floor, wall or other assembly.

.3 FTH Rated and certified in accordance with CAN/ULC-S115-95, and be labelled (WH, cUL, ULC).

.2 Sealants and putty for overhead and vertical joints shall be non=sagging; seals for floors, self-levelling, silicone based.

.3 Products shall be compatible with abutting dissimilar architectural coatings and finishes at floors, wall, ceiling, waterproofing membranes and the like. Check with requirement of Contract Documents and manufacturer of selected materials being installed.

PART - 3 EXECUTION

3.1 **MANUFACTURER'S INSTRUCTIONS**

.1 Compliance: Comply with manufacturer's product data including product technical bulletins, product catalogue installation instructions and product packaging instructions.

3.2 **PREPARATION**

.1 Examine sizes, anticipated movement and conditions to establish correct thickness and installation of back-up materials.

.2 Clean bonding surfaces to remove deleterious substances including dust, paint, rest, oil, grease, moisture, frost and other foreign matter which may otherwise impair effective bonding.

.3 Remove insulation from insulated pipe and duct where such pipes or ducts penetrated a fire separation unless listed assembly permits such insulation to remain within the assembly, or where mechanical trades have installed special fire rated insulated sleeves.

.4 Prepare surfaces, prime, mask adjacent surfaces and clean in accordance with manufacturer's directions and to requirements of tested assembly.

3.3 **INSTALLATION**

.1 General

.1 Mix and apply firestopping, gas and smoke seals in strict accordance with manufacturer's instruction and tested designs to provide required flame rated seal, to prevent the passage of gas and smoke, and where specifically designated, the passage of fluids.

.2 Provide temporary forming and packing as required. Apply materials with sufficient pressure to properly fill and consolidate the mass to seal openings.

.3 Tool or trowel exposed surfaces.

.4 Notify Consultant when random completed installations are ready for review, as directed by Consultant, prior to concealing or enclosing firestopping and as applicable, smoke seals.

3.4 **IDENTIFICATION**

.1 Provide identification of all firestopping as specified.

3.5 **PHOTOGRAPHY**

.1 Provide digital photography of every fire separation penetration showing both the before and after installations. Picture must indicate day and time and be labelled to show exact location.

.2 Duplicate copies of digital photo records are to be submitted directly to the Hospital at the completion of the installation in each building/ wing.

3.6 **CLEAN UP**

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application. Remove and or correct staining and discolouring or adjacent surfaces as directed.

END OF SECTION

WIRES & CABLES 0-1000 VOLTS
26 05 19

PART - 1 GENERAL

1.1 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 01 Electrical General Requirements.

PART - 2 PRODUCTS

2.1 BUILDING WIRES

.1 Copper conductors: size as indicated, stranded for 10 AWG and larger, with 1000 V insulation for 347/600 Volt systems, and 600 V insulation for 120/208 V systems, of chemically cross-linked thermosetting polyethylene material rated RW90 and/or RWU90 to CSA C22.2 No. 38.

.2 Use RWU90 for wiring installed underground.

.3 Wiring in channel back of luminaires shall be 600 volt type GTF or TEW, temperature rating as required by CSA and/or manufacturer requirements..

.4 Conductors shall be colour coded. Conductors No. 10 AWG and smaller shall have colour impregnated into insulation at time of manufacture. Conductors No. 8 AWG and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.

.5 Minimum wire size shall be No. 12 AWG. Home runs to lighting and receptacle panels which exceed 25 m (75') in length shall be minimum No. 10 AWG. Home runs which exceed 40 m (120') in length shall be minimum No. 8 AWG. Home runs which exceed 60 m (180') in length shall be minimum 6 AWG.

.6 Colour coding shall be as follows: Red - Phase A, Black -Phase B, Blue - Phase C, White - Neutral, Green - Ground, Orange - Control.

Standard of Acceptance

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc
- Pirelli Cables Ltd.
- Southwire

2.2 MINERAL INSULATED CABLE

.1 Cable shall have ULC listed 2 hour fire rating.

.2 Cable shall be shipped with ends temporarily sealed and shall be stored under dry conditions.

.3 Cable shall be of capacities and types noted on drawings and shall be terminated using suitable terminating hardware.

Standard of Acceptance

- Pyrotenax

2.3 **INSTRUMENTATION AND CONTROL CABLING**

.1 Control cables shall be designed according to CSA Standard Can3-C2.1-M86 Control Cables - 600 Volts.

.2 Control cables shall be as follows:

Conductors	Quantity, arrangement and gauge shown on drawings or specified elsewhere
Identification	Colour coded or numbered
Insulation	XLPE
Armour	Steel (No armour required if installed in conduit or approved wireway)
Jacket	FT4 Flame Retardant PVC FT6 Plenum rated in open style cable trays in ceiling spaces

.3 Shielded cables shall provide 100% shield coverage and be complete with drain wire.

.4 Multipair twisted shielded cables shall have individual pairs shielded, overall shield and drain wires and overall rated jacket.

Standard of Acceptance

- BICC
- Belden
- Nexans Canada Inc

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Provide grounding / bonding conductor in all conduits whether metallic or non-metallic, sized as per Ontario Electrical Safety Code, and connect to grounding bus. All receptacles, lighting fixtures, panels, transformers, motors, heaters, communications conduits and other powered devices shall be grounded via ground wires.

.2 A dedicated neutral conductor shall be provided for each single phase branch wiring power circuit.

3.2 **INSTALLATION OF BUILDING WIRES**

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 33.

.2 In wireways and auxiliary gutters in accordance with Section 26 05 37.

.2 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.

.3 Splice wire, up to and including No. 6 AWG with nylon insulated expandable spring type connectors. Connector body shall be moulded of thermoplastic and spring insert shall be an expandable square-edged design. Splice larger conductors using split-bolt or compression type connections wrapped with PVC tape.

.4 Where colour coding tape is utilized, it shall be applied for a minimum of 50 mm (2") at terminations, junction and pullboxes. Do not paint conductors under any conditions. Colour coding shall also apply to bussing in panels and bus duct.

3.3 **INSTALLATION OF MINERAL INSULATED CABLES**

.1 Cable shall be installed in trays or exposed on walls, beams, purlins or ceilings, using clamps available from the manufacturer. Fire rated circuits shall be supported on centres not exceeding 1000 mm (3'). Care shall be taken when handling the cable to avoid cable kinks; it is recommended that cable be uncoiled from supply reel by rolling. Cables shall be bent using a suitable hickey with a minimum bending radius of six times the cable diameter.

.2 Embedded cables shall be protected against punctures and mechanical damage.

.3 Single conductor cables forming part of a circuit shall be run in contact with one another throughout their length.

.4 Single conductors in parallel shall be arranged in groups and the groups shall be at least two cable diameters apart.

.5 Cables shall be terminated with manufactured gland and seals. Gland and seal assembly shall be prepared with tools specifically designed for the purpose. Upon completion of termination, the insulation resistance of the cable shall be checked with an insulation tester in accordance with values to be determined by the [Engineer][Consultant].

.6 Cables forming part of circuits rated 200 A and above shall be terminated at each end on a suitably sized minimum 6 mm thick brass plate, installed by removing the steel of the termination panel. A copper bonding conductor, sized per Table 16 of the Safety Code, shall be connected to the termination plate via a Burndy Servit type KC connector or type YA compression connector, and extended to the equipment ground bus and terminated with a Burndy YA compression connector with 12mm stainless steel bolt and hardware.

.7 The entire installation shall be made in accordance with the recommendations of the manufacturer, who shall be retained by the Contractor under this Section to inspect the cable installation and termination methods.

3.4 **INSTALLATION OF INSTRUMENTATION, COMMUNICATION AND CONTROL CABLING**

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 33.

.2 In wireways and auxiliary gutters in accordance with Section 26 05 37.

.3 In open style corridor cable trays in ceiling spaces, using FT6 plenum rated cable assemblies.

.2 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.

.3 Run all instrumentation, communication and control cabling point to point and terminate on terminal strips. Do not splice communication or control cabling. Where long runs make a continuous point to point installation impractical, make splices on labelled terminal blocks installed in an accessible labelled terminal cabinet, installed at 1200 mm (48") above floor, and indicate cabinet location, terminal And wire numbers on As-built drawings.

.4 Terminate control cables in equipment with suitable connectors.

.5 All control cables shall be clearly identified, at both ends, with permanent PVC wire markers, Electrovert type Z or equal, indicating Cable Number and wire numbers.

END OF SECTION

GROUNDING SECONDARY
26 05 27

PART - 1 GENERAL

1.1 REFERENCES

.1 IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.2 CSA C22.1 Electrical Safety Code

.3 CSA-Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.2 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

.2 Nameplates shall be in accordance with Article "Equipment Identification".

1.4 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 01 Electrical General Requirements.

PART - 2 PRODUCTS

2.1 EQUIPMENT

.1 Clamps for grounding of conductors, size as required to electrically conductive underground water pipe.

.2 Insulated grounding conductors: green, type RW90 copper.

.3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

.4 Perimeter ground bus, 6 mm x 50 mm (¼" x 2") copper, mounted 150 mm (6") above floor on insulated spacers 600 mm (24") on centre.

.5 Ground bus mounting spacers

.1 stand off insulators to UL 891

.2 25 to 32 mm high waterproof glass fibre reinforced polyamide

.3 750V insulated

.4 UL 94VO self extinguishing

.5 bichromated zinc plated threaded steel inserts

Standard of Acceptance
- Erico ISO I series c/w insulator mounting kits
- Approved equal

.6 Communication and Computer room raised floor ground clamps: Burndy Uniground

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of local authority having jurisdiction over installation.

.2 Ground electrical equipment and wiring in accordance with Ontario Electrical Safety Code and ANSI/IEEE Standard 142-1982.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

.7 Soldered joints not permitted.

.8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.9 Install separate ground conductor in all conduits. Ground conductor shall be sized as per Table 16 of CSA C22.1 with one ground conductor for every three hot conductors. Minimum size of ground conductor shall be #12 AWG copper.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Install grounding conductors outside electrical rooms and electrical closets in conduit and conceal where possible.

.13 Provide separate ground wire for every feeder, sized as per Table 16 of the OESC.

3.2 **ELECTRODES**

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter. Install water meter shunt.

.2 Install [rod], [plate] electrodes and make grounding connections.

.3 Provide rod electrodes at corners of main electrical room and connect to perimeter ground bus.

.4 Bond separate, multiple electrodes together.

.5 Use size 4/0 AWG copper conductors for connections to electrodes.

.6 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails.

3.3 **SYSTEM AND CIRCUIT GROUNDING**

.1 Install system and circuit insulated copper grounding connections to neutral of secondary systems and for common grounding conductors per CSA C22.1 Table 17.

.2 Install insulated copper grounding conductor for service raceways and service equipment per CSA C22.1 Table 18.

.3 Install grounding conductors in conduit.

3.4 **EQUIPMENT GROUNDING / BONDING**

.1 Install insulated copper bonding connections per CSA C22.1 Table 16 to typical equipment including, but not necessarily limited to following list: Service equipment, transformers, frames of motors, starters, control panels, building steel work and panels, outdoor lighting.

.2 Install bonding conductors in conduit.

3.5 **COMMUNICATIONS SYSTEMS**

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.2 Communications system grounding in accordance with ANSI/EIA/TIA 607, 568A, 569 standards.

.3 Sound, fire alarm, intercommunication systems as indicated

3.6 **PERIMETER GROUND BUS**

.1 Provide exposed perimeter ground bus in main electrical rooms and generator room.

.2 Mount on stand off insulated spacers to wall using zinc plated steel studs, washers, lock washer and nuts.

.3 Connect exposed metal work in electrical rooms and generator room to perimeter ground bus with insulated stranded copper connections, size 2/0 AWG copper in conduit.

.4 Protect ground bus with one coat of insulating varnish.

3.7 **FIELD QUALITY CONTROL**

.1 Perform tests in accordance with Section 26 05 01 - Electrical General Requirements.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

END OF SECTION

FASTENINGS AND SUPPORTS
26 05 29

PART - 1 GENERAL

1.1 RELATED WORK

.1 Fastenings and supports: Section 01 61 00 - Common Product Requirements.

.2 Concrete bases and housekeeping pads for electrical equipment shall be arranged and paid for by Division 26, and installed by trade specialists under respective Carpentry, Concrete, and Painting Divisions.

1.2 SHOP DRAWINGS

.1 Submit design drawings for custom fabricated trapeze hangers, sealed by a professional engineer licensed in the project location jurisdiction.

.1 Shop drawing details:

(a) construction detail drawings for each loading condition,

(b) span deflection calculations,

(c) building attachment load calculations and type.

.2 Provide services of engineer who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site.

PART - 2 PRODUCTS

2.1 SUPPORT CHANNELS

.1 Hot dipped galvanized steel, U shape, size 41 mm x 41 mm x 2.5 mm (1e" x 1e" x 1/10") thick, surface mounted, suspended or set in poured concrete walls and ceilings.

2.2 INSERTS

.1 Inserts for conduits and raceway hangers, for single, double and multiple runs shall be galvanized.

Standard of Acceptance
- Unistrut Canada
- Burndy (Canada) Ltd. - Flexibar
- Pilgrim Technical Products Ltd. - Tufstrut

2.3 HANGERS

.1 Hangers for electrical conduit shall be hot dipped galvanized after fabrication.

Standard of Acceptance
- Burndy Canada Ltd.
- Canstrut
- Electrovert Ltd.
- E. Myatt & Co. Ltd
- Steel City Electric Ltd.

° Pilgrim Technical Products Ltd.

2.4 TRAPEZE HANGERS

.1 Performance:

.1 Manufactured:

(a) to product load listings.

.2 Custom fabricated:

(a) maximum deflection between supports: 1/250 (0.4%) of span

(b) minimum factor of safety : 5 times load to ultimate tensile or compressive strength.

.2 Construction:

.1 Carbon steel shapes, to suit load application:

(a) hollow steel section,

(b) equal leg El section, or

(c) double C channel “strong-back”, with welded clips.

.2 Hanger rods:

(a) as specified above, and

(b) minimum two support rods,

(c) rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.

.3 Finish:

.1 hot dipped galvanized finish in mechanical rooms and outdoors.

.2 black steel finish in other areas.

Standard of Acceptance
° Anvil Fig 45, 46, 50

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions to locate and install inserts.

.2 Secure equipment to masonry, tile and plaster surfaces with lead anchors.

.3 Secure equipment to poured concrete with expandable inserts.

.4 Secure surface mounted equipment with T-bar support hanger fastened to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

Standard of Acceptance
° Caddy model No. 512 c/w BHC clip

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole steel straps to secure surface conduits and cables 50 mm (2") and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm (2").

.3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm (¼") dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm (¼") dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels.

.9 Provide galvanized after fabrication metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of [Engineer][Consultant].

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.14 Supply and erect special structural work required for the installation of electrical equipment. Provide anchor bolts and fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.

.15 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets. Install angle or channel iron supports to bear the equipment where it is shown in or on structural tile walls, or walls that are inadequate to bear the equipment.

.16 Provide channel iron or other metal supports where necessary to adequately support lighting fixtures. Do not use wood. Lighting fixtures shall be supported totally independent of ceiling and supported from structure above.

.17 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members required between beams for supporting conduits.

.18 Do not use explosive drive pins in any section of work without obtaining prior written approval.

.19 Provide re-enforced concrete pads under switchboards, generators, and all other floor mounted electrical equipment. Pads are to formed with chamfered edges to prevent chipping. Pads are to be sealed and painted to prevent dust from entering and interfering with electrical equipment.

END OF SECTION

SPLITTERS, JUNCTION AND PULL BOXES, CABINETS
26 05 32

PART - 1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01 Electrical General Requirements.

1.2 REFERENCE

.1 CSA C22.2 No. 76 Splitters.

.2 CSA C22.2 No. 40 Junction and Pull Boxes.

.3 Cabinets to Section 26 27 18 Panel Trim.

PART - 2 PRODUCTS

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs and connection bars to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters.

.4 Distribution riser splitters shall be of special construction with hinged access door, copper bus bars predrilled to accept two hole compression connectors for all incoming and outgoing cables.

2.2 JUNCTION AND PULL BOXES

.1 Welded steel hot dipped galvanized construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

2.3 CABINETS

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface or flush mounting as indicated.

.3 Surface mounted cabinets shall be finished in ASA 61 grey.

2.4 **INSTRUMENTATION AND CONTROL TERMINAL CABINETS**

.1 Surface mounted, gasketed, drip proof and dust tight, JIC enclosure, CEMA type 12 With hinged door, lock, 2 keys, white raised and removable internal mounting panel, diagram pocket, finished with ASA 61 grey.

Standard of Acceptance
- Hammond

.2 Panel wiring to be contained in PVC wiring ducts complete with cover strips, minimum 50 mm x 50 mm (2" x 2"). Wireway fill to be limited to 60%. Where there are a large number of door mounted devices, door wiring harnesses shall also be contained in wiring ducts at rear door. All door wiring devices to emanate from the control panel terminal strips. Wiring to panel face mounted devices to be bundled neatly on hinge side of panel, enclosed in flexible spiral wrap, and installed such that wiring will not be damaged when opening and closing door. Ground panel door to panel with a flexible copper bonding strap. Label all wiring with permanent PVC sleeve type markers.

.3 Phoenix contact terminal blocks with mounting rails, end covers, terminal markers, partition plates and accessories: UK 2.5 termination of wiring 22 to 12 AWG; UK 5 and UK 10 series for current transformers and other leads #10 AWG and #8 AWG; UDK or UK 5 twin for connecting two or more conductors to one terminal block; DIK 1.5 for three wire sensor device wiring; MTKD for thermocouple leads.

.4 Provide lamacoid nameplates for all panel mounted control and indicating devices, and all internal components such as terminal strips, control transformers, control devices, relays, etc. as per 26 05 01.

PART - 3 EXECUTION

3.1 **SPLITTER INSTALLATION**

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 **JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m (6'-6") above finished floor.

.3 Install terminal block as indicated in Type T cabinets

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m}[100'} of conduit run between pull boxes.

3.3 **IDENTIFICATION**

.1 Provide equipment identification in accordance with Section 26 05 01 - Electrical - General Requirements.

.2 Install size 2 identification labels indicating system name, voltage, phase and source of power.

.3 Provide a typed directory in cabinets showing following information: Nature, actual quantities and room number of device or devices connected to each terminal, as well as signal circuit number where applicable.

END OF SECTION

CONDUITS, FASTENINGS AND FITTINGS

26 05 33

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

1.3 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

.2 Location of Conduit

.3 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

1.4 REFERENCES

.1 CSA C22.2 No. 83 Electrical Metallic Tubing

.2 CSA C22.2 No. 136 Rigid PVC Conduit

.3 CSA C22.2 No. 56 Flexible Metal and Liquid-Tight Flexible Metal Conduit

.4 CSA C22.2 No 211.2 Rigid PVC Conduit

.5 Conduit accessories, conduits and fittings to CSA C22.2 No. 18.

1.5 WIRING METHODS

.1 Install wiring in surface mounted EMT conduit unless otherwise specified. In finished areas, conceal conduit in walls and ceiling spaces.

.2 Where shown on drawings, armoured cable shall be Teck 90 type. Jackets of cable shall have FT-4 rating identified. Connectors shall be equal to T&B Star Teck Type

.3 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass.

.4 Use EMT conduit for branch circuit and signal wiring in ceilings, furred spaces, and in hollow walls and partitions.

.5 Flexible conduit and armoured cable will be accepted in parts of existing building, where furred spaces above ceilings are too congested to permit conduit to be installed, but only

with [Engineer's] [Consultants] written permission. Terminate armoured cable, where shown, in accordance with the manufacturer's recommendations.

.6 [Flexible steel conduit with integral insulated green ground wire is permitted for the final connection to luminaires mounted in suspended ceilings from the branch wiring junction box above, with flexible conduit length not to exceed 3 m (10'), and be neatly installed and attached to luminaire support chain]

.7 [Flexible armoured conduit (or BX) with an integral insulated green ground wire may be used where concealed in walls for wiring to receptacles, and for the final connection to luminaires.

.1 The junction box interfacing the horizontal EMT conduit to the flexible conduit shall be located within 3 m (10') horizontally from the end device in open areas, and in enclosed rooms, located in the same room as the devices being served, in reasonable proximity to the walls, in order to keep the horizontal portion of the run of flexible conduit to less than 3 m (10').

.2 The flexible conduit shall be neatly installed parallel or perpendicular to building lines, and independently supported from the slab structure above.]

.8 Conduit shall be of sufficient size to permit easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

.9 Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

.10 Where existing locations of flush mounted electrical devices (switches, receptacles, etc.) correspond to new devices shown, the existing downdrop conduit and outlet box may be re-used. Provide new devices, new coverplates, new home-run conduit and complete new wire.

.11 Vertical raceways to be provided with insulated cable support bushings or other approved method of supporting the weight of the cable, where vertical runs exceed those of Table 21 of the Electrical Code.

PART - 2 PRODUCTS

2.1 CONDUITS

.1 Electrical metallic tubing (EMT), [hot dipped] galvanized: with couplings.

.2 Rigid PVC conduit.

.3 Flexible metal conduit and liquid-tight flexible metal conduit.

.4 Conduit shall be of sufficient size to allow easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm (2") and smaller. Two hole steel straps for conduits larger than 50 mm (2").

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 Six mm dia threaded rods to support suspended channels.

2.3 **CONDUIT FITTINGS**

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90□ bends are required for 25 mm (1") and larger conduits

.3 [Insulated throat steel set screw] [or] [raintight insulated throat steel compression] connectors and couplings for EMT.

.4 Threaded or compression type raintight/concrete tight insulated throat zinc plated steel connectors and couplings for rigid steel conduit.

.5 Raintight insulated throat steel connectors at all surface panelboards, switchboards and other electrical equipment in sprinklered areas for all conduit terminations.

2.4 **EXPANSION FITTINGS**

.1 Electrogalvanized steel with internal grounding for EMT suitable for 100mm linear conduit movement.

Standard of Acceptance
- Cooper Crouse Hinds XJG-EMT

.2 Weatherproof expansion fittings with internal bonding assembly suitable for [100mm (4")] [200 (8")] linear expansion.

.3 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm (3/4") deflection in all directions.

.4 Concrete type, water tight, corrosion resistant for conduit installations embedded in concrete

.5 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 **FISH CORD**

.1 Polypropylene

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Use electrical metallic tubing (EMT).

.4 Use rigid PVC conduit in slab on grade cast concrete and underground. Do not use PVC conduits in slabs above grade. All conduits shall be surface mounted to minimize risks of future damage when core drilling during future renovations. Where localized congestion or circumstances forces the use of conduits in the floor slabs, they shall be epoxy coated rigid galvanized steel.

.5 Provide PVC conduit with ground wire as per Table 16 of Ontario Electrical Safety Code.

.6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment

.7 Install conduit sealing fittings in hazardous areas. Fill with compound.

.8 Use raintight connectors or hubs for terminating conduits at all surface or floor mounted panelboards, switchboards, and other equipment located in sprinklered areas or where at risk of exposure to dripping liquids.

.9 Install wiring in conduit unless otherwise specified.

.10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.11 Mechanically bend steel conduit over 19mm (3/4") dia.

.12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.13 Install fish cord in empty conduits.

.14 Run two 25 mm (1") spare conduits up to ceiling space and two 25 mm (1") spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm) 6" x 6" x 4") junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete type box.

.15 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.16 Dry conduits out before installing wire.

.17 Conduit manufacturer's touch up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

.18 Install junction boxes or cable anchor boxes wherever necessary for proper pulling or anchoring of cables. Install so as to be accessible after building is completed and set to come within finished lines of building.

.19 Where EMT or rigid PVC is used, run green insulated ground wire in conduit, with minimum one ground conductor per three ungrounded conductors.

.20 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints.

.21 Where conduits or cables are installed under raised floors and are required to be fastened in place, use two hole inverted “U” straps. No sharp edges or corners will be permitted which may damage PVC jackets or cables.

.22 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass. They shall be installed as close to building structure as possible such that, where concealed, necessary furring can be kept to a minimum. Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5m (5') clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.

3.3 **CONCEALED CONDUIT**

.1 Do not install horizontal runs in masonry walls.

.2 Do not install conduits in terrazzo or concrete toppings.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS
26 05 35

PART - 1 GENERAL

1.1 RELATED WORK

.1 Box connectors to Section 26 27 28.

1.2 REFERENCES

.1 CSA C22.2 No. 18.

.2 CSA C22.1 Canadian Electrical Code, Part 1, Ontario Hydro Electrical Safety Code.

PART - 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES - GENERAL

.1 Size boxes in accordance with CSA C22.1

.2 102 mm (4") square or larger outlet boxes as required for special devices

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Hot dipped galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 38 mm (3" x 2" x 1½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.

.3 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

.1 Hot dipped galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Hot dipped galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

.1 Concrete tight hot dipped galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass or brushed aluminum faceplate. Device mounting plate to

accommodate short or long ear duplex single or receptacles. Minimum depth: 28 mm (1¼") for receptacles; 73 mm (3") for communication equipment.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm (½") and 19 mm (¾") conduit. Minimum size: 73 mm (3") deep.

2.6 **CONDUIT BOXES**

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle, outside building and where weatherproof boxes are required.

.2 Explosion proof boxes in areas indicated on drawings.

2.7 **FITTINGS - GENERAL**

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm (1½") and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm (¼") of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area in which it is to be installed.

.6 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.

.7 Offset outlet boxes, shown back to back in partitions, horizontally to minimize noise transmission between adjacent rooms.

.8 Use gang boxes at locations where more than one device is to be mounted. Use combination boxes with suitable barriers where outlets for more than one system are shown.

.9 Where 100 mm (4") square boxes are installed in exposed concrete or cinder block in finished areas, blocks will be cut under masonry division as instructed under this section. Openings shall be cut to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.

END OF SECTION

CABLETROUGHS
26 05 36

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.2 REFERENCES

.1 CSA C22.2 No.126.1 2002, Metal Cable Tray Systems.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

.2 Indicate various types of cabletroughs with terminology used in Part 2.

.3 Show actual cabletrough installation details and suspension system.

1.4 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

PART - 2 PRODUCTS

2.1 TROUGH TYPE (SOLID) CABLE TRAY

.1 Size as shown and as required.

.2 Solid as shown.

.3 Load rating: Class C.

.4 Material: aluminum.

.5 Accessories and fittings as shown and as required for a complete system.

.6 Accessories and fittings of same manufacture and material as the tray, including:

.1 horizontal elbows,

.2 end plates,

.3 box connectors,

.4 vertical risers,

.5 drops,

.6 tees,

.7 wyes,

.8 expansion joints,

.9 reducers,

.10 barriers as shown,

.11 bonding jumpers (copper).

.7 Inside radius of bends, not less than: 24"

.8 Hardware: stainless steel.

Standard of Acceptance

- Canadian Electrical Raceways
- Commercial Roll Formed Products - Comtray
- Cooper B-Line – Cable Tray
- Cope Trof
- Legrand
- Mp Husky

PART - 3 EXECUTION

3.1 INSTALLATION - GENERAL

.1 Provide supports as required. Hanger rods and supports shall be galvanized.

.2 Support cabletrough on both sides.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

.4 Provide cable tray with cover where indicated.

.5 File tray cuts smooth and treat with a galvanized compound where cutting of certain sections is required.

.6 Arrangement, where cable tray is connected to other wiring methods, shall prevent mechanical damage or abrasion to conductors. Maintain effective ground continuity.

.7 Support and secure cable tray on 5' centres and adequately brace to withstand loads due to pulling in of cables.

3.2 CABLES IN CABLETROUGH

.1 Install cables individually.

.2 Lay cables into cabletrough. Use rollers when necessary to pull cables.

.3 Secure cables in cabletrough at 4’-0” centres, with factory made non ferrous cable clamps. Nylon ties may be used where permitted, to the Consultant’s approval.

.4 Identify cables every 10’-0” with size 2 nameplates in accordance with Section 26 05 01 - Electrical General Requirements.

.5 Provide #10 green ground wire in each run of cabletrough and bond to tray at 20'-0” intervals using an approved ground clamp, such as Burndy GC. Connect ground wire to ground bus at each end of run with compression connector.

END OF SECTION

WIREWAYS AND AUXILIARY GUTTERS
26 05 37

PART - 1 GENERAL

1.1 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 01 Electrical General Requirements.

PART - 2 PRODUCTS

2.1 WIREWAYS (LAY-IN CABLE DUCT)

.1 Fabricated from code gauge sheet steel and complete with hinged covers and standard knockouts on 300 mm (12") centres, unless noted otherwise. Inside and outside shall be treated with a rust inhibiting etching process.

.2 Finish: **Inside and outside shall be4 treated with a rust inhibiting process and outside shall be finished in Sherwin Williams Paint, #F65Y4 (Yellow).**

.3 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

.4 Cross-section dimensions as indicated.

Standard of Acceptance
- W. C. Pursley Ltd.
- Square D Company Canada Ltd.
- G. A. Harding Ltd.
- Pilgrim technical Products Ltd.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Install wireways and auxiliary gutters.

.2 Keep number of elbows, offsets, connections to minimum.

.3 Install supports, elbows, tees, connectors, fittings.

.4 Install barriers where required.

.5 Install gutter to full length of equipment.

END OF SECTION

SPECIAL HOSPITAL WIRING
26 07 05

PART - 1 GENERAL

1.1 DESCRIPTION

.1 Patient care areas are as follows:

.1 Critical Patient Care Areas

1.2 REFERENCES

.1 CSA Z32 - “Electrical Safety and Essential Electrical Systems in Health Care Facilities”.

1.3 WORK INCLUDED

.1 Work to be done under this Section includes furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

PART - 2 PRODUCTS

2.1 RECEPTACLES

.1 Receptacles connected to the emergency power system shall be coloured red.

.2 Receptacles in patient care areas shall be Hospital Grade.

.3 Receptacles in patient care areas shall have a circuit identification lamacoid in accordance with CSA Z32-99 Lamacoid shall be secured to the wall above the receptacle and shall be engraved with panel name and circuit number. Lettering shall be minimum¼" (6 mm) high and shall be:

.1 Black letter, white lamacoid for normal power

.2 Red letter, white lamacoid for emergency power

.4 Receptacles identified as “Not for Patient Use” shall have a circuit identification lamacoid in accordance with CSA Z32-99 Lamacoid shall be secured to the wall above the receptacle and shall be engraved with panel name and circuit number. Lettering shall be minimum¼" (6 mm) high and shall be white letter on black lamicoid

PART - 3 EXECUTION

3.1 BONDING TO GROUND

.1 Bonding to ground of receptacles and permanently wired electrical equipment in the patient care areas shall be carried by installing an insulated green equipment bonding conductor in the same conduit as the branch circuit conductors. The bonding conductor shall be terminated in the outlet box and the device at the load end and a ground bar in the panel supplying the equipment or outlet at the source end. A separate bonding conductor shall be provided for each circuit and the bonding conductor shall be sized equal to the branch circuit conductors. In critical care areas the minimum bonding conductor size shall be #10 AWG.

.2 Where the single phase receptacles in a patient care environment are supplied from two 2-wire branch circuits in the same conduit, a single bonding conductor may be provided for the two circuits.

.3 In Critical Patient Care Areas a separate No. 10 ground conductor shall be provided for each circuit back to the panel.

.4 Items to be grounded shall include all receptacles, wall-mounted lights and any other equipment located within 1.5 m horizontally from the nominal position of the bed and 2.3 m vertically above the floor.

.5 Interconnect the ground bus in emergency and normal electrical panels which serve patient care areas with an insulated green copper conductor installed in conduit and sized as in Table 16 of the Electrical Safety Code, but not less than #6 AWG.

3.2 NEUTRAL CONDUCTORS

.1 In both Intermediate Patient Care Areas and Critical Patient Care Areas, a separate neutral conductor shall be provided for each branch circuit phase conductor back to the panel supplying the outlet. Since the neutral is a full current carrying conductor, it is suggested that not more than two beds have a 25 mm conduit home run to the panel to avoid conductor de-rating.

END OF SECTION

WIRING OF ISOLATED POWER SYSTEMS
26 6 27 06

PART 1 - GENERAL

1.1 General Requirements

.1 Conform to Section 26 05 01, Electrical Basic Materials and Methods.

1.2 References

.1 CSA Z32 - “Electrical Safety and Essential Electrical Systems in Health Care Facilities”.

1.3 Work Included

.1 Work to be done under this Section includes furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

2 PRODUCTS

2.1 General

.1 Wiring: 90^{o}C. X-link insulated copper wiring, not less than #10AWG.

.2 Insulation colour-coding as follows:

.1 Line No. 1 - Orange

.2 Line No. 2 - Brown

.3 Bonding conductor - Green

.3 Conduit: FT4 rated rigid PVC conduit not exceeding 27 mm inner diameter.

.4 Drying compound: "dessic powder" or similar material.

.5 Pulling lubricant: talcum powder.

3 EXECUTION

3.1 Installation

.1 Connect line isolation monitor to separate 15A-2P breaker in associated receptacle panel.

.2 Connect each device to its respective 2 pole breaker.

.3 Provide a 2 pole light switch for each luminaire connected to isolated power.

.4 Connect bonding conductor from panel to ground screw in backbox for each receptacle or other outlet and extend to receptacle ground terminal.

.5 Keep wiring from isolated power panel to outlets as short as possible.

.6 Multiple circuits in one conduit are acceptable, within conduit fill limitations, provided that lengths of circuits are not increased.

.7 Where a PVC conduit must penetrate a fire separation, use conduits with an overall (outside) diameter of not more than 25mm.

.8 Clean conduits and swab with drying compound to remove any moisture.

.9 Wire Installation:

.1 Use pulling lubricant when pulling wiring into conduits.

.2 Where lubricant other than the specified lubricant has been used, remove and dispose of wiring, wash out conduits to remove all traces of the lubricant, swab conduits dry and install new wiring using the specified pulling lubricant.

.3 Ensure that the wiring insulation is not subjected to undue strain when pulling in cables, to avoid weak spots in the insulation accentuating leakage currents.

.4 Record the lengths of cables and conduits installed for each room on standard sheets to be furnished at a date prior to installation.

.10 Bond to ground exposed metal non-current carrying parts of equipment located within 1.5 m horizontally from the nominal position of the bed and within 2.3 m vertically above the floor. Use green insulated copper bonding conductors.

.11 Typical equipment to be bonded to ground includes;

.1 fixtures,

.2 headwall units,

.3 service strips,

.4 intercom stations,

.5 nurse call stations,

.6 view boxes,

.7 receptacles,

.8 switches,

.9 cover plates,

.10 conduits,

.11 outlet boxes, and

.12 other equipment as required by Code.

.12 Testing of Installation

.1 Provide testing per Section 26 08 13 “Testing of Hospital Wiring”.

.13 Replace any circuit that does not pass the testing and then subject it to a further test. Repeat until acceptable test results are obtained.

END OF SECTION

WIRING TO MOTORIZED DOORS
26 07 16

PART - 1 GENERAL

1.1 RELATED WORK

.1 Door control panel will be provided with door. Interconnecting power and control wiring and on-off switch will be provided by Division 26.

PART - 2 PRODUCTS

2.1 DISCONNECT

.1 On-off switch shall be rated 15A, 120 volt.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Provide conduit, wiring and on-off switch for each motorized door. Mount door control panel. Install interconnecting power and control wiring to motor, controller, sensors and limit switches.

.2 On-off switch shall be mounted in ceiling space above door.

.3 Wire to fire alarm system to de-energize doors when fire alarm system is activated.

END OF SECTION

TESTING OF HOSPITAL WIRING
26 08 13

PART - 1 GENERAL

1.1 RELATED SPECIFICATION SECTIONS

.1 Comply with all requirements of Division 1

.2 Section 26 05 01 Electrical General Requirements

1.2 DESCRIPTION

.1 Test and check all portions of the electrical system for satisfactory operation. All tests and checks to be done in the presence of the Consultant, suitably logged, tabulated, signed and incorporated into the Operating and Maintenance Brochures. Testing and checking to be carried out under this Contract at no extra cost to Owner. Procedures and tests outlined below are electrical tests required in addition to normal visual and mechanical inspection which shall be carried out prior to placing equipment in service.

.2 Provide certified copies of all production tests required by CEMA and CSA for all power distribution equipment.

.3 All work found to be defective as a result of the testing procedures covered by this Section shall be made good at no cost to the Owner and on completion of remedial work the tests shall be repeated. The costs of such second and subsequent tests is the responsibility of the Contractor and is a pre-requisite to establishing "Substantial Completion" as referred to in "Supplementary Instructions to Bidders".

.4 Give timely notice to the Consultant that the work is ready for testing. The satisfactory completion of all tests is a prerequisite to establishing Substantial Completion of the project.

.5 Testing of electrical systems shall be done by only one of the following acceptable professional independent testing organizations and one complete copy of all reports, studies and test results shall be submitted directly to the Consultant:

.1 Haronitis & Associates

.2 Rondar

.3 Brosz & Associates

.4 Schneider Canada Service

.6 Refer to CSA Standard Z32 for test circuits.

1.3 REPORTS

.1 Prepare and submit the following reports. Submit separate reports for each area to suit construction phasing and occupancy requirements within 5 days of completion of testing in each area. Simultaneously submit one copy directly to the Consultant and a further 6 copies to the contractor to be processed as a shop drawing:

.1 Branch Circuit Breaker Mechanical Operation,

.2 Conductor Insulation Integrity Test (for grounded systems only

.3 Receptacle retentive force test.

.4 Receptacle polarity test.

.5 Branch circuit impedance (Voltage Drop Test – for grounded systems only),.

.6 Ground Point Voltage Rise Test (for grounded systems only),

.7 Potential Difference Between Ground Points Test,

.8 Impedance to Ground Test (single phase isolated systems only),

.9 Maximum Hazard Index Test (single phase isolated systems only).

.2 One complete copy of all reports, studies and test results shall be submitted directly to the Consultant and the Owner along with a certificate, bearing a professional engineer's seal and signature, stating that the installation meets the requirements of the CSA Z32-04 standard, and is suitable for patient use.

.3 Submit additional copies of all reports, studies and test results to the contractor for inclusion in the Maintenance Manuals as required under Section 26 05 01.

PART - 2 PRODUCTS

2.1 **NOT USED**

PART - 3 EXECUTION

3.1 **PRELIMINARY CHECKS**

.1 All equipment and devices to be visually inspected and cleaned. Document that all equipment and devices have correct services, connections, settings, supply voltages, alarm circuits, heater elements, etc., and that they are operational and in accordance with the requirements of contract specifications and drawings, and the manufacturers specifications and recommendations.

3.2 **ELECTRICAL TESTS**

.1 This Section outlines the tests to be carried out and submitted to the Consultant for approval. Be responsible at no cost to the Owner for rectifying all equipment or installations which do not meet the requirements of the various tests listed.

.2 The following tests shall be carried out in accordance with the latest edition of CAN/CSA-Z32-04 "Electrical Safety and Essential Electrical Systems in Health Care Facilities":

.1 Branch Circuit Breaker Mechanical Operation,

.2 Conductor Insulation Integrity Test (for grounded systems only

.3 Receptacle retentive force test.

.4 Receptacle polarity test.

.5 Branch circuit impedance (Voltage Drop Test – for grounded systems only),.

.6 Ground Point Voltage Rise Test (for grounded systems only),

.7 Potential Difference Between Ground Points Test,

.8 Impedance to Ground Test (single phase isolated systems only),

.9 Maximum Hazard Index Test (single phase isolated systems only).

1.1 BRANCH CIRCUIT BREAKER MECHANICAL OPERATION

.1 Requirements:

.1 Each breaker to open and close.

.2 Method:

.1 Confirm that no utilization equipment is connected to the system.

.2 Open and close each branch circuit breaker three times.

.3 Confirm that each branch circuit breaker operates mechanically.

.4 Record go/no go operation of each breaker.

3.3 **CONDUCTOR INSULATION INTEGRITY TEST**

.1 Using a 500V dc megohmmeter, measure the insulation resistance of each branch circuit conductor with all wiring devices connected.

.2 Isolate the branch circuits under test as required to ensure that other circuits serving patients or sensitive equipment are not exposed to the test voltage.

.3 Record all results on tests forms.

.1 Submit tests forms to Consultant for approval.

.2 Where measured values are below the values listed in Z32, the Contractor shall replace the wiring and the independent testing organization shall test the replaced wiring. This process shall be repeated until satisfactory results are obtained. The cost of such work shall be the responsibility of the Contractor.

3.4 **RECEPTACLE RETENTIVE TEST FORCE**

.1 Requirements: A force of 1.1 Newtons shall not remove a test pin from the ground slot of a receptacle. A force of 13.3 Newtons shall not remove a test attachment plug of the same configuration for a receptacle.

.2 Method: Test pins and methods of test specified in CSA Standard C22.2 No. 42 shall be used. As an alternative, a commercially available "tension tester" complying with CSA Standard C22.22 No. 42, General Use Receptacles, Plugs and Similar Wiring Devices may be employed.

.3 Implementation:

.1 Using tension checker, ensure device has calibration as to tension (Newtons) for single-ground pin and tension (Newtons) for multiple pin testing.

.2 For each outlet within a designated area, check tension of ground pin (minimum 1.1 Newtons) and tension of entire plug (minimum 13.3 Newtons).

.3 Record go/no go tension reading for each outlet on a per room and branch circuit basis.

.4 Replace any receptacle which does not meet the requirements listed in method.

3.5 **RECEPTACLE POLARITY TEST**

.1 Requirements: Ensure all receptacles are connected in accordance with configurations listed in Canadian Electrical Code CSA C22.1, latest edition Section 26.

.2 Method: Utilizing polarity test set, check all receptacles on a room by room basis.

.3 Implementation: Correct connection of receptacles where polarity indication is incorrect.

3.6 **BRANCH CIRCUIT IMPEDANCE TEST (VOLT DROP)**

.1 Requirements:

.1 Ensure that all branch circuit wiring from panelboards to receptacles does not exceed a maximum voltage drop of 3% when 80% of the breaker rating is applied at the receptacle. The Contractor shall test all receptacles on a room by room, circuit by circuit basis.

.2 The equipment to be utilized by the Contractor for this test shall be approved by the Consultant. See Figure 1 in standard sheet "Test Circuit Configurations" for test circuit.

.2 Method:

.1 Ensure that all circuits other than the one under test are de-energized.

$$\frac{V_O - V_L}{V_O} \times 100$$

.2 Record no load voltage at receptacle (Vo).

.3 Apply current to 80% of the rating of the overcurrent device protecting the circuit under test record voltage (VL).

.4 Remove load and reconfirm value of Vo.

.5 Calculate voltage drop at receptacle by the formula:

.3 Implementation:

.1 Record all results on tests forms.

.2 Submit tests forms to Consultant for approval.

.3 Where volt drop exceeds 3% by calculation in method, the Contractor shall take all necessary steps to reduce the voltage drop to the required value. The cost of such work shall be the responsibility of the Contractor.

3.7 **GROUND POINT VOLTAGE RISE**

.1 Requirements: Bonding conductors shall be sized and installed so as to limit the voltage rise at the ground point of any receptacle within a patient care area to 3 V when tested. Bonding conductors for branch circuits shall be insulated.

.2 Method: Using the test circuit of Figure 3 in standard sheet "Test Circuit Configurations":

.1 Connect the test circuit to the outlet. With switch SW open, record the voltage indicated by voltmeter V1 as VN, the neutral to ground voltage without load. If it exceeds about 2 V, determine the cause and correct the defect.

.2 Using the low voltage supply, (nominally 5 V open circuit) apply a load of 80% of the rated current of the circuit, between the neutral and the bonding conductor for a period of from 1 to 5 s. To ensure accuracy, the low voltage supply should be energized from a circuit other than the one being tested. Record the current I, the voltage indicated by voltmeter V1 as VR, and the voltage indicated by voltmeter V2 as VO.

.3 Implementation

.1 Record all results on tests forms. Submit test forms to Consultant for approval.

.2 The return path voltage rise VO shall be not greater than 3 V where voltage rise exceeds 3 V. The Contractor shall take all steps necessary to correct the situation.

3.8 **POTENTIAL DIFFERENCE BETWEEN GROUND POINTS**

.1 Requirements: The maximum potential difference between the grounding poles of all receptacles at a patient care location and between these poles and all other exposed conductive non-current-carrying parts at the same patient care location, shall be:

.1 less than 20 mV in Basic Care Areas

.2 less than 20 mV in Intermediate Care Areas; and

.3 less than 10 mV in Critical Care Areas

.2 Method:

.1 Using the standard frequency-weighted test circuit of Figure 2 in standard sheet "Test Circuit Configurations", the following test procedure shall be performed.

.2 Confirm that all receptacles have been installed and that no utilization equipment, either permanently wired or cord-connected, is connected to the system.

.3 Energize the system.

.4 Select a local reference point known to be bonded to ground and record the measured voltage between this chosen reference and each receptacle ground pole and each exposed conductive non-current-carrying metal part in turn. If the test leads are long, the readings should be corrected for pickup (zero reading) when connected together.

.3 Implementation:

.1 Using the standard frequency-weighted test circuit of Figure 2 in standard sheet "Test Circuit Configurations", the procedure shall be carried out.

.2 The voltage measured shall meet the requirements above.

.3 Record all results on tests forms and submit test forms to Consultant for approval.

1.2 IMPEDANCE TO GROUND TEST (SINGLE PHASE ISOLATED SYSTEMS ONLY)

.1 Requirements:

.1 Impedance between each energized conductor and ground to exceed 200,000Ω (not more than 600 microamperes when expressed as a current on a 120 Volt system).

.2 Method:

.1 Confirm that all receptacles have been installed and that no utilization equipment is connected to the system.

.2 Open the circuit breaker to the line isolation monitor.

.3 Verify that the system is ungrounded.

.4 Energize the system.

.5 Use the standard load and measuring device as shown in Figure 3 in CSA standard Z32.

.6 Measure the voltage (Vm1 and Vm2) between a reference ground and each energized conductor in sequence.

.7 Compute the current flow using the formula:

$$I = V_M \times 1000$$

Where:

I is in microamperes

Vm is the greater of Vm1 and Vm2, in volts

.8 Verify that the measured current does not exceed the value:

$$I_{MAX} = 5E$$

Where:

I_{max} is in microamperes

E is the nominal voltage between the energized conductors in volts

.9 Record the results.

.10 Where the system impedance is less than the requirement, test each circuit individually by opening all other breakers on the system in order to identify where the problem exists. Rework the branch circuits as necessary to increase the impedance to the required value.

1.3 MAXIMUM HAZARD TEST (SINGLE PHASE ISOLATED SYSTEMS ONLY)

.1 Requirements:

.1 Hazard index readings to be recorded, this is for future reference when maintaining the isolated power systems.

.2 Method:

.1 Measure the maximum hazard index values on the line isolation monitor with:

(a) all circuit breakers closed,
(b) all permanently installed equipment switched on, (fluorescent lighting ballasts switched off) and
(c) all cord-connected equipment disconnected.

.2 Record the results.

1.4 REPORTS

.1 Prepare and submit reports within 5 days of the completion of testing in an area.

.2 [Submit separate reports for each area to suit construction phasing and occupancy requirements.]

.3 Submit one complete copy of reports, studies and test results directly to each of the Consultant and the Owner. Simultaneously submit a further 6 copies to be processed as a shop drawing.

.4 Include copies of reports, studies and test results in the Maintenance Manuals.

END OF SECTION

ELECTRICAL COMMISSIONING
26 08 15

PART - 1 GENERAL

1.1 SCOPE

.1 The Hospital will retain an Independent Commissioning Agent (CA) who will provide actual Commissioning Services including witness Testing and Commissioning Services as required.

.2 Include all labor and material as required to participate in the commissioning process, as outlined in this section, for equipment installed under Division 26.

1.2 WORK INCLUDED

.1 Commissioning work of Division 26 includes, but is not limited to:

.1 Participation in regular construction meetings as well as separate Commissioning Meetings during the construction period associated with the scheduling, coordination, and implementation of the various commissioning activities within the overall construction program.

.2 Site Testing and start-up of equipment.

.3 Detailed acceptance testing as described under various equipment specifications including supplementary testing required by Commissioning Authority

.4 Cooperation with the Commissioning Authority in developing and implementation of the commissioning plan.

.5 Providing qualified personnel for participation in implementing commissioning test procedures.

.6 Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.

.7 Providing operation and maintenance manuals, and as-built drawings to the Commissioning Authority for verification in a timely manner.

.8 Providing training and demonstrations for the systems specified in this Division prior to turnover to Owner.

.2 Conduct complete and thorough evaluation and documentation of the operation and performance of all components, systems, and sub-systems, including the following equipment and systems:

.1 Fire Alarm System Verification

.2 Nurse Call System Verification

.3 Security System Verification

.4 Medical Equipment Power Conditioning Equipment Verification

.5 Emergency Battery Lighting System Verification

Note:

All of the above Electrical Systems are to be tested/ verified by this Contractor. Commissioning Scope is to ensure the work is completed and acceptable. Requires some active witnessing of some testing.

PART - 2 PRODUCTS (NOT USED)

PART - 3 EXECUTION

3.1 COMMISSIONING MEETINGS

.1 Participate in periodic commissioning team meetings, and trade commissioning meetings.

.2 Construction and Post-Construction:

.1 participate in commissioning meetings as scheduled by the General Contractor.

.2 participate in trade commissioning meetings as required, in addition to the regular commissioning team meetings,

.3 identify to the commissioning group problems relating to the commissioning schedule, identification of start-up issues, etc, and participate in the resolution of these problems.

3.2 COMMISSIONING PROCEDURES

.1 The Owner's designated Commissioning Authority provides the commissioning procedures (checklists, etc) for use by the contractor.

.2 Each commissioning procedure tests the equipment and systems, and consists of the following elements:

.1 Document sign-off

.2 Pre-start and Initial test

.3 Installation Verification - Equipment

.4 Installation Verification - Systems

.5 Performance Validation

.3 Document Sign-Off:

.1 each completed procedure is signed off by the following parties:

(a) Contractor, for testing,

(b) Commissioning Consultant, for review and witnessing,

(c) Owner, for test acceptance.

.4 Installation Verification - Equipment

.1 Checklists to verify the installation of equipment, including: design specification requirements, drawing requirements, manufacturer installation requirements, and other experience-related items.

.2 Use of pre-printed manufacturer installation and start-up checklists are permitted and encouraged; however, the commissioning procedure checklists may contain supplemental items.

.5 Installation Verification - System:

.1 Checklists to verify the installation of the system associated with the equipment.

.6 Performance Validation:

.1 Specific test procedures and record documentation requirements for performance measurements of the various systems.

3.3 COMMISSIONING TEST METHODOLOGY

.1 Step 1 : Notify the Commissioning Consultant in accordance with an agreed schedule and notification period when testing will begin on each procedure type. The Commissioning Consultant will witness the testing on an audit basis, including the first instance, the last instance, and at random during other times.

.2 Step 2 : complete the commissioning procedures including recording results, and sign-off and date separately the completion of Part “A” Verification, and Part “B” Validation. Any deficiencies discovered during this testing are to be corrected prior to sign-off of the test.

.3 Step 3 : on completion of systems which do not require witness demonstration, finalize the report and submit to the Commissioning Consultant and the Consultant for review.

.4 Step 4 : on completion of systems which have been witnessed by the Commissioning Consultant, the Commissioning Consultant is to sign-off the completed procedure document as being witnessed.

3.4 COMMISSIONING IMPLEMENTATION

.1 Conduct operating tests and checks to verify that all components, equipment, systems, and interfaces between systems, operate in accordance with contract documents.

.2 Demonstrate and verify operating modes, interlocks, specified control sequences, specific responses to abnormal or emergency conditions, and verification of the proper response to the Building Automation System, security system, and fire alarm system as applicable.

.3 Roles and Responsibilities:

Organized by:	General Contractor
Test sheets provided by:	Commissioning Authority
Testing Conducted by:	Div 16 Contractors Equipment Suppliers Technical Personnel as appropriate Independent Testing Agent as specified
Testing recorded by:	Div 16 Contractors Equipment Suppliers Technical Personnel as appropriate Independent Testing Agent as specified Commissioning Authority
Tests witnessed by:	Commissioning Consultant Owner (selected tests)
Reports reviewed by:	General Contractor Commissioning Consultant Design Consultant Owner / Commissioning Authority

Organized by:	General Contractor
Reports Accepted by:	Owner

3.5 **OPERATING CHECKS**

.1 The Commissioning Consultant witnesses selected equipment and system tests on an audit basis.

.2 Set the system equipment into operating mode to be tested including but not limited to:

.1 Normal start up, operation, and shut-down

.2 Normal auto position

.3 Normal manual position

.4 Unoccupied cycle

.5 Emergency power operation, including transition states.

.6 Status and Alarm conditions

.3 Inspect and verify the position of each device and interlock identified on the checklist.

.4 Repeat the above tests for each operating mode that applies to the system being tested.

.5 For failed test items, provide appropriate comments to the checklist data sheet and classify whether it is a “Major” or “Minor” deficiency.

.1 The Consultant retains the right to make the final decision regarding classifications of deficiencies.

.6 Test failure is defined as:

.1 Refer to relevant specification sections.

.7 Acceptance

.1 The final reports will be reviewed by the Commissioning Consultant and the Consultant, to determine if verification is complete and the operating systems are functioning in accordance with the contract documents.

.2 The Commissioning Consultant, in conjunction with the Consultant, reviews and makes final classification of all noted deficiencies. Correct deficiencies classified as “Major” before acceptance of the Verification stage.

.3 The Owner will make the final acceptance of test results.

3.6 **PERFORMANCE VALIDATION TESTING**

.1 Conduct performance tests and checks to validate that equipment and system components are providing the required performance (capacity) for each equipment and system.

.2 Special testing requirements:

.1 Conduct acoustic measurement tests outside the building when generators are running, in accordance with local noise by-law procedures.

.2 Conduct acoustic measurement tests inside of generator room when generators are running.

3.7 **PROBLEM RESOLUTION**

.1 In the event that additional work is required to either correct systems, misapplied or improperly installed equipment, and/or deficient performance under varying load conditions, assist the Owner and Commissioning Consultant in developing an acceptable resolution to the problem, including the resources of equipment suppliers.

.2 The Owner has final approval over any additional work required to achieve the required level of performance.

.3 Complete corrective work in a timely fashion to permit the completion of the commissioning process.

3.8 **ACCEPTANCE**

.1 Any identified deficiencies will be reviewed by the Consultant in conjunction with the General Contractor/Construction Manager to determine if correction of the deficiency is as a result of a defect in the equipment or installation.

.2 If it is determined the performance deficiency is as a result of a defect in the equipment or its installation, rectify the deficiency and repeat the performance test until the required performance levels are achieved.

.3 If it is determined the equipment or system has been constructed in accordance with the contract documents, the Owner will decide whether to accept the performance as is, or, direct the installation contractor to make changes to the system as required to obtain performance levels which meet the design intent, and retest the system.

3.9 **POST-SUBSTANTIAL PERFORMANCE COMMISSIONING**

.1 Provide commissioning after Substantial Performance:

.1 Performance testing which is weather or live-load dependent;

.2 For out-of-season system performance testing, conduct initial performance tests to demonstrate off-peak load performance. Schedule peak load performance testing over the succeeding nine (9) months to ensure all equipment is tested at peak load prior to the expiry of the warranty period.

.3 Infra-red thermal imaging of equipment under peak building live-load conditions,

.4 90 day security system testing,

.5 Alternatively, provide temporary equipment (load banks, etc) to simulate full load conditions. Submit proposed methodology for review by the Commissioning Authority and Consultant.

3.10 **ADDITIONAL COMMISSIONING**

.1 Additional commissioning activities may be required after completion of system performance testing. Include in the tender cost a reasonable reserve to complete this work, including assistance from manufacturers' service technicians.

3.11 **SYSTEMS OPERATING MANUALS**

.1 Provide Operating and Maintenance Manuals in accordance with the requirements of section16010.

.2 The Systems Operating Manuals (SOM) are in addition to the Operating and Maintenance Manuals (OMM) required under Section 16010.

.1 Provided by Commissioning Authority and/or Consultant.

3.12 **TRAINING**

.1 Equipment Training:

.1 Provide equipment training in accordance with Section 26 05 01 and the relevant equipment specification sections. The manufacturer's representative training will emphasize operating instructions and preventative maintenance.[][

.2 Systems Training:

.1 In addition to the equipment training described above, provide additional training to describe the operational requirements and design intent of each system.

.2 Include classroom instruction, delivered by competent instructors. Place emphasis on overall systems diagrams and descriptions, and design criteria and conditions.

.3 If required, obtain and pay for the services of the Design Consultant to provide the instructor services and to provide lecture material for inclusion in the training manual.

.4 Training topics to include:

(a) Types of installed systems

(b) Design intent and design criteria

(c) Design constraints

(d) Different operating modes – occupied, unoccupied, emergency conditions, etc.

(e) Seasonal operating modes

(f) Energy efficiency

(g) System operation

(h) Automatic controls

(i) Service, maintenance, diagnostics and repairs

(j) Use of reports and logs

(k) Troubleshooting

.5 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each equipment, with the services of the manufacturers' representative as required. Demonstrate the start-up and shut-down of each system.

.6 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for two (2) training sessions for each topic, separated by approximately one week each, to allow for shift coverage.

.7 Structure each training session based on type of maintenance personnel attending the training session, ie. Plumbers, fitters, general maintenance, controls technicians, etc. Develop the proposed training plan and obtain approval from the Owner before commencing the training.

.8 Complete the training as close to Substantial Performance as possible, so that the Owner's operations staff are prepared to operate the system after Substantial Performance is certified.

.3 Training Manuals

.1 Provide training material hand-outs for each session.

.2 Collect training material and bind into separate binders.

END OF SECTION

PROJECT CLOSE-OUT ELECTRICAL
26 08 19

PART - 1 GENERAL

1.1 SCOPE

.1 Provide documentation deliverables at completion of the Work.

1.2 SUBSTANTIAL PERFORMANCE

.1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.

.2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.

.3 Prepare and submit to the Consultant a comprehensive deficiency list of items to be completed or corrected, as part of the application for a review by the Consultant to establish Substantial Performance of the Work, or for each designated portion of the Work in the case of phased Substantial Performance.

.1 Failure to include an item on the list does not alter the Contractor's responsibility to complete the Work.

.4 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

1.3 TOTAL PERFORMANCE

.1 Submit the following documentation with the application for Total Performance. Application for Total Performance cannot be submitted any earlier than the date of Alternate Season testing.

.1 Where documentation has already been submitted to the Owner, provide a copy of the transmittal.

SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

☐ Contractor has compiled and submitted a detailed deficiency list, identifying work still to be completed, incomplete, or requires correction.

☐ Equipment start-up reports (Interim).

☐ Building department inspection reports.

☐ ESA field inspection reports.

☐ Fire alarm verification certificate.

☐ Independent testing company, coordination study and testing reports submitted.

☐ Equipment and wiring identification completed

☐ Clean-up completed.

☐ Spare parts and replacement parts turned over to Owner; transmittal attached.

☐ Warranty certificates

☐ Operating and Maintenance Manuals, draft, submitted.

☐ As-built drawings submitted

☐ Training completed and attendance logs submitted.

☐ Commissioning reports submitted and reviewed by Consultant

Consultant Review	
Status:	☐ Reviewed ☐ Incomplete or deficient - resubmit
Signed:	
Date:	

TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.

☐ Final commissioning reports submitted and accepted by Owner.

☐ Operating and Maintenance manuals - finalized and submitted (if final version was issued at time of Substantial Performance indicated here:

☐ As-built drawings final version submitted (if final version was issued at time of Substantial Performance indicate here: ☐ Date of delivery: _____

Consultant Review	
Status:	☐ Reviewed ☐ Incomplete or deficient - resubmit
Signed:	
Date:	

END OF SECTION

LIGHTING & RECEPTACLE PANELS
26 27 16

PART - 1 GENERAL

1.1 REFERENCES

.1 CSA C22.2 No. 29-M1989.

1.2 RELATED WORK

.1 Plywood Backboard: Section 06 10 00 - Rough Carpentry

1.3 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 01 Electrical General Requirements.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

.3 Nameplates shall be in accordance with Article "Equipment Identification".

1.5 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.6 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 01 Electrical General Requirements.

1.7 MAINTENANCE MATERIALS

.1 Provide maintenance materials as required and as specified in Section 26 05 01 Electrical General Requirements.

1.8 OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Provide operating and maintenance instructions as specified in Section 26 05 01 Electrical General Requirements.

1.9 PLANT ASSEMBLY

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

1.10 **IDENTIFICATION**

.1 Panels shall be identified with lamacoid plate with shall include panel designation 12 mm (½") lettering, voltage and phase 5 mm (¼") lettering and where panel is fed from 5 mm (¼") lettering.

PART - 2 PRODUCTS

2.1 **PANELBOARDS**

.1 Product of one manufacturer. **Overall Cover shall be hinged to permit access to breakers and wiring compartment.**

.2 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase. When numbering breakers, number from top to bottom and from left to right.

.3 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.4 Two keys for each panelboard and key panelboards alike.

.5 Copper bus with neutral of same ampere rating as mains.

.6 Panels shall be constructed and finished in accordance with details specified in Section 26 27 18 "Panel Trim".

.7 Panels shall be surface or flush mounted type, as shown.

.8 Panels shall be dead front type in code gauge steel enclosure.

.9 Each panel shall be complete with a typewritten directory which shall be mounted inside door with clear plastic cover.

.10 Panels shall have mains of voltage and capacity, and main and branch breakers and contactors, as shown on the "Lighting and Receptacle Panel Schedule". Spaces shall include the necessary bus work such that Owners, at a later date, need buy only the breakers.

.11 Contactors in panel mains shall be electrically operated, mechanically held and shall be rated to control incandescent, fluorescent and other loads as shown. Contactors shall be mounted within panel and shall be open type. Contactors shall be complete with fuse and fuse adaptor mounted and connected to line side of contactor and shall be connected to supply power to operating coil. Coil clearing contacts shall be included in contactor where a contactor is controlled by a time switch.

.12 Breakers shall have bolted type connections.

.13 Panels shall include non-automatic Main Breaker and a bus-mounted, 120/ 208 volt, 3 phase, 4 wire, 200,000 ampere maximum surge capacity built-in transient surge suppression device.

.14 Panels for 120/208 volts, three phase, four wire systems shall be complete with full size breakers, having a symmetrical interrupting rating of at least 10,000 A.

.15 Where indicated breakers shall have a ground fault interrupter.

.16 Panels for 600 volt, 3 phase, 3 wire or 4 wire systems shall be complete with breakers having a symmetrical interrupting rating of 25,000 Amps minimum.

Standard of Acceptance

- **PANELS MUST MATCH EXISTING HOSPITAL STANDARDS AND BE AS MANUFACTURED BY SQUARE D**

2.2 **BREAKERS GENERAL**

.1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 5 - 10 times current rating.

.4 Circuit breakers with interchangeable trips over 150 A.

.5 Lock-on devices for clock outlet, fire alarm, security systems, battery chargers, door supervisory, intercom, stairway, exit and night light circuits.

2.3 **THERMAL MAGNETIC BREAKERS**

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.4 **TRIM**

.1 Front panel trim shall be overall hinged type, door within door construction. Trim assembly shall provide hinged access to the internal tub and wiring channels for access to wiring and breaker terminals without removal of the trim assembly. With overall trim assembly closed and secured, a second integral hinged door forming part of the trim assembly shall provide access to the circuit breakers only for opening and closing purposes

.2 Panels shall be given a rust-resistant treatment to both tub and trim. Locks shall be chrome plated.

.3 Flush panels shall have concealed hinges and flush type combination lock latch. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.

.4 Surface mounted panels shall be constructed in accordance with CSA Type 2 enclosures with overall door assembly protecting all circuit breakers. Door(s) shall be gasketted, with overhanging drip shield, with T-handle 2 point locking system complete with lock and latch.

.5 **Panels shall be finished with two coats of paint in accordance with the following Sherwin Williams colour code:**

.1 **Normal Power: #F65L7, Pale Blue**

.2 **Emergency Power: #F65E37 International Orange**

.6 Panel locks shall be common to one key throughout project.

2.5 **EQUIPMENT IDENTIFICATION**

.1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements.

.2 Nameplate for each panelboard size 4 engraved, Submit nameplate wording.

.3 Complete circuit directory with typewritten legend showing location and load of each circuit. Cover directory with a 0.8 mm (1/32") thick clear plastic sheet.

.4 Nameplates for electrical panels shall indicate panel designation and mains voltage, i.e. 120/208 V, 3 φ, 4 W and panel and circuit number from which this panel is fed

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Locate panel boards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 01 - Electrical General Requirements, or with top of trim at uniform height of 2000 mm (6' -6") or to match door heads or to suit tile layout, or as indicated.

.4 Co-ordinate panel finish with Room Finish Schedule.

.5 Deliver ten (10) duplicate keys for panel locks to Owner.

.6 Connect loads to circuits.

.7 Connect neutral conductors to common neutral bus with respective neutral identified.

.8 Provide minimum #6 AWG green insulated copper bonding conductor in conduit to interconnect normal and emergency power panels serving common patient care areas.

END OF SECTION

MULTI OUTLET ASSEMBLIES
26 27 19

PART - 1 GENERAL

1.1 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 01.

.2 Indicate type of multi-outlet assemblies with similar terminology to these documents.

.3 Product is generally referred to as “Wiremold”

PART - 2 PRODUCTS

2.1 SURFACE RACEWAY FOR WIRING DEVICES

.1 Two piece assembly manufactured for mounting wiring devices and associated wiring.

.2 Cross-section dimensions: as indicated.

.3 Finish: buff enamel.

Standard of Acceptance
- Wiremold
- Canadian Electric Raceways

2.2 WIRING DEVICES

.1 Wiring devices: as indicated, to Section 26 27 26 - Wiring Devices including specified stainless steel cover plates.

2.3 GROUNDING

.1 Ground system through raceway separate insulated conductor.

2.4 FITTINGS

.1 Elbows, tees, couplings and hanger fittings manufactured as accessories to product line supplied.

PART - 3 EXECUTION

3.1 FITTINGS

.1 Install supports, elbows, tees, connectors, fittings.

.2 Keep number of elbows, offsets and connections to minimum.

.3 Install barriers where required.

3.2 WIRING

.1 Install wiring as indicated.

.2 Where Normal and Emergency Power wiring are required to “share” the power section, Contractor is to utilize BX Cable to provide the required separation between sources. Cover is to include suitable labeling noting two sources.

END OF SECTION

WIRING DEVICES
26 27 26

PART - 1 GENERAL

1.1 REFERENCES

.1 CSA C22.2 No. 111-M1986 Switches.

.2 CSA C22.2 No. 42-M1984 Receptacles.

.3 Section 26 28 19 - Ground Fault Circuit Interrupters.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with 26 05 01 Electrical General Requirements.

1.3 IDENTIFICATION

.1 Receptacles in all patient care areas shall have a circuit identification lamacoid in accordance with CSA Z32 - 09.

.1 Lamacoid shall be secured to the wall above the receptacle and shall be engraved with panel name and circuit number from which the receptacle is fed. Lettering shall be minimum 6 mm (¼") high and as follows:

(a) normal power: black lettering on white lamacoid.

(b) emergency power: red lettering on a white lamacoid.

.2 Provide additional lamacoid for dedicated circuit receptacles, of matching colour, indicating the words: "Dedicated Circuit"

.2 All other receptacles shall be labelled with circuit identification using a lamacoid label with colour coding for normal, emergency and UPS sources complete with label attached to cover plate.

1.4 PRE/ POST OCCUPANCY PROVISIONS

.1 Assuming the Hospital will, as the time for occupancy approaches or even after occupying, resolve that some additional receptacles/ power outlets will be required. Include, in the Contract, the following additional installations:

(a) two (2) Emergency Power 15 amp, 120 volt Duplex Receptacles

(b) two (2) Normal Power 15 amp, 120 volt Duplex Receptacles

(c) two (2) 15 amp, 120 volt direct connection outlets

.2 Each component with an average of 50'-0" of wire in conduit installed and terminated at the nearest Electrical Panel will be required. Include outlet box, wire, conduits, face-plates, labels, terminations, testing, and documentation for each. Assume, for bidding purposes, that these can be added at any time during construction including at the end of the construction and in any location as directed on site. Devices not installed at the construction completion are to be turned over to the Hospital as spare parts for future installation.

PART - 2 PRODUCTS

2.1 SWITCHES

.1 20 A, 120 V, silent, AC type, CSA listed, single pole, double pole, three-way, four-way switches "decorative type".

.2 Manually-operated general purpose ac switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 White coloured "rocker" toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Catalogue numbers listed below have been used for convenience only to indicate quality standards:

TYPE	APPROVED CATALOGUE NUMBERS
	HUBBELL(120 VOLT)
SINGLE POLE	HBL2121WA
DOUBLE POLE	HBL2122WA
THREE-WAY	HBL2123WA
FOUR-WAY	HBL2124WA

.6 Combination switches shall have neon pilot light and jewel on stainless steel plate

.7 Switches controlling lights on 120 volt emergency circuits shall be with lighted handle as follows:

TYPE	APPROVED CATALOGUE NUMBERS
	HUBBELL(120 VOLT)
SINGLE POLE	HBL2121ILWA
THREE-WAY	HBL2123ILWA

Standard of Acceptance
- Pass & Seymour
- Harvey Hubbell of Canada Ltd.
- Bryant Electric
- Cooper Wiring Devices
- Leviton

2.2 **DIMMER SWITCHES**

.1 Dimmers for use on LED Luminaires shall be equal to Lutron, "Nova Series", LED compatible as noted and white cover plates.

.2 Matching switches shall be used adjacent to dimmers.

.3 Where more than one dimmer is shown in the same location, mount dimmers in individual backboxes. Provide matching switches where shown adjacent to dimmers.

2.3 **RECEPTACLES**

.1 Receptacles shall be decorator style to be complete with following features:

.1 urea moulded housing.

.2 Suitable for no. 10 AWG for back and side wiring

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and rivetted grounding contacts.

.6 receptacles to be Heavy duty Hospital grade type

.2 Receptacles of one manufacturer throughout project.

.3 Receptacles shall be colour coded as follows:

.1 Normal power: white

.2 Emergency power: red

.4 Receptacles shall be as shown and as specified. For convenience, only one or two catalogue numbers of manufacturers have been shown.

Standard of Acceptance
- Pass & Seymour
- Harvey Hubbell of Canada Ltd.
- Bryant Electric
- Cooper Wiring Devices
- Leviton

.1 The receptacles listed below represent the most common configurations available and are not necessarily used on this project. Refer to drawings for types used.

.2 Duplex receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

Standard of Acceptance

TYPE	APPROVED CATALOGUE NUMBERS				
	P & S	HUBBELL	BRYANT	LEVITON	COOPER
STANDARD (NON-DECORA) (HOSPITAL GRADE)	5262 8200	5262 8200	5262 8200	5262 8200	5262 8200
DECORA (HOSPITAL GRADE)	26252 26262HG	2152 2172	9252 9200	5280 16262-HG	6262 8262

.3 Weatherproof, 15 ampere, 120 volt equal to those above but complete with gasketted cast plate and hinged covers, equal to Leviton No. 4926 (vertical).

.4 Isolated ground duplex receptacle: 15 ampere, 120 volt, CSA Configuration 5-15R:

Standard of Acceptance
- Pass & Seymour IG5262
- Hubbell IG5262
- Bryant 5262IG
- Leviton 5262-IG
- Cooper IG5262

.5 Transient voltage surge suppressor duplex decora receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

Standard of Acceptance
- Pass & Seymour 5262-SP
- Hubbell 5262-SA
- Leviton 7280
- Cooper 5262-S
- Bryant SP52-A

.6 Twistlock receptacle: 15 ampere, 120 volt, grounded CSA Configuration L5-15R

Standard of Acceptance
- Single: Hubbell/P&S/Bryant/Leviton/Cooper 4710
- Duplex: Hubbell/P&S/Bryant/Leviton/Cooper 4700

.7 Duplex safety hospital grade receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

Standard of Acceptance
- Pass & Seymour TR62H
- Hubbell 8200-SG
- Bryant 8200-TR
- Leviton 8200-SG

° Cooper TR 8200

.8 Single receptacle: 15 ampere, 208 volt, single phase, 3 wire grounded CSA Configuration 6-15R:

Standard of Acceptance
° Pass & Seymour 5651
° Hubbell 5661
° Bryant 5661
° Leviton 5661
° Cooper 5661

.9 Duplex receptacle: 15 / 20 ampere, 120 volt, grounded CSA Configuration 5-20R:

Standard of Acceptance

TYPE	APPROVED CATALOGUE NUMBERS				
	P & S	HUBBELL	BRYANT	LEVITON	COOPER
STANDARD (NON-DECORA) (HOSPITAL GRADE)	5362 8300	5362 8300	5352 8300	5362 8300	5362 8300
DECORA (HOSPITAL GRADE)	26352 26362HG	2162 2182	9352 9300	- 16362-HG	6362 8362

.10 Twistlock receptacle: 20 ampere, 208 volt, 2 pole, 3 wire grounded CSA Configuration L6-20R:

Standard of Acceptance
° Pass & Seymour L620R
° Hubbell 2320
° Bryant 70620
° Leviton 2320
° Cooper CWL620R

2.4 FLOOR OUTLETS

.1 Duplex floor receptacles in flush mounted floor box, 15 ampere, 120 volts shall be complete with adjustable, watertight floor boxes, CSA Configuration 5-15R.

Standard of Acceptance
° Hubbell B2431 single gang box (brass)
° Hubbell B2432 double gang box (brass)
° Hubbell B2433 three gang box (brass)

.2 Service fitting for floor receptacle shall be complete with receptacle specified above, unless noted otherwise.

Standard of Acceptance
° Hubbell S3625, duplex screw cover (brass)
° Hubbell S3825, duplex flap (brass)

2.5 COVER PLATES

.1 Switch, receptacle and other plates shall be smooth white nylon decorative style in finished areas and pressed steel in unfinished areas. Cover plates shall be Hubbell "Style Line" or equal as manufactured by:

- Arrow-Hart of Canada Ltd.
- Pass & Seymour Inc.
- Smith & Stone Ltd.
- Leviton
- Westinghouse Canada Ltd.

.2 Cover Plates shall be finished as follows:

.1 Light Switches: White

.2 Receptacles, Normal power: gray

.3 Receptacles, Emergency power: red

.3 Cover plates for wiring devices. Cover plates from one manufacturer throughout project.

.1 Stainless steel 18-8 chrome metal alloy, Type 302, vertically brushed, 1 mm (1/32") thick cover plates for wiring devices mounted in flush-mounted outlet box.

.2 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.3 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.4 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

.5 Letters shall be 6 mm (¼") high filled with red paint where engraving is indicated. Engraving shall be parallel to finished floor level.

Standard of Acceptance
° Pass & Seymour #93000 Series
° Harvey Hubbell of Canada Ltd. #93000 Series
° Bryant Electric #S600 Series
° Leviton #84000 Series
° Cooper #93000 Series

2.6 GROUND FAULT CIRCUIT INTERRUPTERS

.1 Units shall be CSA approved Type A.

.2 Ground fault circuit interrupters (GFCI) shall be complete with receptacle, test feature and reset switch.

.3 Units shall include a 15A grounded duplex decora receptacle, a button to test operation of unit and current transformer and sensing mechanism. Unit to be complete with suitable outlet box.

.4 Units in Hospitals to be hospital grade.

.5 Unless noted otherwise, unit shall trip at 6 mA.

.6 Where shown in outdoor locations, units shall be enclosed in weatherproof surface-mounted enclosures. In other locations units shall be furnished with stainless steel cover plate.

Standard of Acceptance
- Pass & Seymour 1595HG
- Harvey Hubbell of Canada Ltd. GFR8200 Series
- Bryant Electric GF82 Series
- Leviton 7599-HG
- Cooper VGFH15

2.7 OUTLETS IN MOVABLE PARTITIONS

.1 Outlets and switches, shown in movable partitions, shall have special shallow outlet boxes with stainless steel wall plates.

.2 Single pole switches

Standard of Acceptance
- GE Canada #7651-2

.3 Three-way switches

Standard of Acceptance
- GE Canada #7653-2

.4 Stainless steel wall plates

Standard of Acceptance
- Arrow-Hart of Canada Ltd. - Trimline series

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Switches

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height specified in Section 26 05 01 - Electrical General Requirements or as indicated.

.2 Receptacles

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height specified in Section 26 05 01 - Electrical General Requirements or as indicated.

.3 For each type of receptacle 20 ampere or larger, supply and hand to Owner two heavy duty caps.

.4 For each type of receptacle 30 ampere or larger, supply and hand to Owner two heavy duty caps.

.5 Connect receptacle grounding terminal to the outlet box with an insulated green ground strap.

.6 Exact position of service fittings shall be verified to suit furniture layout.

.7 Do not mount receptacles directly on a column, unless column has been appropriately furred, to avoid breaking fire barrier.

.3 Cover Plates

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Install explosion proof wiring and devices in hazardous locations of Class, Division and Group as indicated on Drawings.

.5 Ground fault circuit interrupters:

.1 Mount receptacles at height indicated in Section 26 05 01 - Electrical General requirements or as indicated.

.6 Outlets in Movable Partitions

.1 Co-ordinate installation of outlet boxes and conduits with the particular trade involved.

END OF SECTION

OCCUPANCY SENSOR SWITCHES
26 27 27

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 01 01, Electrical General Requirements.

1.2 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.3 GENERAL DESCRIPTION

.1 The Lighting Control System is to be a complete motion sensing system. All components and services described herein are part of the Division 26 scope.

.2 The system and services are comprised of, but not limited to, the following main components

.1 Power and auxiliary relay packs.

.2 Ultrasonic Occupancy sensors.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01300 - Shop Drawings, Product Data, Samples and Mock-ups and Section 26 01 01 Electrical General Requirements.

.2 Drawings to include electrical detail of, relay type and quantity, ampacity, power supplies, enclosure construction and dimensions.

.3 Submit typical wiring diagrams for all components including, but not limited to, relays, occupancy sensors.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Section 16010 Electrical General Requirements.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials as required and as specified in Section 26 01 01 Electrical General Requirements.

1.7 OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Provide operating and maintenance instructions as specified in Section 26 01 01 Electrical General Requirements.

PART - 2 PRODUCTS

2.1 OVERVIEW DESCRIPTION

.1 The lighting control system consists of occupancy sensors and auxiliary relay packs.

Standard of Acceptance
- **Wattstopper** (or approved equal by Consultant)

.2 Occupancy sensors, and relay packs shall be mounted in the spaces as indicated. Low voltage wiring from the switches and sensors to the relay packs shall be installed in conduit.

.3 Each low voltage wire shall be labeled with the relay number at each switch or sensor. Use only properly color coded, stranded #20 AWG (or larger) wire. All relays and switches shall be tested after installation to confirm proper operation and the loads recorded on the directory card in each panel.

2.2 SYSTEM OPERATION

.1 Lighting in areas shown on drawings is to be turned on and turned off by the occupancy sensors after an adjustable 3 minute to 30 minute delay of no action within the space. The system is to be programmed so if there is activity detected by an occupancy in a room that is accessible via another room(s) and not the corridor, then the lights will remain on the adjacent room(s)

2.3 AUXILIARY RELAY PACKS

.1 Lighting control relay power packs shall have a 120-24 volt transformer for control of 120 volt lighting.

.2 The power pack shall be plenum rated with teflon coated low voltage leads and plenum rated plastic housed in a ABS, UL-rated 94V-0 enclosure.

.3 Switching the relay shall be accomplished with ONE signal wire and a common return. The signal wire shall be able to signal ON and OFF and shall also carry status current that indicates if the relay is ON or OFF.

2.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 01 01 - Electrical General Requirements.

2.5 SWITCH PLATES

.1 Select switch plates to suit number of switches as shown on the plans. Up to 3 switches can be installed in a 1 gang box.

.2 All switch plates are to be made of stainless steel

.3 Provide switch plates for combination of low voltage switches and line voltage dimmer as shown on the drawings.

2.6 OCCUPANCY SENSORS

.1 All ceiling mounted occupancy sensors to be ultrasonic, equal to Watt Stopper WT or UT-300 series.

.2 Ceiling sensors shall be sized for the particular room controlled, with sufficient coverage area to permit site adjustment to particular occupancy patterns and room layouts.

.3 All wall sensors are to be passive inferred, equal to Watt Stopper WA-200 series. Mount sensor at a high level above the latching side of the door. Wall sensors are to be complete with manual override.

.4 Sensors to be integrated into the system that they can provide both on/off switching or off-only switching.

.5 All sensors shall be directly compatible with the power and auxiliary relay packs described above and shall wire directly to the relays without any auxiliary components or devices above the ceiling.

.6 Sensitivity and time delay adjustments shall be readily accessible to the user with LED indication of sensed movement to simplify set up.

.7 User adjustable time delay shall be from 30 seconds to 30 minutes.

2.7 SYSTEM START UP SERVICES

.1 Manufacturer to provide a factory authorized technician to confirm proper installation and operation of all system components.

.1 Typical wiring diagrams for each component.

.2 Manufacturer to provide, install and commission system programming including:

.1 Wiring documentation

.3 Notify Consultant and Commissioning Agent of testing schedule prior to any testing.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Provide motion sensing switching of the type designated in locations as shown on the drawings.

.2 Provide wiring as recommended by the manufacturer. Low voltage wiring to local control devices to be installed in conduit. Adhere to manufacturer's recommendations as to maximum wire length and maximum quantity of relays per switch.

END OF SECTION

WIRE AND BOX CONNECTORS 0-1000 V
26 27 28

PART - 1 GENERAL

1.1 REFERENCES

.1 CSA C22.2 No.65-93 (R1999) Wire Connectors.

.2 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for copper conductors or bars

.2 Clamp for copper conductors or bars.

.3 Stud clamp bolts.

.4 Bolts for copper conductors or bars.

.5 Sized for conductors or bars as indicated or required.

.4 Clamps or connectors for armoured cable, mineral insulated cable, and flexible conduit, as required.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

.4 Install crimp type connectors.

.2 Install box connectors.

END OF SECTION

DISCONNECT SWITCHES UP TO 1000 VOLTS
26 27 33

PART - 1 GENERAL

1.1 REFERENCES

.1 CSA C22.2 No. 4-M89 Manual Switches.

.2 CSA C22.2 No. 39 Fuse Holder Assemblies.

.3 Section 26 28 13 Fuses - Low Voltage

1.2 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

.2 Nameplates shall be in accordance with Article "Equipment Identification".

1.4 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 01 Electrical General Requirements.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials as required and as specified in Section 26 05 01 Electrical General Requirements.

1.7 OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Provide operating and maintenance instructions as specified in Section 26 05 01 Electrical General Requirements.

PART - 2 PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible disconnect switch in sprinkler proof EEMAC 3 enclosure, size as indicated.

.2 2 pole or 3 pole as required for single phase or three phase circuits

.3 2 pole with solid neutral or 3 pole with solid neutral for three wire and four wire circuits with neutral

.4 6 pole for two speed motor applications

.5 Provision for padlocking in off switch position.

.6 Mechanically interlocked door to prevent opening when handle in ON position.

.7 Fuses: size as indicated, to Section 26 28 13 - Fuses - Low Voltage.

.8 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.9 Heavy Duty, quick-make, quick-break action.

.10 ON-OFF switch position indication on switch enclosure cover.

.11 Complete with auxiliary NO/NC contact for hydraulic elevator motors.

Standard of Acceptance
- Square D Company (Canada) Ltd.
- Cutler Hammer
- Siemens Canada Ltd.
- Federal Pioneer Ltd.

2.2 THREE POLE DOUBLE THROW SWITCHES

.1 Non-fusible manual load transfer switch in sprinkler proof EEMAC 3 enclosure, size as indicated.

.2 Continuous duty rated and suitable for switching HP loads

.3 Visible blades for positive indication that switch is in the OFF position

.4 Provision for padlocking in the centre OFF switch position, and in the ON positions.

.5 Heavy Duty, quick make, quick break operating mechanism

.6 Phenolic insulating bases

.7 Compression lugs for switches over 100A

.8 Mechanically interlocked door to prevent opening when handle in ON position.

.9 ON-OFF-On switch position indication on switch enclosure cover.

Standard of Acceptance
- Square D Company (Canada) Ltd.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements.

.2 Indicate name of load controlled on size 4 nameplate.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses.

END OF SECTION

ISOLATED POWER SYSTEMS
26 7 43

PART 1 - GENERAL

1.1 General Requirements

.1 Conform to Section 26 05 01, Electrical Basic Materials and Methods.

1.2 References

.1 CSA Standard C9, "Dry Type Transformers".

.2 CSA C22.2 No. 29, ”Panelboards and Enclosed Panelboards”.

.3 CSA C22.2 No. 204 “Line isolation monitors”

.4 CSA Z32 - “Electrical Safety and Essential Electrical Systems in Health Care Facilities”.

1.3 Work Included

.1 Work to be done under this Section includes furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.4 Shop Drawings and Product Data

1.5 Provide one additional set of reviewed drawings, shipped with the equipment, for start up and maintenance use. Operation and Maintenance Data

.1 Include detailed instructions to permit effective operation, maintenance and repair of the equipment.

.2 Technical data to be included;

.1 Schematic diagrams of components, controls and relays,

.2 Illustrated parts lists with part catalogue numbers.

PART 2 - PRODUCTS

1.6 General

.1 CSA labeled or Inspection Authority Special Inspection approval.

.2 Isolated Power Centres (I.P.C.'s) to be single phase systems including;

.1 a two pole primary breaker,

.2 an isolation transformer of capacity shown,

.3 a breaker panel with ground bus,

.4 a line isolation monitor, and

.5 relays and controls where indicated (for X-Ray and/or portable laser systems).

1.7 Enclosure

.1 Designed for recessed mounting.

.2 Rust-resistant treatment of tubs.

.3 Separately barriered section complete with louvered, removable front cover for transformer.

.4 Sound absorbing material on inside of transformer section.

.5 Enclosure depth not exceeding:

.1 150mm (6") for 5 kVA units

.6 Panel trim:

.1 stainless steel,

.2 concealed fasteners.

.7 Doors:

.1 to open not less than 135°,

.2 concealed hinges,

.3 chrome plated combination latch/lock,

.4 locks common to one key throughout project.

1.8 Primary Breaker

.1 Non-automatic.

.2 2 pole.

.3 Rated for not less than 125% of the transformer full load current.

.4 Breaker interrupting rating: 65,000 A RMS symmetrical, unless indicated otherwise.

1.9 Transformer

.1 Isolation transformer of kVA capacity indicated.

.2 ANN type.

.3 Insulation: Class H system, 115 degree C rise.

.4 All current carrying parts to be copper.

.5 Regulation: 3% no load to full load.

.6 Harmonic distortion: not exceeding 1%.

.7 Electrostatic shielding between primary and secondary wiring, providing:

.1 transverse mode attenuation not less than 50 dB at 10 kHz,

.2 common mode attenuation not less than 80 dB,

.3 double shielded design with primary winding enclosed in grounded copper foil, with a separate grounded copper foil between windings.

.8 Leakage current to UL1047:
  .1 5 kVA 120 volt secondary: not exceeding 25 Micro Amps

.9 Ratings:
  .1 208/120 volts, 60 Hz. 5 kVA, unless otherwise indicated.

.10 Noise level:
  .1 not exceeding 31 dB at 1500mm (5 feet).

.11 Mounting:
  .1 Mounted on anti-vibration mounts.

1.10 Breaker Panel

.1 Copper main bus with terminals for conductor sizes and conductor types shown.

.2 Copper ground bus with terminals for not less than;
  .1 incoming bonding conductor,
  .2 two #6 outgoing bonding conductors to other panels,
  .3 one #10 bonding conductor for each branch circuit, and
  .4 not less than five additional #10 bonding conductors.

.3 One branch breaker for the line isolation monitor plus the quantity of other branch breakers as shown.

1.11 Circuit Breakers

.1 Two pole, bolted-on type.

.2 Interrupting rating not less than 10,000 A RMS Symmetrical.

.3 15 Ampere rating, except where indicated otherwise.

.4 30 Ampere rating for X-Ray and/or portable laser outlets, except where indicated otherwise.

1.12 Line Isolation Monitor

.1 Dynamic self-resetting type that continuously monitors both lines of the isolated power supply.

.2 Non-switching circuitry.

.3 Alarm point of 5 mA.

.4 Leakage current not exceeding 25 microamperes.

.5 With the following features;
  .1 buzzer,
  .2 alarm silencing switch,
  .3 system “safe” light,
  .4 system "hazard" light,

.5 test switch,

.6 hazard index scale, and

.7 controls and terminals for the connection of remote alarm indicators.

1.13 Remote Alarm Indicators

.1 System "safe" light.

.2 System “hazard” light.

.3 Buzzer.

.4 Silencing switch.

.5 Wiring terminals.

.6 Flush-mounting enclosure.

1.14 X-Ray and Laser Receptacles

.1 208V 30Amp single phase receptacle, unless otherwise indicated.

.2 Remote alarm indicator.

.3 Flush mount box.

.4 Stainless steel flush cover with hinged door over receptacle.

.5 Controls to operate the circuit switching relays.

Standard of Acceptance

- **Square D**

PART 3 - EXECUTION

1.15 Installation

.1 Provide isolated power centres (I.P.C.'s) as shown and as specified.

.2 Provide a separate IPC for each bed location, except where indicated otherwise.

.3 Provide remote Line Isolation Monitors where indicated.

.4 Prior to installation, confirm the receptacle configuration requirements for X-Ray and laser outlets with the Hospital.

.5 Provide X-Ray receptacles where indicated.

.6 Provide laser receptacles where indicated.

.7 Flush mount IPC’s, remote alarm indicators and receptacles, unless indicated otherwise.

.8 Provide conduit and wire and interconnect remote Line Isolation Monitor in accordance with the manufacturer’s instructions.

.9 Provide wiring from each I.P.C. to receptacles and outlets shown.

.10 Provide wiring in accordance with Section 26 07 06 Wiring of Isolated Power Systems.

.11 Connect the ground bus in each IPC to a corresponding ground bus in the up steam power panel with an insulated green ground wire, sized not less than required by code and run in the feeder conduit.

.12 Where more than one IPC serves a single room or patient care environment, interconnect the ground busses of the IPC's with 1#6 green insulated bonding wire, or larger where required by code, and run in PVC conduit.

END OF SECTION

FUSES – LOW VOLTAGE
26 28 13

1.1 GENERAL

1.2 REFERENCES

.1 To CAN/CSA Standard C22.2 No. 106-M90.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01.

.2 Submit fuse performance data characteristics for each fuse type and size above 200 A. Performance data to include: average melting time-current characteristics, I^2t (for fuse coordination), and peak let-through current.

1.4 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Section 26 05 01.

.2 Six spare fuses of each type and size installed up to and including 600 A.

1.5 DELIVERY AND STORAGE

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in motor control centres, or disconnect switches.

.3 Store fuses in original containers in storage cabinet.

PART - 2 PRODUCTS

2.1 FUSES GENERAL

.1 Fuse type references L1, L2, J1, R1 etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer

.3 Fuses rated to 600A shall be CSA certified HRCI-J.

.4 Fuses rated 601A and above shall be CSA certified HRCI-L.

2.2 FUSE TYPES

.1 HRCI-J fuses, current limiting, time delay, with blown fuse indication

Standard of Acceptance
- Ferraz Shawmut: Amptrap 2000 type AJT
- Bussman: LPJ
- Littlefuse: JTD ID series

.2 HRCI-L fuses, current limiting, time delay.

Standard of Acceptance
- Ferraz Shawmut: Amptrap 2000 type A4BQ

- Bussman: KRP-C
- Littlefuse: KLPC Series Power-Pro

2.3 **FUSE STORAGE CABINET**

.1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 01 - Electrical-General Provisions.

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices

.3 Ensure correct fuses fitted to assigned electrical circuit.

.4 Provide a spare set of six fuses of each size and type installed on the project [and turn over to Owner] [and locate in fuse storage cabinet].

.5 Mount fuse storage cabinet on wall [in main electrical room] [in maintenance shop] [as directed on site by Owner's maintenance personnel]

END OF SECTION

XRAY MAIN DISCONNECT DEVICES
26 28 14

PART - 1 GENERAL

1.1 REFERENCES

.1 CSA C22.2 No. 4-M89 Manual Switches.

.2 CSA C22.2 No. 39 Fuse Holder Assemblies.

.3 Section 26 28 13 Fuses - Low Voltage

1.2 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

.2 Nameplates shall be in accordance with Article "Equipment Identification".

1.4 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 01 Electrical General Requirements.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials as required and as specified in Section 26 05 01 Electrical General Requirements.

1.7 OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Provide operating and maintenance instructions as specified in Section 26 05 01 Electrical General Requirements.

PART - 2 PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible disconnect switch in custom constructed enclosure, size as indicated.

.2 3 pole as required for three phase circuits

.3 3 pole with solid neutral for three wire and four wire circuits with neutral

.4 Provision for padlocking in off switch position.

.5 Mechanically interlocked door to prevent opening when handle in ON position.

.6 Fuses: size as indicated, to Section 26 28 13 - Fuses - Low Voltage.

.7 Fuseholders: suitable without adaptors, for type and size of fuse indicated.

.8 Heavy Duty, quick-make, quick-break action.

.9 ON-OFF switch position indication on switch enclosure cover.

.10 Complete with:

- Control Transformer
- 3 pole Contactor with remotely controlled Operating Coil
- remote Emergency Power Off Stations

Contactor shall be electrically operated, mechanically held and shall be rated to control CT Scanner loads as shown. Contactors shall be mounted within panel and shall be open type. Contactors shall be complete with fuse and fuse adaptor mounted and connected to line side of contactor and shall be connected to supply power to operating coil. Coil clearing contacts shall be included in contactor.

Emergency Power Off Stations shall be a yellow polycarbonate device with a red pushbutton and red lettering “Emergency Power Off”. Unit shall have two Form ‘C’ Contacts rated 10amps and a clrear flip-up plastic cover.

Standard of Acceptance
Overall System, consisting of Main Disconnect Device and Remote EPO Station and that must match existing Hospital Standards and be supplied by:
Active Power, Inc., attn: Ken Goodwin,
telephone (905) 478-8659, fax (866) 334-6791, email: ksgoodwin@aol.com

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements.

.2 Indicate name of load controlled on size 4 nameplate.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses.

END OF SECTION

MOULDED CASE CIRCUIT BREAKERS
26 28 16

PART - 1 GENERAL

1.1 REFERENCES

.1 CAN/CSA C22.2 No. 5.1. Moulded case circuit breakers.

1.2 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

.2 Nameplates shall be in accordance with Article "Equipment Identification".

.3 Include time-current characteristic curves for breakers with ampacity of 200 A and over or with interrupting capacity of 22,000 A symmetrical (rms) for 120/208 volt and 25,000 A symmetrical (rms) for 600 volt..

1.4 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 01 Electrical General Requirements.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials as required and as specified in Section 26 05 01 Electrical General Requirements.

1.7 OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Provide operating and maintenance instructions as specified in Section 26 05 01 Electrical General Requirements.

PART - 2 PRODUCTS

2.1 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 5 - 10 times current rating.

.4 Circuit breakers with interchangeable trips over 150 A.

.5 25,000 Amps symmetrical interrupting rating at 600 volts

2.2 **THERMAL MAGNETIC BREAKERS**

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 **SOLID STATE TRIP BREAKERS**

.1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase, ground fault and short circuit protection.

2.4 **FEATURES**

.1 Include

.1 on-off locking device

.2 handle mechanism

2.5 **ENCLOSURE**

.1 Mount individually mounted breakers in CEMA 3 enclosure.

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Install circuit breakers as indicated.

END OF SECTION

UNINTERRUPTIBLE POWER SUPPLY (UPS)
26 28 18

PART - 1 GENERAL

.1 Conform with the requirements of all Sections.

1.2 WORK INCLUDED

.1 The Work to be done under this Contract shall include design, manufacture, fabrication, testing, supply, delivery to site, commissioning and guarantee of Electrical U. P. S. and Harmonic Filter equipment. Equipment to be provided shall include items listed in schedule below.

.2 Site work by the equipment supplier shall include the services of a competent superintendent to witness equipment unloading, lifting and placement operation, as well as equipment connection, testing and commissioning.

.3 The following items of Work shall be done as part of the Work of the Contractor.

.1 Unloading equipment from truck

.2 Installing equipment in designated location

.3 Supplying/installing interconnecting cables

.4 Re-assembling factory made shipping breaks

1.3 SCOPE

.1 NEW Uninterruptible Power Supplies shall be continuous duty, three phase, solid state including (refer also to Drawing Details) and shall be as follows:

.1 Provide 250 kva, 600-480 volt as indicated

.2 Input Source Selector Switches, make before break (unit to have both an Emergency Power feed (“Duty Feed”) and a Normal Power Feed (“Back-up Feed”)

.3 Active Input Harmonic Filter

.4 UPS component with static bypass and maintenance bypass

.5 Remote UPS Monitor Panel (installed in the Control Room)

.6 Battery Cabinets complete with Batteries

.7 Remote monitoring interface unit designed to connect to the Hospital’s Network and to provide remote alarm indication by telephone/ pager/ computer/ email/ etc.

.8 Materials and equipment described in each Section of the Specification are designed to establish standards of construction and workmanship.

.2 Where manufacturers or manufacturers products are identified in lists with phrase "Standard of Acceptance", these are manufacturers and/or products which meet standards with regard to performance, quality of material and workmanship.

.3 Manufacturers and or products used are to be chosen from these lists.

.4 Where the Specification states “to match existing Hospital Standards” it is mandatory that the existing Standard be maintained and that the product must be as manufactured the identified manufacturer and must be the product identified.

1.4 **REFERENCES**

.1 The UPS shall be in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

.1 ANSI C62.41 (IEEE 587)

.2 ASME

.3 CSA 22.2, No. 107.1

.4 FCC Part 15, Class A

.5 Ontario Hydro Electrical Code

.6 UL Standard 1778

.7 The UPS shall be UL listed per UL Standard 1778, and shall be CSA certified.

1.5 **SYSTEM MANUFACTURER/ SUPPLIER**

.1 Overall, UPS, Harmonic Filter System, including the “Service” for the PET CT Scanner re-used UPS System, shall match existing Hospital Standards and be supplied by:

Active Power, Inc., attn: Ken Goodwin,
telephone (905) 478-8659, fax (866) 334-6791, Email: ksgoodwin@aol.com

1.6 **SYSTEM DESCRIPTION**

.1 UPS Module

.1 Voltage: Input/output voltage specifications of the UPS shall be:

.1 Input: 600 volts, three-phase, 3-wire-plus-ground.

.2 Output: 277/480 volts, three-phase, 4-wire-plus-ground.

.2 Output Load Capacity: Specified output load capacity of the UPS shall be 225 kVA at 0.9 lagging power factor.

.2 Matching Battery Cabinet

.1 Initial Battery installation shall be capable of maintaining a load.

.2 Battery Cells: Sealed, lead-acid, valve-regulated.

.3 Reserve Time: minimum 10 minutes at specified capacity with ambient temperature between 20 and 30□C.

.4 Recharge Time: to 95% capacity within ten (10) times discharge time using up to 60 minutes Battery Size.

.3 Modes of Operation

.1 The UPS shall be designed to operate as an on-line reverse transfer system in the following modes:

.1 Normal: The critical AC load is continuously supplied by the UPS inverter. The rectifier/charger derives power from a utility AC source and supplies DC power to the inverter while simultaneously float-charging a power reserve battery.

.2 Emergency: Upon failure of utility AC power, the critical AC load is supplied by the inverter, which without any switching, obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.

.3 Recharge: Upon restoration of utility AC power, after a utility AC power outage, the rectifier/charger shall automatically restart, walk-in, and gradually assume the inverter and battery recharge loads.

.4 Bypass: If the UPS must be taken out of service for maintenance or repair, or should the inverter overload capacity be exceeded, the static transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.

.4 Performance Requirements

.1 AC Input to UPS

.1 Voltage Configuration: three phase, 4 wire plus ground.

.2 Voltage Range: + 10%, -25% of nominal.

.3 Frequency: Nominal frequency +/- 5%.

.4 Power Factor: 0.85 lagging minimum at nominal input voltage and full rated UPS output load.

.5 Inrush Current: 800% of full load current maximum.

.6 Current Limit: 125% of nominal AC input current maximum. 100% of nominal for optional generator operation.

.7 Input Current Walk-in: 20 seconds to full rated input current maximum. Field selectable 5 or 20 seconds.

.8 Current Distortion: 30% THD maximum at full load. A separate electronic input filter shall be supplied to reduce input current distortion to > 3% THD maximum at full load.

.9 Surge Protection: Sustains input surges without damage per criteria listed in ANSI C62.41-1980.

.5 AC Output, UPS Inverter

.1 Voltage Configuration: three-phase, 4-wire plus ground.

.2 Voltage Regulation:

.1 +/- 1% three-phase RMS average for a balanced three-phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

.2 +/- 2% three-phase RMS average for a 50% unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

.3 Frequency: Nominal frequency +/- 0.1%.

.4 Frequency Slew Rate: 1.0 Hertz per second maximum. Field selectable from 0.1 to 1.0 Hz per second.

.5 Phase Displacement:

.1 +/- 1 degree for balanced load.

.2 +/- 3 degrees for 50% unbalanced load.

.6 Bypass Line Sync Range: +/- 0.5 Hertz. Field selectable +/- 0.5, 1.0, 3.0, 5.0 Hz.

.7 Voltage Distortion:

.1 < 2% total harmonic distortion (THD) for linear or non-linear loads.

.2 1% maximum for any single harmonic.

.8 Load Power Factor Range: 0.9 leading to 0.5 lagging.

.9 Output Power Rating: Rated kVA at 0.8 lagging power factor.

.10 Overload Capability:

.1 125% for 10 minutes (without bypass source).

.2 150% for 60 seconds (without bypass source).

.11 Inverter Output Voltage Adjustment: +/- 5% manual adjustment.

.12 Voltage Transient Response:

.1 20% to 50% load step: +/- 2%

.2 100% load step: +/- 3%

.3 Loss or return of AC input power: +/- 1%

.4 Manual transfer of 100% load: +/- 3%.

.13 Transient Recovery Time: to within 1% of output voltage within 16.7 milliseconds.

.14 Voltage Unbalance: balanced load to 20% unbalanced load +/- 1%, 50% unbalanced load +/ 2%, 100% unbalanced load +/- 5%.

.15 Fault Clearing: Sub-cycle current of at least 300%.

1.7 **ENVIRONMENTAL CONDITIONS:**

.1 Operating Ambient Temperature:

.2 UPS Module: 32°F to 105°F (0°C to 40°C).

.3 Battery: 77 +/- 9°F (25 +/- 5°C).

.4 Storage/Transport Ambient Temperature: -4°F to 158°F (-20°C to 70°C).

.5 Relative Humidity: 0 to 95%, non-condensing.

.6 Altitude:

.7 Operating: to 6600 ft. (2,000 metres) above Mean Sea Level. Derated for higher altitude applications.

.8 Storage/Transport: to 40,000 ft. (12,200 metres) above Mean Sea Level.

.9 Audible Noise: Noise generated by the UPS under any condition of normal operation shall not exceed 65 dBA measured 1 metre from surface of the UPS.

1.8 **PROPOSAL SUBMITTALS:**

.1 System configuration with single-line diagrams.

.2 Functional relationship of equipment including weights, dimensions, and heat dissipation and Size and weight of shipping units to be handled by installing contractor.

.3 Descriptions of equipment to be furnished, including Item by Item identification of compliance and deviations from these specifications.

1.9 **SHOP DRAWINGS TO INCLUDE:**

.1 Detailed layouts of customer power and control connections and detailed installation drawings including all terminal locations.

1.10 **OPERATION AND MAINTENANCE DATA**

.1 Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) instruction manual that shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

1.11 **WARRANTY:**

.1 UPS module for 12 months after acceptance and battery manufacturer's standard warranty shall be passed through to the end user.

1.12 **FACTORY TESTING:**

.1 Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification. These tests shall include operational discharge and recharge tests on at least a one-minute battery plant to assure guaranteed rated performance.

PART - 2 PRODUCTS

2.1 **GENERAL**

.1 Materials

.1 All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing.

.2 The maximum working voltage, current, and di/dt of all solid-state power components and electronic devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature of solid-state component sub-assembly shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the maximum rectifier charging voltage.

.2 Wiring

.1 Wiring practices, materials and coding shall be in accordance with the requirements of the Ontario Electrical Safety Code (OESC). All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the OESC and other applicable standards. All electrical power connections are to be

torqued to the required value and marked with a visual indicator. Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

.3 Construction and Mounting

.1 The UPS unit, comprised of rectifier/charger, inverter, static transfer switch, and maintenance bypass switch, shall be housed in a single free-standing NEMA type 1 enclosure. Cabinet doors/covers shall require a tool for gaining access. Casters and levelling feet shall be provided for ease of installation. Front access only shall be required for expedient servicing, adjustments, and installation. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.

.2 The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard colour. The UPS shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug-in. Like assemblies and like components shall be interchangeable.

.4 Cooling

.1 Cooling of the UPS shall be by forced-air. Redundant fans shall be used. Low velocity fans shall be used to minimize audible noise output. Fan power shall be provided by the UPS output.

.2 The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded.

.5 Grounding

.1 The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for local bonding shall be provided.

2.2 EQUIPMENT

.1 Input Source Selector Switch

.1 The input Source Selector Switch (make before break) and source status indicator and alarm displays shall be housed in a separate wall mounting type cabinet.

.2 Input Source Selector Switch shall have provision for two feeds, one from Emergency Power and one from Normal Power. The Source Selector Switch shall be designed to permit manual selection of either power source.

.2 Rectifier/Charger

.1 General

.1 The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a phase-controlled, solid-state SCR type with constant voltage/current limiting control circuitry.

.2 AC Input Current Limiting

.1 The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 125% of the full

input current rating. The rectifier/charger shall operate at a reduced current limit mode whenever the critical load is powered from the UPS static bypass circuit such that the maximum UPS input current will not exceed 125% of full load input current. In addition, the rectifier/charger input current limit shall be automatically reduced to 25% of full load input current whenever the critical load is powered from the UPS internal maintenance bypass circuit. An optional second circuit shall limit input current to 100% of rated full load current when activated by a customer supplied contact closure to signal a customer function such as generator operation.

.3 Input Current Walk-in

.1 The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 20-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 or 20 seconds.

.4 Fuse Failure Protection

.1 Power semiconductors in the rectifier/charger shall be fused with fast-acting fuses, so that loss of any one power semiconductor shall not cause cascading failures.

.5 DC Filter

.1 The rectifier/charger shall have an output filter to minimize ripple voltage into the battery. Under no conditions shall ripple voltage into the battery exceed 2% RMS. The filter shall be adequate to insure that the DC output of the rectifier/charger will meet the input requirements of the inverter. The inverter shall be able to operate from the rectifier/charger with the battery disconnected.

.6 Automatic Restart

.1 Upon restoration of utility AC power, after a utility AC power outage and prior to a UPS automatic end-of-discharge shutdown, the rectifier/charger shall automatically restart, walk-in, and gradually assume the inverter and battery recharge loads. Upon restoration of utility AC power, after a utility AC power outage and after a full UPS automatic end-of-discharge shutdown, the UPS will (customer selectable) automatically restart, performing the normal UPS start up walk-in.

.7 Battery Recharge

.1 In addition to supplying power for the inverter load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

.8 Overvoltage Protection

.1 There shall be DC over-voltage protection so that if the DC voltage rises to the pre-set limit, the UPS is to shut down automatically and initiate an uninterrupted load transfer to the static bypass line.

2.3 **INVERTER**

.1 General

.1 The term inverter shall denote the solid-state equipment and controls to convert DC power from the rectifier/charger or battery to regulated AC power for supporting

the critical load. The inverter shall be a transistorized, phase-controlled, space vector modulated (SVM) design capable of providing the specified AC output.

.2 Overload Capability

.1 The inverter shall be capable of supplying current and voltage for overloads exceeding 100% and up to 150% of full load current. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

.3 Fault Clearing and Current Limit

.1 The inverter shall be capable of supplying an overload current of 150% of its full-load rating for thirty seconds. For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The inverter shall be self-protecting against any magnitude of connected output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses.

.4 Phase Balance

.1 Electronic controls shall be provided to regulate each phase so that an unbalance loading will not cause the output voltage to go outside the specified voltage unbalance or phase displacement.

.5 Fuse Failure Protection

.1 Power semiconductors in the inverter unit shall be fused with fast-acting fuses, so that loss of any one power semiconductor will not cause cascading failures.

.6 Inverter Shutdown

.1 For rapid removal of the inverter from the critical load, the inverter control electronics shall instantaneously turn off the inverter transistors. Simultaneously, the static transfer switch shall be turned on to maintain continuous power to the critical load.

.7 Inverter DC Protection

.1 The inverter shall be protected by the following disconnect levels:

.1 DC Overvoltage Shutdown

.2 DC Undervoltage Warning (Low Battery Reserve), user adjustable 1-99 minutes

.3 DC Undervoltage Shutdown (End of Discharge)

.8 Over-Discharge Protection

.1 To prevent battery damage from overdischarging, the UPS control logic shall automatically raise the shutdown voltage set point as discharge time increases beyond fifteen (15) minutes.

.9 Inverter Output Voltage Adjustment

.1 To prevent battery damage from overdischarging, the UPS control logic shall automatically raise the shutdown voltage set point as discharge time increases beyond fifteen (15) minutes.

.10 Output Frequency

.1 The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and hold the inverter output frequency to +/- 0.1% for steady state and transient conditions. Drift shall not exceed 0.1% during a 24-hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.

2.4 DISPLAY AND CONTROLS

.1 Monitoring and Control

.1 The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. A system power flow diagram shall be provided as part of the monitoring and controls sections which depicts a single-line diagram of the UPS. Illuminated visual indicators shall be of the long-life light-emitting diode (LED) type. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, status and alarms shall be displayed on an alphanumeric LCD display. Additional features of the monitoring system shall include:

.1 Menu-driven display with text format selectable

.2 Real time clock (time and date)

.3 Alarm history with time and date stamp

.4 Battery back-up memory

.2 Metering

.1 The following parameters shall be displayed:

.1 Input AC voltage line-to-line and line-to-neutral for each phase

.2 Input AC current for each phase

.3 Input frequency

.4 Battery voltage

.5 Battery charge/discharge current

.6 Output AC voltage line-to-line and line-to-neutral for each phase

.7 Output AC current for each phase

.8 Output frequency

.9 Percent of rated load being supplied by the UPS

.10 Battery time left during battery operation

.3 Alarm Messages

.1 The following alarm messages shall be displayed:

.1 Input power out of tolerance

.2 Input phase rotation incorrect

.3 Incorrect input frequency

.4 Charger in reduced current mode

.5 Battery Charger Problem

.6 Battery failed test

.7 Low battery warning (adjustable 1 to 99 minutes

.8 Low battery shutdown

.9 DC bus overvoltage

.10 Bypass frequency out of range

.11 Load transferred to bypass

.12 Excessive retransfers attempted

.13 Static switch failure

.14 UPS output not synchronized to input power

.15 Input power single phased

.16 Input voltage sensor failed

.17 Inverter leg over current in X-phase

.18 Output undervoltage

.19 Output overvoltage

.20 Output overcurrent

.21 System output overloaded

.22 Load transferred to bypass due to overload

.23 Overload shutdown

.24 Control Error

.25 Critical power supply failure

.26 Load transferred due to internal protection

.27 External shutdown (remote EPO activated)

.28 Fan failure

.29 Over-temperature shutdown impending

.30 Over-temperature shutdown

.2 An audible alarm shall be provided and activated by any of the above alarm conditions.

.4 Status Messages

.1 The following UPS status messages shall be displayed:

.1 Normal operation

.2 Load on maintenance bypass

.3 Load on UPS

.4 Load on static bypass

.5 System shutdown

.6 UPS on battery

.2 For each of the Status Messages (Normal operation, Load on maintenance bypass, Load on UPS, Load on static bypass, System shutdown & UPS on battery) provide an additional contact for remote connection to the Building Control System. Electrical Contractor to wire from each of these contacts to a labelled box in the Computer Room ceiling space. Connection from this point to the Building Automation System will be provided by Mechanical Contractor

.5 Controls

.1 UPS start-up, shutdown, and maintenance bypass operations shall be accomplished by a single rotary control switch. An advisory display and menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. Pushbuttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms.

.6 Power Status Diagram

.1 A mimic panel shall be provided to depict a single line diagram of the UPS. Indicating lights shall be integrated within the single line diagram to illustrate the status of the UPS. Two LEDs located on the diagram shall indicate whether UPS input and/or output power is present. The diagram shall be collor coded with the positions of the rotary control switch for visual confirmation of the UPS operating mode.

.7 On-Line Battery Test

.1 The UPS shall be provided with a menu driven On-Line Battery Test feature. The test shall ensure the capability of the battery to supply power to the inverter while the load is supplied power in the normal mode. If the battery fails the test, the system shall automatically do the following:

.1 Transfer the load to bypass

.2 Restart the rectifier/charger

.3 Display a warning message

.4 Sound an audible alarm

.5 Retransfer the load back to normal mode

.2 The battery test feature shall have the following user selectable options:

.1 DC bus voltage threshold (pass/fail value)

.2 Interval between tests (2 to 9 weeks)

.3 Date and time of initial test

.4 Enable/disable test

2.5 STATIC TRANSFER SWITCH

.1 General

.1 A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be a naturally commutated high-speed static (SCR-type) device rated to conduct full load current continuously. The switch shall have an overload rating of 125% rated load continuously, 200% rated load for thirty seconds, and 2000% rated load for two cycles. The static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the

inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

.2 Uninterrupted Transfer

.1 The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:

.1 Inverter overload capacity exceeded

.2 Critical AC load overvoltage or undervoltage

.3 Battery protection period expired

.4 UPS fault condition

.2 The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

.1 Inverter/bypass voltage difference exceeding preset limits

.2 Bypass frequency out of limits

.3 Bypass out-of-synchronization range with inverter output

.3 Uninterrupted Retransfer

.1 Retransfer of the critical AC load from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following condition exists:

.1 Bypass out of synchronization range with inverter output

.2 Inverter/bypass voltage difference exceeding preset limits

.3 Overload condition exists in excess of inverter full load rating

.4 UPS fault condition present

2.6 MAINTENANCE BYPASS SWITCH (INTERNAL)

.1 General

.1 A manually operated maintenance bypass switch shall be incorporated into the UPS cabinet to directly connect the critical load to the input AC power source, bypassing the rectifier/charger, inverter, and static transfer switch.

.2 Isolation

.1 All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come in contact with energized parts or terminals. A means to de-energize the static switch shall be provided when the UPS is in the maintenance bypass mode of operation.

.3 Maintenance Capability

.1 With the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery, and static transfer switch.

2.7 BATTERY POWER PACK

.1 The battery power pack shall include sealed, lead-acid valve regulated battery cells housed in a separate cabinet that matches the UPS cabinet styling to form an integral system line-up. Battery cells shall be mounted on slide-out trays for ease of maintenance. A disconnect means shall be included for isolation of the battery pack from the UPS module. Casters and levelling feet shall also be provided with the battery power pack cabinet for ease of installation

2.8 MANUAL WRAP-AROUND BYPASS CABINET

.1 The Wrap-Around Bypass System shall be provide in a separate 208/120 volt power source in the event of a total loss of the UPS System. It shall include a separate 100 kVA Isolation Transformer, Transient Voltage Suppression, two Moulded Case Breakers operating make before break. Provision shall be made to ensure that only synchronized sources are used in the no-break transfer.

2.9 UPS SYSTEM HARMONIC FILTERS

.1 General

.1 Summary

.1 These specifications describe the requirements of automatic harmonic correction at the input of an UPS system. This correction shall be done by means of installing an electronic harmonic filter, parallel to the line, which is capable of correcting harmonic currents as they are and/ or may become generated by both the load connected to the UPS system and by the UPS System Rectifier. Harmonic currents within the rating of the filter between the 2nd and 51st harmonic shall be corrected (supplied by the filter) so as to reduce the voltage and current distortion on the UPS output to a level that is suitable to the requirements of the other connected loads but no greater than 5% THD voltage and 5% THD current . The filter shall also reduce the stress on the UPS input distribution system components; thus providing more reliable operation.

2.10 STANDARDS

.1 American National Standards Institute (ANSI)

.2 Canadian Standards Association (CSA)

.3 Institute of Electrical and Electronic Engineers (IEEE)

.4 National Electrical Code (NEC – NFPA70)

.5 National Electrical Manufacturers Association (NEMA)

.6 National Fire Protection Association (NFPA)

.7 Underwriters Laboratories (UL)

2.11 PRODUCTS

.1 Acceptable Manufactures

.1 Aim Energy Inc., Series 3A, AIM Conditioners 100 Amp, 600 volt Configurations

.2 General Requirements

.1	Input Voltage:	600V, 3 Phase, 3 Wire, ground, 60Hz.
.2	Nominal Voltage:	600VAC, 60Hz.
.3	Cancellation Harmonic Current:	90 Amps. RMS

.3 Electrical ratings

.1	Corrective Reactive Current:	75 Amps RMS
.2	Total Current Injected:	117 Amps RMS
.3	Corrective VARs (85% electronic)	78 kVAR
.4	Losses @ Rated Output):	2.2 kW
.5	Input Voltage Range:	Nominal +6%, -14% steady state, Nominal +11%, -19%, 20 minutes
.6	Transient Protection:	Transient IEEE 587, Class B
.7	Input Frequency Range:	+ 3 Hz at 60 Hz.
.8	Interrupting Capacity:	25 ka RMS SYMM
.9	Peak Harmonic Current:	3x nominal RMS maximum rating
.10	Start-up time:	6 seconds

.11 Harmonic Current Attenuation Factor

Harmonic Number	Harmonic Factor (typical) I_H (source) / I^H (load)
2	0.3
3	0.2
4	0.1
39574	0.05
39670	0.08
39796	0.1
16-21	0.15
22-27	0.2
28-33	0.3
34-41	0.4
42-51	0.5

2.12 OPERATION

.1 The harmonic filter shall consist of an electronic bridge that injects into the bus, canceling harmonic currents in the 2nd to 52nd harmonic spectrum. The filter shall respond within 150 microseconds and automatically adjust for changing harmonics in the electrical system.

.2 The filter shall current limit its output to the rated harmonic injection current but continue to operate providing the full rated harmonic current correction. This condition will be displayed on the control panel.

.3 The harmonic filter shall be capable of being paralleled with additional harmonic filters of the same make and size for additional capacity and redundancy.

.4 The filter shall be able to correct for harmonic currents, resonance, and or ringing on the electrical sine wave. The filter shall be designed to work in conjunction with diesel generators, static UPS systems, variable frequency drives, and other non-linear loads.

.5 At harmonic currents within the electrical system of less than the rated harmonic current injection, the filter shall correct the total current distortion within the electric system to less than 5% THD and within the limits set by IEEE 519-1992. In addition to harmonic current correction, the filter shall also add the rated kVar of electronic power factor correction to the system.

.6 The harmonic filter shall be housed in a separate cabinet and shall operate independent from the UPS Module (Rectifier). Failure or removal of the harmonic filter shall not effect the operation of the UPS Output.

.7 The harmonic filter shall operate at 600VAC (a Unit with a step-up transformer will not be acceptable).

PART - 3 EXECUTION

.1 Field Quality Control

.1 The following inspections and test procedures shall be performed by factory trained field service personnel during the UPS startup.

.1 Visual Inspection

.1 Inspect equipment for signs of damage

.2 Verify installation per drawings

.3 Inspect cabinets for foreign objects

.4 Verify neutral and ground conductors are properly sized and configured

.5 Inspect battery cases

.6 Inspect battery for proper polarity

.7 Verify all printed circuit boards are configured properly

.2 Mechanical Inspection

.1 Check all control wiring connections for tightness

.2 Check all power wiring connections for tightness

.3 Check all terminal screws, nuts, and/or spade lugs for tightness

.3 Electrical Inspection

.1 Check all fuses for continuity

.2 Confirm input voltage and phase rotation is correct

.3 Verify control transformer connections are correct for voltages being used

.4 Verify control transformer connections are correct for voltages being used

.2 Unit Start-up and Site Testing

.1 Site testing shall be provided by the manufacturer's field service personnel if requested. Site testing shall consist of a complete test of the UPS system and the associated accessories supplied by the manufacturer. A full load power test including a partial battery discharge test shall be provided as part of the standard start-up procedure. This shall be accomplished without disturbing user wiring and completed prior to operation of the site critical load from the UPS output. The test results shall be documented, signed, and dated for future reference.

.2 Start-up shall include basic operator training - owner's representatives shall be present during site test.

END OF SECTION

GROUND FAULT CIRCUIT INTERRUPTERS
26 28 19

PART - 1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

PART - 2 PRODUCTS

2.1 BREAKER TYPE GROUND FAULT INTERRUPTER

.1 Single or Two pole ground fault circuit interrupter for 15A, 120 or 208V, 1 phase circuit c/w test and reset facilities.

2.2 RECEPTACLE TYPE GROUND FAULT INTERRUPTER

.1 Unit shall include a 15A grounded duplex receptacle, a button to test operation of unit and current transformer and sensing mechanism. Unit to be complete with suitable outlet box.

.2 Units in Hospitals to be hospital grade.

.3 Unless noted otherwise, unit shall trip at 6 mA.

.4 Where shown in outdoor locations, units shall be enclosed in weatherproof surface-mounted enclosures. In other locations units shall be furnished with stainless steel coverplates.

Standard of Acceptance
- Bryant #GFR82 Series
- Pass & Seymour #2091-S
- Hubbell #GF8200 Series

PART - 3 EXECUTION

.1 Installation

.2 Provide dedicated branch wiring neutral conductor for each individual breaker type ground fault interrupter.

.3 Do not ground neutral on load side of ground fault relay.

.4 Connect wiring to equipment in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Electrical - General Requirements.

.2 Demonstrate simulated ground fault tests.

END OF SECTION

LIGHTING
26 51 13

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Conform with the requirements of Section 26 05 01 Electrical General Requirements.

1.2 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete Electrical systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 26 05 01 Electrical General Requirements - Shop Drawings and Product Data.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.

.3 Photometric data to include:

.4 Total input watts, candlepower summary, candela distribution zonal lumen summary, luminaire efficiency, CIE type, coefficient of utilization, lamp type and lumen rating in accordance with IESNA testing procedures.

1.4 REQUIREMENTS

.1 Luminaires shall not be delivered to building or stored therein until dry and protected space is available for proper storage of luminaires.

.2 Submit samples of luminaires which are not catalogue items for approval. Additional luminaires shall not be manufactured until sample has been approved. Each approved sample shall be retained on job site until final completion of project. Luminaires which do not match quality and workmanship of standard sample will be rejected.

.3 Finishes of luminaires, as specified in the "Luminaire List" must be maintained. Where the description of the luminaire directs a "colour/ finish to suit Architect" it is to be understood that during construction the final colour/finish will be selected. The Architect must be permitted to make their choice from a standard colour/finish range but the selected colour will apply to all of the particular type of luminaire unless otherwise specified.

.4 "Allowances" when shown, are in Canadian dollars and cover the cost of the lighting luminaires and lamps. Allowances do not include applicable taxes, delivery to the site, handling, installation, overhead or profit.

1.5 SUBSTITUTIONS

.1 Luminaires included under this Section are specified by approved manufacturer and type. Furnish equipment, as specified, unless substitutions are mutually agreed upon, as follows:

.2 During the construction period, no substitutions shall be considered unless compelling reasons are given such as inability to meet delivery schedule. This reason shall not be acceptable if delay is caused by Contractor's failure to order luminaires in accordance with the schedule. In such cases, it is the Contractor's responsibility to provide luminaires as specified without delay to the project and without additional cost to the Owner.

.3 Substitutions shall be named, samples, catalogue cuts and complete photometric reports submitted, and cost savings documented. Submit a written request for proposed luminaires to be substituted to Lighting Consultant at least two weeks before the end of the bid period. Make the request an alternate, separate proposal, accompanied by complete descriptive and technical data. Indicate addition or deduction from the base bid. Substitutions proposed less than two weeks before the end of the bid period, or not including proper documentation shall not be considered. Lighting Consultant shall accept or reject proposed substitutions.

.4 Where proposed substitutions alter functional or visual design, or change the space requirements or mounting details indicated here or on the drawings, detail such changes in the proposal and include costs for revised design and construction for trades involved.

.5 Reimburse Consultant and Sub-Consultants for costs of evaluating proposed substitutions, after the bid period, whether or not such substitutions are accepted.

PART - 2 PRODUCTS

2.1 GENERAL

.1 Similar luminaires shall be products of same manufacturer.

.2 Luminaires shall be suitable for individual or continuous mounting.

.3 Supply recessed luminaires, where installed in plaster or in acoustic ceilings, complete with plaster trim frame or ring and mounting brackets.

.4 Fluorescent troffers in ceiling shall be equipped with adjustable mounting brackets.

.5 Luminaires shall be completely assembled in factory and shall be delivered to building in cartons or in palletized form, as directed.

2.2 LAMPS

.1 Light Emitting Diodes (Accent/Decorative)

.1 Greater than 50 lumens per watt

.2 30 to 40 lumens per watt (3200°K)

.3 0.5 to 1 watt per LED chip

.4 Bin number requirements for colour temperature consistency

.5 Maximum temperature at the base of the “LED cap” mounted to the sub-strate shall be controlled to ensure full lamp life.

.6 Warranty: 5 years

.7 LED Drivers shall be high frequency to prevent “FLICKER”

Standard of Acceptance - Driver Acceptance
- Advance
- Lite Tech
- Primo (China)
- VLM (Italy)
- Lumi-Drives (UK)
- Osram

Standard of Acceptance - Lamp Acceptance:
- Cree
- Lumileds
- Nichia
- Osram

2.3 **LENSES**

.1 K12 distribution acrylic lenses. 3.2mm (125") thick, shall have a recessed prismatic pattern of 5mm (3/16") square based female cones running 45□ to the parallel and perpendicular axis to the panel. Panel shall be made of ultraviolet inhibited injection moulded clear virgin acrylic.

.2 Panels shall be strain-free and uniform in production. There shall be no fade-outs or streaks to detract from job performance.

.3 Lenses shall be low brightness, sparkling crystal panel that provides maximum efficiency and good brightness control in the direct glare zone.

Standard of Acceptance
- A.L.P. Lighting and Ceiling Products
- I.C.I. Acrylics Canada Inc.
- Holophane Canada Inc.

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Locate and install luminaires as indicated.

.2 Locate hangers on tile centres or intersections. Mount recessed incandescents, troffers and surface mounted luminaires in or on full tiles.

.3 Verify quantity of luminaires before placing orders.

.4 Verify ceiling types with the latest revised Architectural Drawings and order luminaires to suit the correct ceiling.

.5 Check lighting luminaires and mountings for their electrical and physical characteristics in relation to conditions due to building construction and mechanical equipment. Make necessary adjustments to luminaires or hanging arrangement without expense to Owners. Give notification at time of shop drawings and before construction if decision on necessary changes is required.

.6 Co-operate with other trades to ensure proper installation of lighting luminaires.

.7 Carefully align luminaires, shown in continuous lines or rows, so that rows appear as straight lines.

.8 Mount luminaires perfectly level or plumb. Luminaires shall fit tightly to ceiling without showing a space or light leak between frame and ceiling.

.9 Take down any improperly installed luminaires and re-install without expense to Owner.

.10 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.

.11 Attach boxes or hickies directly to poured concrete with 6mm (¼") minimum diameter bolts and lead expansion anchors where luminaires are suspended directly from concrete slabs. Use 8mm (5/16") minimum bolts through precast slabs, welded to 100mm x 100mm (4" x 4") minimum, 3.5mm (10 gauge) plate above slabs.

.12 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidably tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan co-operatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown

.13 All luminaires mounted in or on ceilings shall be supported independently of ceiling by means of chains.

.14 Provide continuous 12mm x 38mm (½" x 1½") channel above the ceiling, where luminaires are suspended or mounted on furred ceilings. Fasten luminaires to channel with two 6mm (¼") minimum diameter studs with minimum 1220mm (4'- 0") on centre.

.15 Luminaires installed in or on "T" bar ceilings shall be equipped with safety chains anchored in an approved manner to the floor slab or roof structure above. Fluorescent luminaires shall have two chains, each supporting two corners of the luminaire. Chain shall be #10 Tensile jack chain, installed as noted below.

.16 Chain shall be No. 10 Tensile jack chain, bright zinc coated, with a strength of 180 kg (400 lbs.) where luminaires are indicated to be chain hung. Attachments shall be made using a No. 10 "S" hook. Caddy fasteners may be used where applicable. "S" hooks must be closed after installation.

.17 Industrial luminaires where suspended shall be 12mm (½") conduit hangers and ARB ball aligners. Length and location shall clear equipment, ducts and pipes. Metal strut (Flexibar or equal) may be used for mounting of luminaires in mechanical areas and electrical rooms.

3.2 **LIGHTING LUMINAIRES**

.1 Provide lighting luminaires exactly as shown and as specified in the following schedule. Luminaires shall be complete with necessary accessories and lamps at time of acceptance.

.2 All luminaires shall be ULC or CSA certified.

.3 Each fluorescent luminaire installed on branch circuits with voltage exceeding 150 volts-to-ground shall be provided with a disconnecting means integral to the luminaire that simultaneously opens all circuit conductors between the branch circuit conductors and the

supplying ballast(s) and marked in a conspicuous, legible and permanent, manner adjacent to the disconnecting means, identifying the specific purpose in accordance with the Canadian Electrical Code Part 1 Rule 30-308(4).

3.3 LUMINAIRE LIST

.1 Luminaire manufacturers are listed in alphabetical order and not in order of preference.

Title	Description	Lamp Schedule
LA	Recessed 1'-0" x 4'-0" LED luminaire with: - 20 gauge CRS, hole free, one piece constructed housing - Aluminum heat sink - One piece CRS door frame with welded corners, powder coated with internal hinge design and captive mounted head stainless steel fasteners - antimicrobial finish on exposed surfaces, - one piece, high efficiency, smooth diffused acrylic lens - securely fastened in a. The lens frame shall be gasketted with a closed cell silicone gasket that seals the lens to the frame of the housing. **White Light only** Luminaire shall be suitable for installation in a drywall ceiling**.** Luminaire shall include dimmable LED Driver Voltage: 120 volt Manufacturers: Kenall #M4SEDI-14-76L-35K9-DCC-120-2F-2H-SYM-RM	38 Watt, 3500K, White LED

Title	Description	Lamp Schedule
LA1	Recessed 1'-0" x 4'-0" LED luminaire with: - 20 gauge CRS, hole free, one piece constructed housing - Aluminum heat sink - One piece CRS door frame with welded corners, powder coated with internal hinge design and captive mounted head stainless steel fasteners - antimicrobial finish on exposed surfaces, - one piece, high efficiency, smooth diffused acrylic lens - securely fastened in a. The lens frame shall be gasketted with a closed cell silicone gasket that seals the lens to the frame of the housing. **White Light and Green Light** Luminaire shall be suitable for installation in a drywall ceiling**.** Luminaire shall include dimmable LED Driver Voltage: 120 volt Manufacturers: Kenall #M4SEDI-14-40G/38L-35K9-DCC-120-2F-2H-SYM-RM	38 Watt, 3500K, White LED and 40 Watt, Green LED
LB	Recessed 6” (nominal) round LED downlight complete with clear polycarbonate lens and 0-10 volt dimming driver digitally controlled dimming driver. Luminaire shall be suitable for a drywall or T-bar ceiling. Luminaire shall include dimmable LED Driver and shall be dimmable to 1% Voltage : 120 volt Manufacturer: Kenall #M4DL6-NF-2FW-33L-35K9-W-FW-T-RSI6-120-DIM1	30 Watt, 3300 Lumen integral LED

Title	Description	Lamp Schedule
LB1	Recessed 8” (nominal) round LED downlight complete with clear polycarbonate lens and 0-10 volt dimming driver digitally controlled dimming driver. Luminaire shall be suitable for a drywall or T-bar ceiling. Luminaire shall include dimmable LED Driver and shall be dimmable to 1% Voltage : 120 volt Manufacturer: Kenall #MRR-08855-5000-120-MLF-DIM1	55 Watt, 5000 Lumen integral LED
LC	Recessed 4” (nominal) round LED downlight complete with clear polycarbonate lens and 0-10 volt dimming driver digitally controlled dimming driver. Luminaire shall be suitable for a drywall or T-bar ceiling. Luminaire shall include dimmable LED Driver and shall be dimmable to 1% Voltage : 120 volt Manufacturer: Kenall # M4DL4L-20L-35K9-120-DCC-ALG-CSS-T-DIM1	20 Watt, 2000 Lumen integral LED
LD	Suspended or Surface Mounted, industrial type luminaire (+/- 50” long x 8” wide). Luminaires shall be suspended from ceiling/structural steel at a height that avoids interference with mechanical/electrical equipment. Mount luminaires with a chain suspension system. Manufacturers: Pioneer #STO-0850-3L-3500-UNV	34 Watt, 3500K LED

Title	Description	Lamp Schedule
LE	Wall mounted 8"x 12" x 2" deep (nominal) L.E.D. luminaire sign with custom wording to read as follows: **"X-RAY ON – DO NOT ENTER"**. Luminaire shall be constructed of extruded aluminum. Message shall be red letters screened onto a black background and complete with "black-out" feature. Frame to be black. Verify mounting height with Architect prior to installation. Voltage: 120V Manufacturer: Beghelli #BE2000 "X-RAY ON – DO NOT ENTER" Emergi-lite #CLLPEX52B-120V "X-RAY ON – DO NOT ENTER" Lumacell #LE450SW "X-RAY ON – DO NOT ENTER"/Back/Blank out of face Notes: 1) Luminaire shall have double the amount of LED's that are standard. They will require a strip of High Brightness LED's on the top as well as on the bottom of the interior of the luminaire. 2) Wording must <u>not</u> be visible when light is "off" and must be readily visible when light is "on"	Integral LED
LF	Continuous lengths of colour changeable, in lengths as required, regressed (in ceiling niche), flat diffuser, LED "Accent Lighting" Luminaire "System" to include Power Supplied as required, 0-10 Volt Dimming and "Niche Rated" Diffuser GVA #HL-300/1200-6600 RGBW-HO-CA Colours-RLV-120-5W-IP66	Integral LED

END OF SECTION

UNIT EQUIPMENT FOR EMERGENCY LIGHTING
26 52 00

PART - 1 GENERAL

1.1 REFERENCE

.1 CSA C22.2 No. 141 Unit Equipment for Emergency Lighting.

1.2 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 26 05 01 Electrical General Requirements.

.2 Nameplates shall be in accordance with Article "Equipment Identification".

1.4 WORK INCLUDED

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 05 01 Electrical General Requirements.

1.6 MAINTENANCE MATERIALS

.1 Provide maintenance materials as required and as specified in Section 26 05 01 Electrical General Requirements.

1.7 OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Provide operating and maintenance instructions as specified in Section 26 05 01 Electrical General Requirements.

1.8 WARRANTY

.1 For batteries, the 12 months warranty period is extended to 120 months, with a no-charge replacement during the first 60 months and a pro-rate charge on the second 60 months.

1.9 TESTING

.1 Conduct witnessed testing of battery lighting systems including disconnecting power to each battery unit for the minimum length of time required for full run down time and verify each and every light head. Record exact length of time the battery maintains the full lighting and “certify” both the battery life and remote lighting operation. Notify Consultant and Commissioning Agent of testing schedule prior to conducting tests.

.2 Submit test reports directly to the Consultant and the Commissioning Agent.

PART - 2 PRODUCTS

2.1 EQUIPMENT

.1 Supply voltage: 120 V, AC.

.2 Output voltage: 12 V DC.

.3 Operating time:

.1 12 volt units: 180 watts for 60 minutes.

.4 Battery: sealed, maintenance free, lead acid or lead calcium.

.5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected. Unit shall have externally accessible means for testing of unit and shall have two lamps indicating A.C. on, and high charge. Unit shall include a low voltage cut-off protection circuit and self diagnostic auto test.

.6 Solid state transfer.

.7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.8 Signal lights: solid state, life expectancy 100,000 h minimum, for 'AC Power ON' and 'High Charge'.

.9 Lamp heads: integral on unit and remote, 360□ horizontal and 180□ vertical adjustment.

.10 Lamp type (integral and remote):

.1 Finished Areas:

(a) Wall mounted adjustable type LED, 12 VDC, glare free mounted in a Lexan cube approximately 113 mm square

.11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.12 Cabinet finish: Painted steel enclosure

.13 Units shall include "Flasher" remote test system with one hand-held controller.

.14 Auxiliary equipment for central battery units:

.1 Ammeter.

.2 Voltmeter.

.3 Lamp disconnect switch.

.4 Test switch.

.5 Time delay relay.

.6 Battery disconnect device.

.7 ac input and dc output terminal blocks inside cabinet.

.8 Shelf.

.9 RFI suppressors.

2.2 WIRING OF REMOTE HEADS

.1 Conduit: type EMT, to Section 26 05 33 - Conduits Fastenings and Fittings.

.2 RFI suppressors.

.3 Conductors: RW90 type to Section 26 05 19 - Wires & Cables 0-1000 Volts, sized in accordance with manufacturer's recommendations.

Standard of Acceptance

- Emergi-Lite
- Lumacell Inc.
- Beghelli

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Provide complete emergency battery lighting system as shown and specified.

.2 Unless otherwise noted, mount units on the wall 2440mm above floor. Unit shall be hardwired to source. Provide lock-on devices on breakers.

.3 Where heads are shown remote from unit, provide suitable outlet box at 2440 mm and install head. Connect with conduit to battery and charger unit. Wire size to suit manufacturer's recommendations, but not less than #10 gauge, and for a minimum of 3% voltage drop at remote heads. Ensure remote head wiring lengths are reviewed with manufacturer prior to installation. Voltage drops will be tested by Engineer and Building Inspector. Replace any wiring not passing the 3% voltage drop test with new size and retest.

.4 Direct heads as indicated. Allow for re-adjustment of head directions as requested by Consultant after completion of emergency light review.

END OF SECTION

TELEPHONE & DATA RACEWAYS
27 05 28

PART - 1 GENERAL

1.1 SYSTEM DESCRIPTION

.1 Empty raceways systems shall consist of outlet boxes, cover plates, conduits, pull boxes, fish wires and service poles.

.2 Empty conduit systems being installed shall be for installation of wiring installed at a later date by communications contractor:

.1 Telephone and data communications systems.

1.2 PRE/ POST OCCUPANCY PROVISIONS

.1 Assuming the Hospital will, as the time for occupancy approaches or even after occupying, resolve that some additional telephone/ data outlets/ monitor/ CCTV/ Security System outlets will be required. Include, in the Contract, the following additional installations:

- Two (2) typical Analog Voice outlets
- Five (5) typical Data/ VoIP outlets
- Four (4) typical WAP
- Two (2) Building Automation System Network Connection outlets

.2 Each drop with an average of 20m of conduit installed and terminated at the Hub Room will be required. Assume, for bidding purposes, that these can be added at any time during construction including at the end of the construction and in any location as directed on site.

PART - 2 PRODUCTS

2.1 MATERIAL

.1 Conduits: EMT type, to Section 26 05 33 - Conduits Fastenings and Fittings.

.2 Junction boxes and pull boxes to Section 26 05 32 - Splitters, Junction and Pull Boxes, Cabinets.

.3 Outlet boxes, and fittings: to Section 26 05 35 - Outlet Boxes, Conduit Boxes and Fittings.

.4 Cover plates: to Section 26 27 26 - Wiring Devices.

.5 Fish wire: polypropylene type

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Install empty raceway system, including fish wire, outlet boxes, pull boxes, cover plates, conduit, service poles, miscellaneous and positioning material to constitute complete system.

.2 Verify exact location of outlets to suit furniture layout.

.3 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install 3 mm (c")

polypropylene pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.4 Conduit bends shall have a bending radius of not less than ten times conduit diameter. Ream out conduits and identify end with green paint.

.5 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 m (100') in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease.

.6 Minimum space requirements in pull boxes, having one conduit each in opposite ends of box, shall be as follows:

Maximum Size of Conduit in Millimetres (Inches)	Size of Box in Millimetres (Inches)			For each Additional Conduit, Increase Width (Millimetres)Inches)
	Width	Length	Depth	
20 mm (¾")	100 mm (4")	300 mm (12")	75 mm (3")	50 mm (2")
25 mm (1")	100 mm (4")	400 mm (16")	75 mm (3")	50 mm (2")
32 mm (1¼")	150 mm (6")	500 mm (20")	75 mm (3")	75 mm (3")
38 mm (1½")	200 mm (8")	675 mm (27")	100 mm (4")	100 mm (4")
50 mm (2")	200 mm (8")	900 mm (3')	100 mm (4")	125 mm (5")

.7 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum Size of Conduit in Millimetres (Inches)	Size of Box in Millimetres (Inches)			For each Additional Conduit, Increase Width Millimetres (Inches)
	Width	Length	Depth	
20 mm (¾")	150 mm (6")	300 mm (12")	100 mm (4")	50 mm (2")
25 mm (1")	200 mm (8")	400 mm (16")	150 mm (6")	50 mm (2")
32 mm (1¼")	250 mm (10")	450 mm (18")	200 mm (8")	75 mm (3")
38 mm (1½")	300 mm (12")	600 mm (24")	250 mm (10")	100 mm (4")
50 mm (2")	350 mm (14")	750 mm (30")	300 mm (12")	125 mm (5")

.8 Maintain separation of communications conduits to sources of electromagnetic interference as follows:

Item	**Minimum Clearance**
Fluorescent ballasts	150mm (6”)
Conduit and cables used for electrical distribution less than 1kV	300mm (12”)
Conduit and cables used for electrical distribution greater than 1kV	1000mm (36")
Motor	1200mm (48”)
Transformer	1200mm (48”}

.9 The above tables provides a guideline and at all times the Consultant may advise greater clearances if the currents being carried through these devices are particularly likely to cause interference.

.10 Interference shall be minimized by ensuring that, wherever possible, communications conductors cross sources of interference at right angles.

.11 Install cables, conduit and cable tray, etc. along or at right angles to building lines unless impractical to do so. Verify specific cases of deviation in advance with consultant.

END OF SECTION

COMMUNICATIONS CABLING
27 15 00

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with General Conditions of Contract, Supplementary Conditions and Division 01 - General Requirements.

.2 Where conflict occurs between Codes, Specification and Drawings, plan and riser, the maximum condition to govern, and the Tender to be based on whichever indicates the greater cost.

.3 Conform with the requirements of the Electrical Tender Specifications and Drawings.

.4 Refer also to Sunnybrook 'Data Centre and Hub Room Access Policy' Appended to this Specification. Refer also to Sunnybrook 'ICN Cable Installation Standards' Appended to this Specification

1.2 WORK INCLUDED

.1 Price quotations are to include the furnishing of all materials, equipment, maintenance and training manuals, tools, and the provision of all labor and services necessary or proper for the completion of the work, except as may be otherwise expressly provided in the Contract Documents. The Owner will not be liable for any costs beyond those proposed herein and awarded.

.2 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete Communications systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation. Provide equipment, materials, labor, and services not specifically mentioned or shown which may be necessary to complete or perfect all parts of this installation and in compliance with requirements stated or reasonably inferred by the Contract Documents.

.3 All work shall be performed as per the schedule prepared by the General Contractor. Allow for work to be done after hours and on weekends as dictated by the schedule.

.4 "Power over Internet" Network Switch

. **Provide new "Power over Internet" Network Switch**, Rack mountable type as required for the System Network connections. Switches shall have adequate power capacity for the ultimate number of connected devices, shall be IEEE.802.3af compliant with adequate 10/100 PoE Ports as required plus minimum 4 spares.

.1 **Network Switches and associated Service requirements to be purchased from:**

TELUS Enterprise Solutions
Contact: Michele K House, Sales Specialist
(416) 999-6109
michele.house@telus.com

3 Switches shall be 1u and be as manufactured by:

New Network Switches to be CISCO as follows:

CATALYST C9300 48-PORT – E Edge Switch	C9300-48P-E
SOLN SUPP 8X5XNBD CATALYST 9300 48-PORT POE+ NETWORK ESSE	CON-SSSNT-C93004PE
C9300 NETWORK ESSENTIALS 48-PORT LICENSE	C9300-NW-E-48
NORTH AMERICA AC TYPE A POWER CABLE	CAB-TA-NA
50CM TYPE 1 STACKING CABLE	STACK-T1-50CM
CATALYST 3750X STACK POWER CABLE 30 CM	CAB-SPWR-30CM
C9300 DNA ESSENTIALS 48-PORT TERM LICENSES	C9300-DNA-E-48
C9300 DNA ESSENTIALS 48-PORT 3 YEAR TERM LICENSE	C9300-DNA-E-48-3Y
715W AC CONFIG 1 POWER SUPPLY	PWR-C1-715WAC
Catalyst 9300 8 x 10GE Network Module	C9300-NM-8X
NO SECONDARY POWER SUPPLY SELECTED	C9300-SPS-NONE
UA POWER SUPPLY BLANK	PWR-C1-BLANK
CAT9300 UNIVERSAL IMAGE	S9300UK9-166

.4 New network equipment need to be purchased and provisioned by Project as follows:

- One new Cisco C9300-48P-E Edge Switch for M2E Hub room M2269
- 3 years Cisco 8X5XNBD maintenance contract
- Switch provisioning must include
  - Upgrade to current Sunnybrook standard of IOS XE Software, Version 16.06.06
  - Configuration with current Sunnybrook standard for Edge Switches
  - Sunnybrook Ether-channel standard uplink to the Hub room Aggregation Switch stack
- Contractor must provide 4 weeks notice to PM and IT for the scheduling of the switch installation

- Contractor must have direction from IT for the equipment rack and rack position of the switch
- Must have IT review and verification before the installation is approved as completed

.5 Service to be provided by Telus

Service Description	Service	Minimum
Site: Main Site		
System: NETWORK		
Stand-alone rtr/sw or First switch in a stack (static routes, RIP, no QOS)	NENG	4.00
Stand-alone rtr/sw or First switch in a stack (static routes, RIP, no QOS)	NICD	2.00
Technical Project Management REG	NIMPMR	1.00
Stand-alone rtr/sw or First switch in a stack (static routes, RIP, no QOS)	NISOL	1.00

.5 **Installations in existing Hospital Network Hub Rooms:**

.1 Access to Sunnybrook Hospital Network Rooms is <u>severely restricted</u> and <u>Contractors will not be allowed to access these rooms un-escorted/ un-supervised</u>. To complete this installation the following applies:

- **Contractor must retain the Hospital's Security Department to <u>allow access to and supervise activities of the Contractor while in the Hub Room</u> for any Cable/ Equipment installation in the Hub Room (it is assumed Contractor can install Cabling to a point outside of the Hub Room but can not install the Cable into the Hub Room without Security Supervision) and to complete Cable connections and equipment installation (Patch Panels)**

- **Arrangements for Security Supervision is to be coordinated directly between Security and the Contractor with the Contractor providing a minimum seven days written request**
- **The Hospital's Security Department will charge the Contractor $50.00 (fifty dollars) per hour for a minimum four hours at any one time**

.6 **AS THE CONTRACTOR IS RESPONSIBLE TO COVER ANY/ ALL COSTS REQUIRED TO RETAIN THE HOSPITAL'S SECURITY GROUP, IT IS STRONGLY RECOMMEND THE CONTRACTOR PROPERLY SCHEDULE THE NEED TO ACCESS HUB ROOMS AND THAT THE TIMES REQUIRING ACCESS BE ACCURATELY INDICATED ON THE PROJECT SCHEDULE**

.7 GENERAL:

.1 "CATEGORY 6 CABLING JACKS"
To clarify all Network Type outlets require 'Category 6 Jacks' and 'Category 6 Cabling'. There is no 'Category 5E' jacks/ cabling on this project.

.2 "FIBRE PATCH CORDS"
All fibre Patch Cords are to be "single mode type". Delete all references to "multimode type patch cords"

1.3 **PRE/ POST OCCUPANCY PROVISIONS**

.1 Assuming the Hospital will, as the time for occupancy approaches or even after occupying, resolve that some additional telephone/ data outlets/ monitor/ CCTV/ Security System outlets will be required. Include, in the Contract, the following additional installations:
- two (2) typical Data/ VoIP outlets

.2 Each drop with an average of 90m of cables installed and terminated at the Hub Room will be required. Include cable, patch cords, jacks, face-plates, labels, terminations, testing, and documentation for each drop. Assume, for bidding purposes, that these can be added at any time during construction including at the end of the construction and in any location as directed on site. Devices not installed at the construction completion are to be turned over to the Hospital as spare parts for future installation.

1.4 **INSTALLATION STANDARDS**

.1 The following are typical outlet types used on this project:
- Emergency Telephone outlet consisting of a single gang box with one 'RJ-45' voice jack and one 'Cat 3' voice cable in conduit/ wireway system to Telephone backboard
- Wireless Receiver (WAP) outlet consisting of a single gang in-line 'RJ-45' data jack and one 'Cat 6' cable in conduit/ wireway system to Hub Room. Provide a minimum 25'-0" cable coiled in ceiling space to allow flexible location of the receiver.
- typical Data/ VoIP outlet consisting of a single gang box with three 'RJ-45' data jacks (two for "data" and one for "VoIP") and three 'Cat 6' data cables in conduit/ wireway system to Hub Room
- Data/ VoIP/ Printer outlet consisting of a single gang box with three 'RJ-45' data jacks and three 'Cat 6' data cables in conduit to Hub Room
- Data/ VoIP/ Printer/ Telephone (could be Fax or Conference Phone) outlet consisting of a single gang box with three 'RJ-45' data jacks, one 'RJ-45' voice jack, three 'Cat 6' data cables in conduit/ wireway syatem to Hub Room and one 'Cat 3' voice cable in conduit/ wireway system to Telephone backboard
- CCTV to Network outlet consisting of a single gang box with one 'RJ-45' CCTV jack and one 'Cat 6' data cable in conduit to Hub Room

- Security System to Network outlet consisting of a single gang box with one 'RJ-45' Security System jack and one 'Cat 6' data cable in conduit to Hub Room
- Smart Board outlet consisting of a single gang box with one 'RJ-45' data jack and one 'Cat 6' data cable in conduit to Hub Room
- Alarm outlet consisting of a single gang box with one 'RJ-45' Alarm jack and one 'Cat 6' Alarm cable in conduit to Code White System

.2 All Data, Monitor, TV, CCTV and Security System outlets shall be PS5+ Gigaflex eight (8) position Cat 6 module.

.3 All cables shall have **"Category 6", white coloured**, eight -24 AWG thermoplastic insulated, solid conductors formed into individually twisted pairs and enclosed in a **CMP (FT-6)** rated thermoplastic jacket and all individual conductors to be insulated with fluorinated ethylene propylene (FEP).

.4 All drops will be routed through conduit system provided and installed by Division 16 Contractor. If conduits are provide for the entire route of the cable, CMR (FT-4) cable can be used.

.5 Where cable is run through modular furniture all cables must be protected by spiral wrap from the "service" pole to the furniture race way. The Communication Cabling Contractor is responsible to supply and install spiral wrap.

.6 All cables will be terminated on flush mount outlets as determined by the type of wall or furniture used.

.7 All Data/ VoIP Cables must have a orange coloured insert, all Voice Cables must have a blue insert, all TV Cables must have yellow insert, all CCTV to Network Cables and all Security to Network Cables must have white inserts.

.8 All **Data, CCTV to Network and Security System to Network drops** will terminate on 48 port MDVO modular patch panels completely filled with black EZ MDVO PS5 modular jacks in the telecommunications room as noted on drawings. The number of patch panels will be determined by the total number of data ports that the closet must serve plus 20% space capacity for future use.

.9 All **Voice drops** will terminate on the BIX blocks. The pigtail cable shall connect voice patch panel with the BIX block on the wall. See Drawings for details.

.10 All **TV drops** will terminate on **dedicated TV system** 48 port MDVO modular patch panels completely filled with black EZ MDVO PS5 modular jacks in the telecommunications room as noted on drawings. The number of patch panels will be determined by the total number of data ports that the closet must serve plus 20% space capacity for future use.

.11 All drop locations and quantities to be confirmed prior to the start of the installation.

.12 "Cabletalk" heavy duty 19" x 84" floor mounted communications racks with two (2) vertical managers shall be used. Two 12-outlet power bars shall be installed on the back of each rack.

.13 The Racks shall be bolted to the floor. New Racks are required in the new Hub Room. Refer also to Drawing Details.

.14 Rack mounted vertical cable managers are to be manufactured by Cabletalk, and a minimum of 6" wide with a swing-out door.

.15 Horizontal rack mount cable managers are to be manufactured by Cabletalk, 2u wide for 19" Communications Racks with a swing-out door. Provide one (1) horizontal cable manager for each patch panel (copper and fibre).

.16 Telecommunications racks shall be grounded as per the electrical code to the Telecommunications Ground Bar (TGB). #6 AWG green grounding cable shall be used.

.17 Performance of the cables shall comply with the latest draft of ANSI/EIA/TIA-568A Addendum 5 Attenuation and Power Sum Near End Cross Talk (NEXT) parameters for UTP Category 6 cable.

.18 For horizontal voice terminations provide spare QCBIX1A4 and QCBIX 1A connectors in any spare or partially filled mount, such that all mounts are completely filled. Use standard BIX single jumper channel layout.

.19 The fibre optics panels for the incoming fibre backbones shall have a slide out shelf or swing out drawer for access to the fibres. The fibre optics panels shall provide bend radius control and use a strain relief to accommodate the fibre optics cables. Use NORDX FIBEREXPRESS 19" shelf manager with 12 modules. See drawings for details.

.20 The Fibre Patch cords shall be included in the base bid price. The quantity of the cords is 12duplex SC-SC type 10' M/M, and 4 duplex SC-SC type 10' S/M for each telecommunications closet. Factory assembled only. Site prepared will not be accepted.

.21 The number of patch panels shall be as required for outlets shown on the floor plans plus 20 % spare capacity which shall be provided for the future applications.

.22 The communication contractor shall refer to the construction schedule prepared by the General Contractor and include for premium labour costs if required to meet the schedule.

.23 Horizontal Data and Monitor cabling will be split and dressed down the back and each side of the Rack, terminating on **Beldon 48 port HD Patch panels.**

.24 For horizontal Data terminations, **provide one spare Patch Panel**. For horizontal voice terminations, **provide one spare QCBIX1A4 connector** in any spare or partially filled mount. Use standard BIX single jumper channel layout.

.25 The Rack mountable Patch Panels performance shall comply with the latest draft of ANSI/EIA/TIA-568A Attenuation and Power Sum Near End Cross Talk (NEXT) parameters for UTP Category 6 hardware.

.26 All Patch Cords shall be factory assembled and not site prepared.

1.5 INSTALLATION REQUIREMENTS, WORKSTATION

.1 All Data, Voice, TV, CCTV to Network and Security to Network outlets shall be **Beldon EZ-MDVO RJ45** flush mounted where possible, otherwise a **Beldon** surface mount shall be used unless otherwise indicated on the supplied drawings.

.2 The number of patch panels shall be as required for the number of cables shown plus the spare specified.

1.6 INSTALLATION GUIDELINES

.1 Codes and Standards

.1 All work performed on this project will be installed in accordance with the current edition of the Canadian Electrical Code and all local codes and ordinances, authorities having jurisdiction, and the following standards (including all sub-headings, addenda, and TSBs):

ANSI/TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements, 2001.

ANSI/TIA/EIA-568-B.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components, 2001.

ANSI/TIA/EIA-568-B.3, Optical Fiber Cabling Components Standard, April 2000

ANSI/TIA/EIA-569-B, Commercial Building Standards for Telecommunications Pathways and Spaces, 2003.

ANSI/TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure, 2002

ANSI J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002.

CSA C22.1-02, Canadian Electrical Code, Part 1, 2002.

CSA T527, Grounding and Bonding for Telecommunications in Commercial Buildings, 1999.

CAN/CSA T528, Design Guidelines for Administration of Telecommunications Infrastructure in Commercial Buildings, 1997.

CSA T529, Telecommunications Cabling Systems in Commercial Buildings, 2000
CSA T530, Commercial Build Standard for Telecommunications Pathways and Spaces, 1999
Building Industry Consulting Service International (BICSI) TDM Manual latest editions at the time of tender
Manufacturers design guide

.2 The Contractor's performance of the work shall comply with applicable national, provincial and local laws, rules, and regulations. The Contractor shall give required notices, shall procure necessary governmental licenses and inspections, and shall pay without burden to the Owner, all fees and charges in connection therewith unless specifically provided otherwise. In the event of violation, The Contractor shall pay all fines and penalties, including attorney's fees, and other defense costs and expenses in connection therewith.

1.7 QUALIFICATION OF SYSTEM

.1 General

.1 Acceptable proposed system will be covered by a two part certification program provided by the single manufacturer and that manufacturer's Reseller (Vendor, Installer or similar designation).

.2 Manufacturer shall administer a program through the Installer to provide support and service to the purchaser.

.3 The first part is an assurance program which provides that the certified system will support the applications for which it is designed, during the lifetime of the certified system.

.4 The second portion of the certification is a 25-year warranty provided by the Manufacturer and the Reseller on all products within the system (jacks, cables, cross-connects, baluns, etc.).

.5 In the event that the certified system ceases to support the certified applications, whether at the time of cut over, during normal use or when upgrading, the Manufacturer and Reseller shall commit to promptly implement corrective action.

.6 Documentation proving the cabling system's compliance to the recommendations, as listed in the Codes and Standards section shall be provided by the Reseller prior to the structured cabling system being installed.

.7 Workmanship and installation methods used shall be equal to or better than that found in the BICSI (Building Industry Consulting Service International) TDM manual and the NeiS document "Installing Commercial Building Telecommunications Cabling".

.8 Purchaser demands strict adherence to the performance specifications listed in the Codes and Standards section. The manufacturer shall maintain 9001 Quality Control certification for the facilities that manufacturer the product used in this cabling system.

PART - 2 MANUFACTURER

2.1 GENERAL

.1 Manufacturer refers to the company that manufactures the components and is responsible for the design and installation guidelines used by the Reseller (Installer, Vendor, or similar designation) to complete this cabling system installation.

.2 The manufacturer along with the Reseller is responsible for the final warranty and certification of the application assurance.

.3 The Reseller shall show proof of a contractual relationship with the Manufacturer, and shall pass through the Manufacturer's certification to purchaser.

.4 The cabling manufacturer shall provide an end-to-end cabling solution, including horizontal cables, backbone cables, jacks and connectors, patch panels, termination blocks, patch cords and jumpers. For this project only end-to-end solutions shall be accepted.

.5 Where no manufacture is specified, provide products from manufactures in compliance with the listed requirements.

2.2 SUBMITTALS

.1 Pre-construction Submittals

.2 Submit the following documents for Review prior to construction:

.1 A cable labelling schedule (see Administration Section for more information)

.2 Cross-connect schedule for approval by the Owner.

.3 A list of all staff to be used, including proof of experience of installing structured cabling.

.4 Shop drawings:

.1 Submit shop drawings, product data, and samples with promptness as not to cause delay in work or in the activities of separate contractors. Submit shop drawings, product data, and samples as a complete set within thirty (30) days of award of contract for Engineer's Review.

.2 By submitting shop drawings the Contractor represents that the materials have been carefully reviewed and verified, as well as related quantities, field measurements, and field construction criteria. It also represents that the Contractor has checked, coordinated, and verified that information contained within shop drawings and samples conform to the requirements of the contract documents.

.3 The Review of shop drawings, product data, and samples submitted by the Contractor shall not relieve the Contractor of responsibility for deviations from requirements of the contract documents, unless the contractor has specifically informed the Engineer in writing of such deviation at time of submittal, and the Engineer has given written approval of the specific deviation. The Contractor shall continue to be responsible for deviations from requirements of the contract documents not specifically noted by the Contractor in writing, and specifically approved by the Engineer in writing.

.4 The Engineer's Review of shop drawings, product data, and samples shall not relieve the contractor of responsibility for errors or omissions in such shop drawings, product data, and samples.

.5 The Engineer's Review of shop drawings, product data, and samples, is for the limited purpose of checking for conformance with information given and design concept expressed in the contract documents. The Engineer's Review of such submittals is not conducted for the purpose of determining accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the contractor as required by the contract documents. The Review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences, or procedures. The Engineer's Review of a specific item shall not indicate approval of an assembly of which the item is a component.

.6 Perform no portion of the work requiring submittal and review until the Engineer has Reviewed the respective submittal.

.7 Submit two (2) copies of each shop drawing for Review. One (1) copy shall be retained by the Engineer. All other copies shall be returned.

.5 Post-construction Submittals (Maintenance Manuals)

.6 The Contractor shall submit within two (2) weeks of the end of construction:

.1 Manufacturer's technical documentation on all devices used in cabling system.

.2 Manufacturer supplied Application Guidelines for required applications.

.3 The Manufacturer's and Contractors Warranty and Certification

.4 Complete cable testing documentation in hard and soft copies. Provide licenced versions of any software required for viewing test results.

.5 An End User's Manual describing the essential system elements as well as the end user's responsibility for maintaining the integrity of the cabling system over time. This Manual shall include, as a minimum, guidelines for system expansion and modification (moves, additions, changes of service) as well as labelling and record keeping.

.6 The project shall not be considered complete until all documents, including the original Manufacturer's Certification, have been delivered to the Owner.

.7 Within 30 days prior to substantial completion, the Contractor shall submit a draft copy of the proposed contents of each manual to the Consultant for review prior to substantial completion. Within 10 days the Consultant shall provide a review of this document to the Contractor.

.8 Once the draft copy is approved, the Contractor will supply four (4) copies in suitably labelled, hard back, D-Ring type commercial binders, each complete with an index and tabbed title sheets for each section. Final copies of manuals are to be received by Consultant not less than 7 days prior to substantial completion.

2.3 AS-BUILT DRAWINGS

.1 The Contractor shall keep one complete set of prints at the site office, including all addenda, change orders, site instructions, clarifications and revisions for the purpose of record drawings. As the work on site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions that deviate from the original contract documents.

.2 Within two (2) weeks of the Project's completion the Contractor shall submit a complete set of As-Built drawings including cable routing, Telecommunication Rooms layouts, riser diagrams and telecommunications outlets. The layout shall detail locations of all equipment and indicate all wiring pathways, and outlets (including cable ID numbers). This as-built information shall include Addenda, Change Orders, Clarifications, Revisions, and Site Instructions.

.3 Upon completion the Contractor shall certify, in writing that the as built records are complete and that they accurately indicate all communication services related to the communications infrastructure. This shall include all visible and all invisible items. The information shall also correspond with all identifications applied by the Contractor to cables and termination devices in the buildings.

.4 The Contractor shall forward a letter of certification to the Consultant for final review and as-built CAD drawings to the Consultant for final review.

.5 The contractor may obtain copies of the telecommunication contract drawings (Tender Issue) in dwg format from the Consultant on request. A drawings release form needs to be signed by the Contractor prior to releasing the drawings.

.6 After as-built drawings have been reviewed, print four (4) full size copies of the drawings. Deliver two (2) copies to the Owner and two (2) copies to the Facilities Management (if different from the Owner).

PART - 3 COMMUNICATIONS CONTRACTOR

3.1 PROJECT MANAGER

.1 Within ten (10) days of the date of acceptance of this Bid, the Contractor shall notify the Consultant of the appointment of a competent Project Manager, experienced in the design and installation of structured cabling systems and in the supervision of similar contract work.

.2 The Project Manager shall be available during the entire life of the Contract to answer all questions pertaining to the contractual work, and shall be available at the site from the commencement date of equipment delivery to the commissioning completion date.

.3 The Project Manager shall represent the Contractor and shall have authority to carry out directions given to him as the Contractor's representative.

3.2 COMMUNICATIONS INSTALLERS

.1 The staff selected for the installation of the structured cabling system shall conform to the following:

.1 An installer on site that is a current member of BICSI and holds a valid RCDD designation. This installer along with the Project Manager will ultimately be responsible for the construction of this project.

.2 The Contractor must also have BICSI Registered Installers and Technicians on staff and assign them to this project. The project shall be staffed at all times by Installers and Technicians who, in the role of lead craftspersons, will be able to provide leadership and technical resources for the remaining craftspersons on the project.

.3 Submit to the Consultant within seven days of Contract Award a list of all staff to be used in above installation including proof of experience.

.4 *ONLY* qualified technicians directly employed by the CSV or Reseller shall terminate all cables (at both ends), test and perform cross-connects.

.5 Certification in the installation of structured cabling system under the title of CSV, Reseller, Vendor, or other similar status issued by the cabling manufacturer.

.6 Provide Manufacturer's Certification Number within two weeks upon award of contract.

.7 If, in the opinion of the Owner, the RCDD does not possess adequate qualifications to support the project, the Owner reserves the right to require the Contractor to assign an

RCDD who, in the Owner's opinion, possesses the necessary skills and experience required of this project.

PART - 4 INSTALLATION GENERAL REQUIREMENTS

4.1 GENERAL REQUIREMENTS

.1 All voice and data outlets shall be flush mounted where possible; otherwise a surface mount shall be used unless otherwise indicated on the supplied drawings.

.2 All face plates shall be coloured to match electrical face plates in the area unless otherwise noted.

.3 Blank inserts are to be placed in to outlet ports not containing communications jacks. The blanks are to be coloured to match the faceplate.

.4 All four pairs of horizontal cables are to be terminated. ISDN T568A wiring configuration is to be used. The splitting of pairs is strictly prohibited.

.5 All drop locations and quantities to be confirmed prior to the start of the installation. Allow a variation of 4.5m (15').

.6 Horizontal cabling will be split and dressed on ply-wood backboards and rack. Distribute cables evenly and neatly in bundles.

.7 The length of each individual run of horizontal cable from the patch panel on each floor to the telecommunications outlet shall not exceed 90m (295').

.8 All cables shall be loosely bundled using Velcro cable ties every 150mm (6"). To minimize the effects of alien cross-talk, do not comb-out cables.

.9 Utilize all indicated and available cable pathways such as conduit, cabletrays, ducts, raceways and furniture system channels except where otherwise noted. Exercise caution when pulling cables in such pathways to avoid damage to any cabling and to ensure that the cable manufacturers' maximum pull-force and minimum bend radii specifications are adhered to.

.10 All free running cables shall be securely fastened to appropriate cable supports so that cables routed to the under side of the floor tiles with a maximal inter-harness cable sag of 150mm (6"). All cables shall be completely supported by the harness so that the entire mass of the cables and harnesses are self supporting and no weight is transferred to any other existing fixture or structure in the ceiling space. The Contractor shall be responsible for the supply of all materials (such as hangers, harnesses or supports) and labour that may be required to achieve this.

.11 Route all cables to maintain minimum separations from sources of lighting, power cables, HVAC and electrical equipment as indicated in the Manufacturer's minimum separation schedule or otherwise required. The Contractor shall be responsible for the supply of all materials (such as hangars, harnesses or supports) and labour that may be required to maintain the indicated minimum separations.

.12 In the Telecommunications Rooms all communications cables shall be neatly bundled, supported and routed to the corresponding termination panel. The Contractor shall be responsible for the supply and installation of any additional cable supports. Velcro tie-wraps on cables should be loose and rotate freely.

.13 Each run of cable between the termination block and the data outlet shall be continuous without any joints or splices.

.14 Where the Contractor is required to remove ceiling tiles, such work shall not break or disturb grid or tiles.

.15 Terminated conductor ends shall be properly trimmed to assure a minimum clearance of 0.250" between the conductors of adjacent modules.

.16 Ground all Telecommunications equipment, racks and cabletrays using green insulated #6 AWG copper wire to the Telecommunications Ground Bar. All ground wires shall be home-run back to the Telecommunications Ground Bar. Do not daisy chain.

.17 Completely test out systems and, before they are turned over to Owner, demonstrate them to Owner's representative until such time as he is fully conversant with the operation of the systems.

.18 Six months after installation has been accepted by Owner, arrange a time convenient to the Owner to do necessary re-aligning, and replace defective components.

4.2 COMMUNICATIONS HORIZONTAL CABLING

.1 General

.1 All horizontal cables will be FT6 rated for plenum environment (CMP).

.2 All terminations shall be in T568A configuration.

.3 For all horizontal cables provide 3m of slack at the cabinet end and 1m of cable slack at the workstation end.

.4 Follow the Manufacturer’s guidelines for pulling force. If no guidelines are present the maximum pull-force for 4-pair horizontal twisted-pair cables is 111N (25 lbf).

.5 Maintain the manufacturer’s recommended bend radius at all times. If no guidelines are present ensure the bend radius does not exceed four (4) times the outside cable diameter.

.6 The communications wiring system shall be an end-to-end solution provided by a single manufacturer.

.7 Cables will be routed through conduits, cabletray. The Division 26 Contractor will provide the conduits and cabletray where shown.

.8 Approved manufactures for the end-to-end cabling solution are as follows:

Standard of Acceptance
Belden/CDT (To match existing facility standard)

.2 Horizontal Data Cables

1. Provide horizontal cables to connect each information outlet to the backbone subsystem on the same floor.
2. All horizontal cabling shall be **BELDON Category 6, IBDN for FT-6** environment. All Category 6 cables shall conform to or exceed the EIA/TIA 568 Commercial Building Wiring Standard. Horizontal Cable Section and the EIA/TIA Technical Systems Bulletin 36 for Unshielded Twisted Pair Cables. Other standards supported include IEEE 802.3, 1Base5, 1OBASE-T;IEEE 802.5,4 Mbps, 16Mbps (328 ft [100m], 104 Workstations) and proposed ANSI X3T9.5 TPPMD requirements for UTP at 100 Mbps. In addition, cables shall be capable of supporting evolving high-end applications such as 155 Mbps ATM.
3. The 4 pair UTP cable shall be UL Listed type CM. or CMP.

4. All plenum rated Category 6 Unshielded Twisted Pair (UTP) cables shall be composed of 24 AWG solid copper conductors, dual insulated with high density polyethylene (HDPE). The insulated conductors are twisted into pairs and jacketed with Polyvinyl Chloride (PVC) and shall meet or exceed the Electrical Specifications listed below:

1. Maximum DC resistance 28.6 S/1,000 ft (9.38S/100m)Maximum DC

resistance

2. Unbalance: 5%Mutual Capacitance @1kHz: 14nF/1,000 f
3. Mutual Capacitance Unbalance (pair to ground): 4OOpF/1,000 ft (131.2 pF/100m)
4. Attenuation (dB/1,000 ft [305m]):@ 0.772 MHz: 5.5@ 1.0 MHz: 6.3@ 4.0 MHz: 13@ 8.0 MHz: 18@ 10.0 MHz: 20@ 16.0 MHz: 25@ 20.0 MHz: 28@ 25.0 MHz: 32@ 31.25 MHz: 36@ 62.5 MHz: 52@ 100 MHz: 67
5. Characteristic Impedance (S):@ 0.064 MHz: 125 ± 15S@ 0.128 MHz: 115 ± 15S@ 0.256 MHz: 110 ± 15S@ 0.772 MHz: 105 ± 15S@ 1.0-

25.0 MHz: 100 ± 15S

6. Pair to Pair Next (db) at 1,000 ft (305 m):

FREQUENCY	EIA STANDARD	90 TH PERCENTILE
1.0 MHZ	62	68
4.0 MHZ	53	59
8.0 MHZ	48	54
10.0 MHZ	47	53
16.O MHZ	44	50
20.0 MHZ	42	48
25.0 MHZ	41	47
31.25 MHZ	40	46
62.50 MHZ	35	41
100.0 MHZ	32	38

7. UL Listed
8. CSA Certified

5. The UTP-based cabling system shall be capable of supporting the following applications:
6. 1.2 Gbps ATM*
7. Gigabit Ethernet (1000BASE-T)
8. Broadband Video
9. 25/52/155/622 Mbps ATM
10. Fast Ethernet (100BASE-TX, 100BASE-T4)
11. 100VG-AnyLAN
12. TP-PMD

13. Ethernet (10BASE-T)
14. 4/16 Mbps Token-Ring
15. Baseband Video
16. ARCnet/ARCnet Plus
17. IBM System 370/3270
18. IBM 3x - AS/400
19. IBM 4700 Financial Communication System
20. IBM 5080/6090 Graphics System
21. EIA-232/EIA-422
22. Voice

.3 Information Outlet (eight (8) position Category 6 modular jacks at working station. Unless otherwise noted all information outlets shall be:

1 Eight (8) position Cat 6 modular type
2 insulation displacement
3 modular
4 universal application/multi vendor supportive
5 accepting most phone and data plugs. Provide corresponding faceplate

4. All Category 6 outlets shall be:

1 The outlet UTP connection module shall be Power Sum rated, with a Power Sum NEXT performance equal to or better than ANSI/TIA/EIA-568 Category 6 pair-to-pair NEXT performance specifications, and shall have a PS5 marking to indicate compliance.

2 The eight-position outlet UTP connection module shall accommodate sixposition modular plug modular cords without damage to either the cord or the module.

3 The outlet UTP connection module shall use a hand-termination installation method, without the need for punch down tools or slip lock pliers.

4 The outlet UTP connection module shall have an optional cover to protect the module when not in use.

5 The outlet UTP connection module and its optional cover shall be available in the following colours: grey, almond, white, black, orange, red, yellow, green, blue, purple, and brown.

.6 The outlet UTP connection module shall be designed for use at the Work Area, Telecommunications Closet and/or Equipment Room without modification.

.7 The outlet UTP connection module shall only have a single insulation displacement connection block for the termination of wire pairs.

.8 The outlet UTP connection module shall be available in both the T568A-ISDN and T568B-ALT wiring configurations.

.9 The outlet UTP connection module shall be UL Listed and CSA Certified.

.10 The outlet UTP connection module shall be made of fire-retardant UL 94V-0 plastic.

.11 The outlet UTP connection module shall have an insulation displacement connection featuring insulation-slicing, tin-plated clips, forming a gas-tight connection.

.12 The outlet UTP connection module shall have a maximum Contact Resistance of 1 milliohm per contact.

.13 The outlet UTP connection module shall have an minimum Insulation Resistance of 100 megaohms between clips.

.14 The outlet UTP connection module shall have a durability rating of 200 insertions/withdrawals of any combination of 24 and 26 AWG wire.

.15 The outlet UTP connection module modular jack shall be FCC Part 68, Subpart F compliant.

.16 The outlet UTP connection module modular jack durability shall be 1500 mating cycles.

.17 The outlet UTP connection module modular jack contact material shall be nickel with 50 micro-inches gold plated.

.18 The outlet UTP connection module modular jack maximum Current Rating shall be 1.5 amperes.

.19 The outlet UTP connection module modular jack Dielectric Strength shall be 1000V RMS at 60 Hz for 1 minute.

.20 The outlet UTP connection module modular jack minimum Insulation Resistance shall be 500 megaohms.

.21 Outlet Faceplate:

1. The faceplate housing the outlet UTP connection modules shall provide a symmetrically-centered appearance for the modules.
2. The faceplate housing the outlet UTP connection modules shall have no visible mounting screws.
3. The faceplate housing the outlet UTP connection modules shall be removable without requiring the removal of screws or other fasteners.
4. The faceplate housing the outlet UTP connection modules shall have an outlet wiring diagram stamped on the inside.
5. It shall be possible to inspect and/or reterminate the UTP cable at the outlet through front access at the faceplate.
6. The faceplate housing the outlet UTP connection modules shall have aperture plugs to cover any unused openings in the faceplate.
7. It shall be possible to install the outlet UTP connection modules in wall mounted single and dual-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer-supplied faceplates and/or adapters, equipped with front, side or angled-entry options for modular cords.
8. The faceplate housing the outlet UTP connection modules shall be available in the following colors: grey, almond, white, and black.

.22 Outlets shall be wired in an EIA/TIA 568 A configuration.

.23 Unless otherwise noted on the floor plans, the information outlet shall be surface flush mounted, single or multi jacks as indicated.

.24 Each work area shall be supplied with a telecommunications outlet/connector (previously called a modular jack) for connection to the horizontal media. All telecommunications outlet/connectors shall be installed in an appropriate faceplate. All telecommunications outlet/connectors shall be complete with faceplate and attached permanently to a fixed structure, such as building walls, utility poles or modular furniture partitions.

.25 The work area telecommunications outlet/connector must provide maximum flexibility in supporting UTP, fibre, and coax while maintaining performance in order to meet the changing requirements that are likely to occur throughout the life of the system.

,26 8 Position modular telecommunications outlet/connectors shall accept 8 position modular plugs while providing proper electrical connection and not damaging telecommunications outlet/connector (jack). Manufacturer shall warrant all 8 position modular outlets used in such a manner to be usable for 8 position modular plugs in the future.

.27 In order to allow normal expansion of service during the life of the cabling system, flush work area telecommunications outlets shall provide sufficient density to support up to a maximum of eight connectors per single gang telecommunications outlet and twelve connectors per double gang telecommunications outlet.

2 BACKBONE SUBSYSTEM

.1 Multi-strand 50/125:m Multi-mode fibre run between the existing Network Rooms as shown on the plans and the new Telecommunications Room. Terminations shall be on NORDX FIBEREXPRESS 19" fibre patch panels, 2u, complete with 4x 3 SC-duplex Universal

Connector Modules. Multimode SC fibre pigtails are to be fusion spliced for termination. Install one patch panel in each telecommunications closet and four (4) in the POP room. See drawings for details.

.2 Optical fibre cable to be as follows:

1 The fibre cable shall be enclosed in a CSA , FT4 rated overall jacket. The all fibre runs shall be installed inside orange inner-duct tube for additional physical protection or inside empty conduit provided by electrical contractor.

2 Attenuation shall be measured in accordance with EIA optical fibre test procedure EIA/TIA-456-46, -61, OR-53 (Ref B1.39).Information transmission capacity shall be measured in accordance with EIA/TIA-455-51, or -30 (Ref B1.39).

3 The fibre cable shall meet the NEC requirements for OFNR or OFNP and comply with Bellcore. FDDI. GIGABIT ETHERNET, EIA/TIA-568 and ICEA standards.

4 The optical fibre shall be multimode and single mode optical fibre with a nominal 62.5/125 [9/125] micron core/cladding diameter. The fibre shall comply with ANSI/EIA/TIA-592AAA (Ref B1B) and also with ANSI/TIA/EIA 568A (future CAN/CSA-T529) on Mechanical Terminations.

5 Multi-mode backbone optical fibre cables should be of all dielectric construction and with the following characteristics:

Multi-mode Fibre Cable	850:m	1300:m
Attenuation - dB/km	3.75	1.5
Minimum Bandwidth - Mhz.km	3500	500

6 Each fibre shall be buffered with colour-coded PVC.The fibre cable shall meet the following specifications:

1 Fibre Dimensions:

Multi-mode Fibre Optics Cable	50m – core	
	1	25:m. – cladding
	2	50mm – coating
		900:m – buffering

.2 Cable Minimum Bending Radius:

During Installation: 15 times cable diameter (Short term load).	
Multi-mode Fibre Optics Cable	7.9" (20.1 cm)
After Installation: 10 times cable diameter (long term no load).	
Multi-mode Fibre Optics Cable	5.3" (13.4cm)

.3 Buffered Fibre Minimum Bend Radius: .75 in. (1.91 cm)

.4 Operating Temperature Range: -20°C to 70°C
.5 Storage Temperature Range: -40°C to 80°C
.6 Numerical Aperture: 0.275
.7 UL Listed
.8 The optical cable shall be fully dielectric, with no metallic elements in the cable.
.9 The optical cable shall have decreasing sequential print on cable jacket of remaining cable length.
.10 The optical cable shall have a crush resistance of 2000 N/cm.
.11 The optical cable shall have an impact resistance of 2000 impacts with 1.6 N/m.
.12 The optical cable shall have a minimum Flexure rating of 2000 cycles.

.13 All Data Fibre Optic Distribution Panels shall be complete with Rack Mountable Fibre Optic Distribution Centre complete with the following:
.1 Cabinet to accommodate up to 6 x 12 fibre connectors and minimum of two separate tight buffered cables.
.2 Spools for storing patch cord slack and mechanism to control bend radius of fibres within cabinet.
.3 Hinged front or shelf providing easy accessibility to connectors and splices.
.4 12 Connector Panel Modules each with 6 LC-compatible interconnection sleeves. See drawings for details.
.3 For a multi mode, 50/125:m fibre optics cable factory made pigtail cables to be “fusion method” spliced in the field and used. All connectors shall have the following minimum performance specification:

Parameter	Specification
Max. Attenuation	0.3 dB
Typical Attenuation	= <0.2 dB
Connector Durability	<0.2 dB increase/1000 matings
Reflectance (Db)	-20

4.3. ADMINISTRATION SUBSYSTEM

1. The Administration Subsystem links all of the subsystems together. It consists of labelling hardware for providing circuit identification and jumper wire used for creating circuit connections at the cross connects.

2. The administration subsystem shall consist of wiring blocks for termination of copper cables and fibre patch panels for the termination of optical fibres. All rack layouts to be approved prior to installation.

3. EQUIPMENT RACKS

.1 The 19" equipment racks shall be supplied and installed in the new Hub Room. The Racks shall be manufactured by “Cabletalk” or approved manufacturer.
.2 The Two Vertical managers shall be provided for each section of the rack. (Cabletalk CTR-CMS series) For two racks a horizontal wiring manager on the top of the racks shall be provided (Cabletalk CTR-CMS-2M)
.3 Provide two power bars with 12 outlets each, mounted on 6” spacers in the back of the racks.
.1 The on/off switch on the power bars shall be factory disabled.
.2 The Rack shall be provided with two full size fold-up tray for Cable-talk rack.
.3 The racks usable space height shall be 80"
.4 The Racks shall be “Cabletalk” CRT-1984 or approved manufacturer
.5 The XLBET NORDX/CDT QPBIX24A BIX Frame shall be provided for termination of cables inside point of Presence Room.
.6 The frame shall be provided with BIX mounts and blocks for termination of 4000 pairs of voice cables.

.7 The frame shall include a BIX frame end kit.

1.4 PATCH PANELS

1. The termination block shall support the appropriate 'Category 6' applications and facilitate cross-connection and inter-connection using cross connect wire. The UTP cross-connect/interconnect system rack mount shall feature built-in wire management to secure cable bundles, control and maintain proper cable bend radius and provide physical protection for terminations..
2. Patch panel installations shall contain a retaining trough between every 50 pair termination block.
3. The wiring block shall be able to accommodate 24 AWG cable conductors.
4. Termination blocks that require rotation after connection of horizontal/vertical wiring will not be allowed.
5. The block shall be Underwriter's Laboratories (UL) listed.
6. All 'Category 6' Patch Panels shall support 100 Mbps TP-PMD and 155 Mbps ATM and shall meet or exceed the NEXT Values listed as follows: 1.0 MHz: 86@ 4.0 MHz: 74@ 8.0 MHz: 68@ 10.0 MHz: 66@ 16.0 MHz: 62@ 20.0 Mhz: 60@ 25.0 MHz: 58@ 31.25 MHz: 56@ 62.50 MHz: 50@ 100.0 MHz: 46

7. Horizontal cabling will be split and dressed down the back and each side of rack 2, terminating on NORDX 48 port HD Patch panels.
8. The termination block shall support the appropriate Category 6 applications and facilitate cross-connection and inter-connection using cross connect wire. The UTP cross-connect/interconnect system rack mount shall feature built-in wire management to secure cable bundles, control and maintain proper cable bend radius and provide physical protection for terminations.

9. The wiring block shall be able to accommodate 24 AWG cable conductors.
10. Termination blocks that require rotation after connection of horizontal/vertical wiring will not be allowed.
11. The block shall be Underwriter's Laboratories (UL) listed.
12. Contractor shall supply cross-connect wire and patch cords for cross-connection and inter-connection of termination blocks and fibre optics termination units.
13. One patch cord shall be provided for each workstation outlet, and one for each data port in the telecommunications closet.
14. The type of jumper cables shall depend on EIA/TIA Category 6 applications and the termination block used. i.e. a punch panel, a patch panel termination block.
15. The UTP data patch cord for connecting a computer workstation to its corresponding equipment jack shall be manufactured by NORDX.
16. The UTP data patch cord lengths shall be as follows: 10 ft
17. The Data Backbone Duplex Optical Fibre Patch Cords shall be comprised of dual multimode 50/125 um graded index, dual window fibres terminated on all ends with ceramic LC compatible connectors.
18. The Plus series patch cord shall be available in 4 pair version with lengths of 10 feet and shall meet or exceed the following electrical, mechanical and NEXT specifications listed below:

19. The modular plug shall meet the requirements of the latest issue of ANSI/TIA/EIA-568.

a. The modular plug shall meet the requirements of the latest issue of ISO/IEC 11801.
b. The modular plug shall meet the requirements of the latest issue of FCC Part 68, Subpart 5.
c. The modular plug shall meet the requirements of the latest issue of IEC 603-7
d. The modular plug shall have a maximum Voltage Rating of 150V AC.
e. The modular plug shall have a minimum Dielectric Withstanding Voltage of 1000V RMS at 60 Hz for 1 minute.
f. The modular plug minimum insulation resistance shall be 500 megaohms.
g. The modular plug maximum contact resistance shall be 10 milliohms.
h. The modular plug housing shall be made of UL 94V-0 rated polycarbonate.
i. The modular plug contacts shall be made of phosphor bronze.
j. The modular plug contacts shall be plated with a minimum of 50 microinches of gold.
k. Each modular plug of every modular cord shall be legibly and indelibly stamped with the wiring configuration of the cord (T568A or T568B).
l. The modular plug shall be crimped such that the distance between the top of each contact and the bottom of the plug is 0.237 +/- 0.005 inch. The insulated conductor shall be visible from the front of the plug.
m. The modular plug shall be UL 94V-0 Flame Rating compliant.

20. Plus Series Modular Cord Assembly:
    a. The modular cord assembly shall meet or exceed the short link NEXT requirements of 34 dB when tested with enhanced Category 5 connecting hardware.
    b. The modular cord assembly shall meet the requirements per the latest issue of ANSI/TIA/EIA-568
    c. The modular cord assembly shall meet the requirements per the latest issue of ISO/IEC 11801
    d. The modular cord assembly shall be UL listed as a Communication Cable Assembly.
    e. The modular cord assembly shall be CSA Certified as a Communication Cord Set.
    f. The modular cord assembly shall be capable of withstanding an 11.25 pound pull test. Each of the individual conductors shall be capable of withstanding a 3 pound pull.
    g. Each conductor in every modular cord assembly shall be capable of withstanding, without breakdown for 1 minute, an AC (RMS) potential of 1000V (1500V DC). Each conductor shall be tested against all other conductors and/or any metal enclosure part of a connector, all electrically connected together and grounded. The test voltage shall be increased from zero at a rate not exceeding 200 V/s until the required value has been attained.
21. The patch cord shall have built-in exclusion features to prevent accidental polarity reversals and split pairs.
22. The panels shall accommodate LC type adapter sleeves. Rack mounted fibre patch panels shall be lockable & rugged enclosures that can accommodate both splices and field mountable connectors. Both sides of the connection shall be protected by the enclosures
23. The optical fibre distribution terminal with the highest density of fibre terminations while maintaining a high level of manageability shall be selected.
24. The fibre cladding shall be covered by aramid yam and a Jacket of flame-retardant PVC.
25. The fibre patch cord shall meet the following specifications:

a. minimum bend radius: 1.00 inch (2.54 cm)
b. operating temperature: -4 to 158° (-20° to 70°)
c. loss: 0.4 Db/mated connector
d. minimum bandwidth: 3500MHz-km at 850 nm
e. 500MHz-km at 1300 nm

26. The Fibre patch panels shall provide cross-connect, inter-connect, splicing capabilities and contain the proper troughs for supporting and routing the fibre cables/jumpers.
27. Fibre Panels should provide for a flexibility point for cross connection or inter connection of optical fibre cables for in-building applications.
28. The panels should accommodate LC type adapter sleeves. They should be rugged and provide for strain relief for fibre connections.
29. The patch/distribution panels should be adaptable to 19" wide equipment racks or allow for wall mounting where indicated.
30. The panels should also accommodate storage and management of at least two metres of slack per fibre.
31. The panels should provide for grounding (where non dielectric cables are used).
32. Fibre Connections can be made with fibre splices (fusion) and pigtails. Connectors are the LC type according to the TIA/EI!-568-B.
33. Fibre patch cords shall be equipped with appropriate connectors. They shall use either single or dual fibre cables. Buffered fibre overlaid with strength material, such as kevlar, and a second PVC jacket shall be used. The maximum loss values shall not exceed the manufacturer specified values.
    a. Splice (mechanical/fusion) 0.30 dB
    b. Connector (mated pair) 0.75 dB
    c. Cross-Connect (two mated pairs) 1.5 dB
34. The length of cords shall be 10' for each telecommunication closet.
35. The Fibre patch panels shall consist of a modular enclosure with retainer rings in the slack storage section to limit the bending radius of fibres.
36. The fibre patch panels shall have a "window" section to insert connector panels for mounting of connected fibres (LC connectors).
37. LC connectors shall meet or exceed the following specifications:
    1. Operating Temperature: -40 to 185 degree F (40 to 85 degree C)
    2. Average Loss: 0.3 dB

4.5 COMMUNICATIONS CONNECTING CORDS, DEVICES AND ADAPTERS

i. Data Patch Cords
    1. For each data drop installed provide one (1) patch cord at the patch panel end. Provide quantities as follows:
        a. 100% Category 6 patch cords (RJ45-RJ45), 1.2m (4') in length
    2. For each data drop installed provide one (1) patch cord at the workstation end. Provide quantities as follows:
        a. 100% Category 6 patch cords (RJ45-RJ45), 2.1m (7') in length
    3. All data patch cords shall be installed by the Contractor.
    4. All data patch cords shall be RJ45 to RJ45 with booted connector ends.
    5. All patch cords shall be FT6 rated.

1.6 IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

.1 General

.1 The Administration Subsystem links all of the subsystems together. It consists of labelling hardware for providing identification.
.2 Administration shall be in compliance with the TIA/EIA-606-A standard for Class 2 Administration. Identifiers are required in the following locations:
(a) Security Server Room
(b) Intrabuilding backbone cable
(c) Horizontal link
(d) Cabinets
(e) Patch panels
(f) TMGB
(g) TGB
.3 The Owner may deviate from the TIA/EIA-606-A standard to suit they own particular administration system.
.4 Submit a complete labelling schedule (as noted in the per-construction submits section) to the Owner for review. Allow for the Owner to make changes.
.5 The Contractor shall provide labels at the following locations:
(a) At each end of the cable jacket within 6" of where the jacket has been stripped.
(b) On the front of each faceplate
(c) On the inside of each outlet box
(d) On the front of the patch panel or termination block
(e) At each end of each patch cord and pigtail cable within 50mm (2") of the connector
.6 Labels shall be machine printed with black text on white backing.
.7 The minimum height of text shall be 3/16".
.8 Use labels produced by the cabling manufacture as recommended for the application.
.9 For labels on racks, cabinets, and patch panels supply lamicoid name plates. Colours shall be black text on white backing.

.2 Numerical Identification
.1 Label Telecommunication Rooms as follows:
(a) FS
(b) F = floor the Telecommunications Room is located
(c) S = unique idnetifier for the Telecommunications Room on that floor (A, B, C...)
.2 Label all horizontal data links as follows:
(a) FS-DXXX
(b) FS = the Telecommunications Room identifier for the room the cable is terminated
(c) D = Data
(d) XXX = unique cable number
.3 Label all horizontal voice links as follows:
(a) FS-VXXX
(b) FS = the Telecommunications Room identifier for the room the cable is terminated
(c) V = Voice
(d) XXX = unique cable number

.3 Coloured Identification
.1 Use the following colours to identify different systems:
.2 All horizontal UTP cables shall be coloured blue.
.3 All workstation jacks shall be coloured white.
.4 All jacks in patch panels shall be coloured black
.5 Patch cords shall be coloured as follows:
(a) data = white
(b) voice = blue

5 COMMISSIONING OF COMMUNICATIONS

5.1 GENERAL

.1 Provide Commissioning Verification, Inspection and Certification.

.2 Provide commissioning verification, inspection and certification of all communications cables installed.

.3 100% of all cables installed must be tested, and certified.

5.2 COPPER CABLE TEST REQUIREMENTS

.1 Every cabling link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-B.1.

.2 The installed twisted pair horizontal links shall be tested from the IDF in the Telecommunications Room to the telecommunication outlet in the work area against the Basic Link performance limits specification as defined in ANSI/TIA/EIA-568-B.1.

.3 100% of the installed cabling links must be tested and must pass the requirements of the standards mentioned in above specifications. Any failing links must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section below.

.4 Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests.

.5 The test equipment (tester) shall comply with the accuracy requirements for Level III field testers as defined in TIA-568-B.1

.6 The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

.7 The tester interface adapters must be of high quality and the cable shall not show excessive twisting or kinking resulting from repetitive coiling and storing of the tester interface adapters.

.8 The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests. Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.

.9 A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks.

.10 A representative of the consultant and end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase 5 business days before testing commences.

.11 A representative of the consultant and end-user will select a random sample of 5% of the installed links. The representative (or his authorized delegate) shall test these randomly selected links and the results are to be stored in accordance with the prescriptions in Specifications. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the end-user representative shall repeat 100% testing and the cost shall be borne by the installation contractor.

5.3 COPPER CABLE TEST STANDARDS

.1 Test all horizontal copper cable links to Category 6 standards.

.2 The test parameters for Category 6 are defined in ANSI/TIA/EIA 568B.1. The test of each link shall contain all of the following parameters as detailed below. In order to pass the link test all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the above-mentioned Category 6 standard.

.3 When testing cables the correct NVP value must be entered in to the tester for the particular cable being tested or the test results will be considered void.

5.4 TEST RESULT DOCUMENTATION

.1 The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.

.2 The test results records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.

.3 The test results records saved by the tester shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.

.4 The database for the completed job shall be stored and delivered on CD-ROM including the software tools required to view, inspect, and print any selection of test reports.

.5 A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information

.6 The identification of the link in accordance with the naming convention defined in the overall system documentation.

.7 For OTDR testing include all ray traces and graphical outputs.

.8 The date and time the test results were saved in the memory of the tester. Ensure that the correct information has been entered.

.9 Test results must be received by the Consultant for review within 2 weeks of completion of testing or they will be considered void.

5.5 CLEAN-UP

.1 General
- .1 Remove all redundant cables completely-both horizontal and vertical cable
- .2 All existing cables and communications equipment needs to be removed.
- .3 The Telecommunications Rooms are to be cleaned using canned compress air suitable for cleaning electronic equipment. All equipment shall be cleaned of dust and debris. The floors are to be vacuumed and all garbage removed prior to the owner taking occupancy.
- .4 Do not dust and vacuum until all trades have completed work.

5.6 OCCUPANCY

.1 General
- .1 When the owner is ready to take occupancy the Communications Contractor is to provide an onsite communications technician to assist during the move.

.2 The communications technician is to have extensive knowledge in the design and construction of the system.
.3 The communications technician is to assist the owner during the move and answer any questions related to the system.
.4 If the owner deems the technician unable to provide proper assistance for any reason, another technician will be provided by the contractor immediately with no addition charge to the owner.
.5 The owner will decide the time and date that the technician is to arrive. The owner must give at least 48 hours notice to the communications contractor before such time.
.6 The technician is to remain on site for a maximum of 8 hours. These hours may occur during premium time or during weekends. Any additional time must be arranged with the Communications Contractor.

6 EXECUTION

1 Data Cable Installation

2 Communications cables shall be placed through shafts, conduit, raceways or floor penetration. All optical fibre shall be handled, installed, and supported as per the manufacturer recommendations. During the laying of the cable, installer shall take care not to stress the cable. After the cable is installed, the installer shall make sure that all parts of the cable are supported properly according to the manufacturer guidelines. There shall be acceptable (to the manufacturer) minimum physical stress on installed cables.

3 In order to achieve a level of reliability that approximates that of a factory manufactured connector, field installable connector shall have a factory physical contact (PC) polish. Every fibre shall be terminated with the appropriate pigtail cable with factory installed connector, tested and test results provided in writing to Purchaser. The fibre patch cord shall consist of two single, buffered, graded index fibres with a 50 micro-meter core and a 125 micro-meter cladding(or 9.0/125 :m for single mode fibres). All fibres will be run in metal raceway and terminated in the TC's with SC connectors rack or wall mounted fibre optic patch panels equipped with sufficient panels, couplers and jumper storage shelves to terminate and secure all fibres.

4 The fibre cable shall be protected by metal raceway or appropriate apparatus at all times. Each end of the fibre cable shall contain a slack storage box with approximately seven feet of cable slack.

5 Communication Contractor shall be required to supply #6 AWG for grounding all equipment including communication cable trays.

6 All fibre cable not run in conduit shall be enclosed in appropriate flexible spiral wrapping for maximum mechanical and environmental protection. This includes up communications rooms riser.

7 The spiral wrapping shall be installed 'butted' and shall meet all relevant codes.

8 Supply all materials and labour for the installation of the complete Riser Cabling system including all cables and terminations.

9 Ensure that proper cable support techniques are utilized for suspending and supporting riser cables as per manufacturer's specifications. Cable ties shall also be used to prevent side to side movement of the cable. The cable ties shall not be installed so as to deform the cable jacket.

10 Fibre cable inside Communications Room shall be protected with max 0.97" cross-sectional area innerduct FT4 rated. The installation must be done in compliance with OBC 3.1.5.19

11 Provide, install and terminate the indicated quantities of riser cables in the communications rooms.

12 Communication Contractor shall be required to supply #6 AWG for grounding all equipment including communication cable trays.

13 The spiral wrapping shall be installed 'butted' and shall meet all relevant codes.

14 Supply all materials and labour for the installation of the complete Communications Cabling system including all cables and terminations.

15 Ensure that proper cable support techniques are utilized for suspending and supporting riser cables as per manufacturer's specifications. “Velcro” cable ties shall also be used to prevent side to side movement of the cable. The cable ties shall not be installed so as to deform the cable jacket.

16 Provide, install and terminate the indicated quantities of riser cables in the communications rooms.

17 All cables shall be neatly bundled, tie-wrapped and routed together. Secure cable bundles to vertical and horizontal supports and neatly fasten to plywood backboards or termination racks when routing to termination panels.

18 Installation shall be suitably tested and demonstrated to the Engineer consistent with standard industry practice.

19 Connect equipment is to closet ground bus with #6 AWG green grounding wire.

20 Submit shop drawings of all communications equipment, cabling, receptacles and miscellaneous hardware.

21 Installation shall conform to the standard, EIA/TIA 568A.The length of each individual run of horizontal cable from the administration subsystem (Communications Closet) on each floor to the information outlet shall not exceed 295 ft (90 m).

22 All cables shall be neatly bundled and tie-wrapped. Secure cable bundles to vertical and horizontal supports in Communications rooms to support cable bundles.

23 Utilize all indicated and available cable pathways such as conduit, cable trays, ducts, raceways and furniture system channels except where otherwise noted. Exercise caution when pulling cables in such pathways to avoid damage to any cabling and to ensure that the cable manufacturers' maximum pull-force and minimum bend radii specifications are adhered to.

24 All free-running cables shall be securely fastened to appropriate cable supports and harnesses a minimum of every 1500mm so that cables are bundled tightly. All cables shall be completely supported by the harness so that the entire mass of the cables and the harnesses is self supporting and no weight Is transferred to any other existing fixture or structure in the ceiling space (such as suspended ceiling or light fixtures), The Contractor shall be responsible for the supply of all materials (such as hangers, harnesses or supports) and labour that may be required to achieve this.

25 Route all cables to maintain minimum separations from sources of lighting, power cables, HVAC and electrical equipment as indicated in

the "NORDX/CDT" minimum separation schedule or otherwise required. The Contractor shall be responsible for the supply of all materials (such as hangars, harnesses or supports) and labour that may be required to maintain the indicated minimum separations.

26 In the building Communication Closets all communications cables shall be neatly tie-wrapped, bundled, supported and routed to the corresponding termination panel in the hub rooms or computer room. The Contractor shall be responsible for the supply and installation of any additional cable supports. Tiewraps on Cat 5e cables must of be velcro type only (plastic cable ties are not acceptable)

27 The communications contractor is to coordinate the installation of the data and voice cables with other contractors and tenants as required for the installation of these cables.

28 Inform the Consultant of any cable lengths in excess of 90 m in length prior to installation.

29 Each run of cable between the termination block and the data outlet shall be continuous without any joints or splices.

30 In suspended ceiling and raised floor areas where systems duct, cable trays or conduit are not available, the Contractor shall bundle station wiring with velcro cable ties at appropriate distances (plastic cable ties are not acceptable for Cat 5e cabling). The cable bundling shall be supported via "J' hooks attached to the existing building structure and framework. Plenum cable will be used in all appropriate areas where cables are not enclosed in metal raceways or concrete encased conduits.

31 If the interior of walls are not obstructed, the Contractor shall conceal horizontal distribution wiring internally within the walls. If such obstructions exist. Contractor shall secure approval prior to the use of an alternate method.

32 Where the Contractor is required to remove ceiling tiles, such Work shall not break or disturb grid or tiles.

33 Contractor shall provide detailed cable run diagrams for cable runs within raised floors detailing exact locations of cable for review and approval after coordination with other contractors and engineer.

34 Conduit runs installed by the contractor should not exceed 100 feet or contain more than two 90 degree bends without utilizing appropriately sized pull boxes.

35 Dedicated four-pair 24 AWG UTP horizontal distribution cable shall be provided for each application or service planned, present and future, Each of the four cable pairs of each horizontal cable must be terminated on an individual 8 position modular connector at the telecommunications outlet/connector. Pairs within a cable shall not be split and all pairs must be terminated.

36 The splitting of pairs within a cable between different jacks is not permitted. Terminating resistors in the case of ISDN applications shall be placed external to the telecommunications outlet/connector.

37 Cable shall be provided on reels or in Reelex boxes. Cable shall be marked decrementally from 100 ft to indicate both the length of a run as well as the amount of cable remaining on the reel or within the carton

38 The installation of the horizontal cable shall follow the appropriate recommendations covered in the Manufacturer's Design Guide and the appropriate standards documents. This is done in order to ensure adequate protection from Electro-Magnetic Interference (EMI) sources

and to ensure that all components and cables are in good condition after installation.

39 Copper cables shall be handled, installed, and supported as per the manufacturer's guidelines. During the laying of the cable, installer shall take care not to over stress the cable. After the cable is installed, installer shall make sure that all parts of the cable are supported properly and shall be stress free at both ends and throughout their length.

40 Appropriate attention shall be given to the handling of Category 5e copper and optical fibre cables to ensure that bending radius conforms to the manufacturer's requirements. At no time shall the cable's static or dynamic bending radius be exceeded.

41 All telecommunications outlet/connectors shall be securely mounted at all work area locations and shall be located so that the cable required to reach the work area equipment will be no more than 3 meters long.

42 All optical fibre and copper cables shall be handled, installed, and supported as per the manufacturer's guidelines. During the laying of the cable, installer shall take care not to over stress the cable. After the cable is installed, installer shall make sure that all parts of the cable are supported properly and shall be stress free at both ends and throughout their length.

43 Appropriate attention shall be given to the handling of Category 5e copper and optical fibre cables to ensure that bending radius conforms to the manufacturer's requirements. At no time shall the cable's static or dynamic bending radius be exceeded.

44 All telecommunications outlet/connectors shall be securely mounted at all work area locations and shall be located so that the cable required to reach the work area equipment will be no more than 3 meters long.

45 The total optical attenuation through the cross-connect from any terminated fibre to any other terminated fibre shall not exceed 2.0 dB.Optical fibre splices, fusion or mechanical, shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI/EIA/TIA-455-34.

46 Surface mount telecommunications outlets where indicated shall provide up to six telecommunications outlet/connectors.

47 A non-impact termination method using either a stuffer cap with pliers or fullcycle terminating tool having both tactile and audible feedback to indicate proper termination shall be used. High impact tools are not permitted.

48 Terminated conductor ends shall be properly trimmed to assure a minimum clearance of 0.250 in. between the conductors of adjacent modules.

49 Face plates shall be clean in appearance. Mounting hardware shall not be visible on the faceplate. If colour coded modules are employed, colors shall comply with the requirements of CAN/CSA 528.

50 The work area telecommunications outlet/connectors shall not be responsible for creating "resonance" on short cable runs as described 'in the Field Testing TSB 67 (Draft 13 section 7.8 Short Links/Channels). This problem is related to return loss and/or the balance of the link and can cause transmission errors.

51 Telecommunications outlet/connector shall require (or specifically not allow more than) only one single connection to horizontal cable as per TIA/EIA-568-B.

52 Flush mounted face plates shall accommodate modular telecommunications outlet/connectors and be available in four connectors per single gang telecommunications outlet.

53 All telecommunications outlets shall be made of high impact plastic.

54 The same modular telecommunications outlet/connectors as found in the flush and surface mount telecommunications outlets shall be installable in utility poles and modular furniture using manufacturer face plates or adapters for this purpose. Each telecommunications outlet shall house as many as three telecommunications outlet/connectors.

55 The eight position modular UTP telecommunications outlet/connector and its pin assignments shall meet the requirements described in the standard CAN/CSA-T529 as T568A.

56 Each telecommunications outlet shall be uniquely labelled. The label shall form an integral part of the faceplate.

7 WARRANTY

1 Provide written verification confirming that the testing and inspection has been completed and that all cable runs have passed. Also document that all defects have been identified, corrected, and retested successfully.

2 Contractor shall provide a 25 year Extended Product Warranty and System Assurance Warranty for this Structured Cabling System.

.1 Provide ”NORDX” IBDN certification, certifying that the cabling system is Installed In accordance to manufacturer's Category standards. The certification must include a minimum of 25 years application assurance warranty, which warranties that the installed cabling system Is compliant with standard current network applications and emerging technologies such as TPPMD, 100 Mbps Ethernet, Gigabit Ethernet, UTP based ATM and other 100 + Mbps applications.

END OF SECTION

CLOCK SYSTEM
27 53 13

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Conform to Section 26 01 01, Electrical General Requirements.

.2 Conform to Section 26 05 01, Electrical Basic Materials and Methods.

.3 Conform to Section 27 15 00, Communications Cabling.

1.2 REFERENCES

.1 Industry Canada specifications RSS 119 Issue 6.

.2 Bluetooth wireless technology standard 4.1.

1.3 WORK INCLUDED

.1 Work to be done under this Section includes furnishing of labour, materials, software and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

.2 Furnish and install all system devices, accessories, and materials in accordance with these specifications and drawings to provide a complete and operating Wireless Clock System using the Primex OneVue platform. The model designations are that of Primex.

.3 System to include the system devices below:

.1 Bridge with Ethernet/Power over Ethernet (PoE) technology and Bluetooth low energy wireless technology

.2 Repeater with Bluetooth low energy wireless technology

.3 **Digital Clocks with Bluetooth low energy wireless technology**

1.4 **1.4 SYSTEM DESCRIPTION**

.1 General Specifications

.1 System to provide synchronized time by way of system devices and a cloud-based system software hosted by the Manufacturer that allows Owner to manage and monitor system devices.

.2 System shall consist of system Bluetooth clocks enabled with Bluetooth low energy wireless technology.

.3 System to consist of system Bluetooth repeaters enabled with Bluetooth low energy wireless technology.

.4 System to consist of system Bridge devices with Ethernet/Power over Ethernet (PoE) and Bluetooth low energy wireless technology.

.5 System Bridge devices to be required to have a direct connection to the Owner's existing Ethernet/Power over Ethernet (PoE) network.

.6 System Bluetooth repeater devices to not be required to have a direct connection to the Owner's Ethernet/Power over Ethernet (PoE) network or 802.11 wireless network.

.7 System Bluetooth devices to form a system Bluetooth wireless network by way of the proprietary Bluetooth Network Protocol designed and developed by the Manufacturer, that allows system Bluetooth devices to form a Bluetooth wireless technology network to allow a communication path to send clock data to the system Bridge devices.

.8 System Bridge(s) to receive data from system Bluetooth clocks and repeater devices and send data to the system software. Bridge shall download settings from the system software and send settings to the system Bluetooth devices.

.9 System to not require the installation of any on-site system hardware or software, with the exception of the specified system devices.

.2 System Bluetooth wireless network

.1 System Bluetooth wireless network to be able to adjust and synchronize system Bluetooth clocks and repeater devices to specified Time Zone Offset and DST rules; time zone settings are managed within the system software and sent to the system Bluetooth clocks and repeater devices over the system Bluetooth wireless network.

.3 System Bridge

.1 Bridge to be equipped with Bluetooth enabled gateway; which allows the device to send and receive communication to and from system Bluetooth clocks and repeater devices.

.2 Bridge devices to connect to the Owner's existing wired Ethernet/PoE network to send its device data and system Bluetooth device data to the system software and download its device settings and clock settings from the system software.

.3 Bridge device to have a LCD screen that displays connection status, and indicate when in an error or alarm state.

.4 Bridge device shall have LED indicators, located on the front of the device, that provide a visual indicator of its current status and operating state.

.4 System Clocks enabled with Bluetooth (System Bluetooth clocks)

.1 Clocks to not require manual or direct configuration by an end user to establish a connection to a system Bluetooth wireless network, nor does an end user need to know about the intricacies of Bluetooth networking. The entire Bluetooth network infrastructure is transparent to the end user.

.2 Clocks to be equipped with a Bluetooth low energy wireless technology radio component; that allows system Bluetooth clocks to establish wireless Bluetooth connections to form a system Bluetooth wireless network. Each clock to be a node within the system Bluetooth wireless network.

.3 Clocks to form a wireless connection and communication path by way of the proprietary system Bluetooth Wireless Networking protocol designed and developed by the Manufacturer.

.4 Clocks to wake-up once a day, at a system defined time, to form and build a system Bluetooth wireless network; allowing each system clock to send and/or forward its status data to a Bridge and receive setting updates sent by a Bridge. Each clock connects to another Bluetooth clock or repeater based on the strongest

Bluetooth signal. The Bridge stores and sends clock status data to the system software once a day. When a Bridge is in 8-hour deployment mode, clock data is sent every 30 minutes to the system software.

.5 Clocks to not be required to be in plain line of sight or directly connected to a system Bridge device and shall act as independent nodes within the system Bluetooth wireless network.

.5 System Repeaters enabled with Bluetooth (System Bluetooth repeater devices)

.1 Repeaters to not require manual or direct configuration by an end user to establish a connection to a system Bluetooth wireless network, nor does an end user need to know about the intricacies of Bluetooth networking. The entire Bluetooth network infrastructure is transparent to the end user.

.2 Repeaters to be equipped with a Bluetooth low energy wireless technology radio component; that allows device to establish wireless Bluetooth connections to form a system Bluetooth wireless network. Each repeater to be a node within the system Bluetooth wireless network.

.3 Repeaters to form a wireless connection and communication path by way of the proprietary system Bluetooth Wireless Networking protocol designed and developed by the Manufacturer.

.4 Repeaters to wake-up once a day, at a system defined time, to form and build a system Bluetooth wireless network; allowing each system Bluetooth device to send and/or forward its status data to the Bridge and receive setting updates sent by the Bridge. Each repeater connects to another system Bluetooth device based on the strongest Bluetooth signal.

.6 System devices with Ethernet network communication

.1 Network Communication Protocols: Hypertext Transfer Protocol Secure (HTTPS) | IP Addressing: Dynamic Host Configuration Protocol (DHCP), static IP addressing | Data Packet Size: typically less than 5 kilobytes (kB).

.2 Network setting data is stored locally in devices shall be encrypted and access to locally stored setting data can be controlled by a system admin user.

.3 Manufacturer to provide stand-alone configuration software to locally configure a device to meet Owner security policies if network setting data cannot be stored in third-party software or to troubleshoot device network connectivity issues.

1.5 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit samples and cut sheets of clocks for review and selection of the desired types and styles. Samples to be equivalent to the specified types and styles.

.2 Provide one additional set of reviewed drawings, shipped with the equipment, for start up and maintenance use.

.3 Include with the shop drawings;

.1 description of system operation,

.2 riser diagrams.

1.6 OPERATION AND MAINTENANCE DATA

.1 Include detailed instructions to permit effective operation and maintenance of the equipment.

.2 Technical data to be included;

.1 Setup and operation instructions,

.2 Cut sheets with specification for each component used in the system,

.3 List of spare parts included with the system,

.4 Illustrated parts lists with part catalogue numbers,

.5 “as built” layout, wiring and installation diagrams.

PART - 2 PRODUCTS

2.1 WIRELESS SYNCHRONOUS CLOCK SYSTEM

.1 General

.1 The system and equipment is specified as described in this section.

.2 All bids to be based on the equipment as specified herein. The model designations are that of Primex.

.2 System Software:

.1 Basis of Design Software Product: Primex OneVue Wireless Clock System.

.2 System Software Platform: Cloud-based software platform that resides on Amazon Web Services (AWS) and is accessed via the internet.

.3 System stores and monitors system devices operating conditions.

.4 All system device and system settings are managed within the system software.

.3 Digital Clocks:

.1 **The clock LED display must include a 12- or 24-hour time display, a seconds display, a PM indicator light, and an alternating time and date display option.**

.2 Clock to be capable of automatically adjusting for Daylight Saving Time.

.3 AC 24 VAC (18-28) models, with Bluetooth wireless technology, to include a 10” (25 cm) cord with pigtail.

.4 Clock to be viewable from 30 m.

.5 Clock to have highly visible 7-segment LED digits.

.6 Clock to have display dimmer options, including 100%, 75%, 50%, and 25%.

.7 Additional LED colors, sizes, digit layouts, mounts, and timer options are available from the Manufacturer.

.8 Supply Model: Digital Clock

a) Flush Mount 2.5” Digits

- **Technology: Bluetooth low energy wireless technology**
- **Number of Digits: 6 Digit**
- **Digit Colour: Green**

.4 Bridge

.1 Enclosure: ABS plastic | Dimension: 4.7" H x 3.7" W x 1.3" D (11.93cm x 9.39cm x 3.30cm) | Weight: 0.3 lb (136 gram) with 2 AA batteries.

.2 Display: Liquid crystal display (LCD), dimension: 0.75 in. H x 1.38 in. W (1.90 cm x 3.50 cm) | LED Status Indicator: green, yellow, red.

.3 Mounting: Keyhole slot with lock down screw holes in back panel for wall mount; or surface mount with supplied dual-lock adhesive mounting strips.

.4 Configuration: configured from system software or locally at device with supplied device configuration software

.5 Backup Battery-power: 3.0v Primex Lithium/Iron Disulfide Battery Pack or two stand-alone 1.5v Lithium AA batteries. Use of alkaline batteries is not recommended.

.6 Local memory storage capacity: configuration data for up to 1400 Bluetooth clocks.

.7 Environment: Operating Temperature: 32 °F to 122 °F (0 °C to 50 °C), indoor use only | Storage Temperature: -4 °F to 140 °F (-20 °C to 60 °C).

.8 AC-power: 5V DC USB Mini B (5 pin) connector interface, 5 feet (1.5 meter) cable, Input: 100-240 VAC, 50/60 Hz, 0.4A, Output: 5V DC, 1.0A max.

.9 Supply Model: Bridge

a) Technology: Ethernet (PoE) Technology

b) Power: Power over Ethernet (PoE)

.5 Repeater

.1 Enclosure: ABS plastic | Dimension: 4.7" H x 3.7" W x 1.3" D (11.93cm x 9.39cm x 3.30cm) | Weight: 0.3 lb (136 gram) with 2 AA batteries.

.2 Mounting: Keyhole slot with lock down screw holes in back panel for wall mount; or surface mount with supplied dual-lock adhesive mounting strips.

.3 Battery-power: 2 DD batteries; typical five (5) year battery life.

.4 Environment: Operating Temperature: 32 °F to 122 °F (0 °C to 50 °C), indoor use only | Storage Temperature: -4 °F to 140 °F (-20 °C to 60 °C).

.5 Supply Model: Repeater

a) Technology: Bluetooth low energy wireless technology

b) Optional AC power accessory: 5V DC USB Mini B (5 pin) connector interface, 5 feet (1.5 meter) cable, Input: 100-240 VAC, 50/60 Hz, 0.4A, Output: 5V DC, 1.0A max.

.6 System Verification

.1 Test and demonstrate the operation of the complete system to the Owner, including:

a) test and demonstration of overall system operation,

b) test and demonstration of each operable device,

.2 On completion of the installation, manufacturer/supplier to supply documentation including:

a) record sheets showing the location of each device,

b) record sheets showing the test results for each device,

c) a certificate confirming that the system is installed and operates in accordance with the Specifications and the Manufacturer’s

recommendations.

Standard of Acceptance
Primex OneVue
Supplied by:
Dave Wipp
Manager – Systems Products
Troy Life & Fire Safety Ltd.
555 Wentworth Street East, Unit 7
Oshawa, Ont. L1H 3V8
T: 905 725 5553 ext 225 (Oshawa)
F: 905-725-4294 (Oshawa)
E: dave.wipp@troylfs.com

PART - 3 EXECUTION

3.1 GENERAL

.1 Install the clock system in accordance with the clock system manufacturer's recommendations.

3.2 WIRELESS SYNCHRONOUS CLOCK SYSTEM

.1 System manufacturer to determine optimal locations for transmitters on site and include for the relocation of transmitters and associated equipment as required for correct system operation.

.2 Co-ordinate the location of a network drop to suit the bridge/repeater location(s).

.3 Connect the bridge/repeater to the network drop using a Cat 6 cable.

3.3 CLOCKS:

.1 Do not install clocks until painting and other finish work in each room is complete.

.2 Locate clocks 450 mm (18 in) below finished ceiling unless indicated otherwise.

.3 Provide a deep recessed receptacle at each clock.

.4 Provide new batteries in battery powered clocks.

.5 Set clocks to correct time, time zone, Standard/Daylight Savings Time and date.

.6 Adjust the display brightness of each digital and combination clock to suit both daytime and nighttime illumination levels, to the satisfaction of the Owner. Provide each combination clock with a control reset station.

.7 Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by clock manufacturer.

3.4 WIRING

.1 Provide wiring as required for a complete, fully operating system.

.2 Provide wiring in accordance with the recommendations of the clock system manufacturer.

.3 Install wiring in conduit.

3.5 **TESTING**

.1 Conduct complete testing of the system to verify:

.1 operation during loss of power,

.2 operation on generator power,

.3 ability to correct secondary clocks,

.4 ability to restore correct time following loss and restoration of power,

.5 Daylight Saving Time adjustment,

.6 time zone adjustment.

.2 Submit a written report, identifying the results of the above tests and certifying that the system has been installed correctly and is functioning correctly.

.3 Assist the manufacturer in conducting the manufacturer's verification of the system. Submit a written report, prepared by the system manufacturer, identifying the verification results and certifying that the system has been installed in accordance with the manufacturer's recommendations.

3.6 **TRAINING**

.1 Provide the Owner's staff with complete training in the operation and maintenance of the system and it's components. Allow for two separate (repeat) sessions so that all of the Owner's facility personnel can attend.

END OF SECTION

3RD PARTY FIRE ALARM VERIFICATION
28 08 15

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 05 01, Electrical General Requirements.

1.2 WORK INCLUDED

.1 The Division 26 contractor shall retain and pay for the services of an Independent 3rd Party Fire Alarm Verification Specialist Firm to provide Fire Alarm and Emergency Voice and Communications System Inspection and Verification services in accordance with the details specified herein. This does not eliminate the requirement for the Fire Alarm System manufacturer to perform testing and verification as part of their scope of work as indicated in Section 28 31 19 - Addressable Fire Alarm System.

.2 The Division 26 Contractor shall include in the Bid Amount the cost for the services of tradesmen to handle equipment, make temporary connections, operate equipment and make repairs and adjustments and assist the verification organization's on-site specialists during the on-site inspection, testing, and verification phase of the work.

.3 The Bidders for Division 26 work shall advise all fire alarm equipment suppliers bidding for the equipment supply for this project prior to Bid close of the requirement for comprehensive 3rd party verification and ensure the services and associated costs on the part of the fire alarm equipment supplier are included in the suppliers' quotations for the project and in the Division 26 bid amount.

.4 The Owner Fire Prevention Coordinator will also be involved to witness Verification. Contractor to co-ordinate with Owner.

1.3 GENERAL SCOPE

.1 Witness and provide 3rd party verification of the Fire Alarm, Emergency Voice Communication System, and submit completed typed copies of inspection record sheets as described herein. Ensure that the complete system is left fully functioning.

.2 Provide adequate qualified technicians to witness the complete system verification being performed under the Div 16 contract in accordance with the Division 26 contractor's schedule. Provide any necessary equipment, test apparatus, ladders and scaffolding as required.

.3 The Fire Alarm & Emergency Voice Communication System supplier will undertake testing and verification of their system in accordance with applicable standards and the Authorities Having Jurisdiction over the project.

1.4 VERIFICATION REPORTS

.1 Submit verification reports in accordance with Section 26 05 01 Electrical General Requirements.

1.5 **ACCEPTABLE AGENCIES FOR INDEPENDENT 3RD PARTY WITNESS OF TESTING AND VERIFICATION.**

.1 The firm selected for the independent 3rd party witnessing of the testing and verification of the Fire Alarm, Emergency Voice Communication System shall be suitably recognized by the Professional Engineers of Ontario. Completed copies of reports shall be submitted directly to the Consultant as well as part of the requirements for shop drawings/data books

.2 The independent agency shall act as an independent witness on behalf of the Owner of the complete testing and verification of the fire alarm system.

Standard of Acceptance
- Insta Tech (416 565-6762)

PART - 2 SCOPE OF WORK

2.1 **GENERAL**

.1 System verification shall be in accordance with the current CAN/ULC-S537" Standard for the Verification of Fire Alarm System". On completion of the verification, the witnessing agency shall submit directly to the Owner one signed certificate together with detailed inspection record sheets outlining location of each system, item, device and certification of the test results per unit. The certificate must clearly confirm that the system is installed, supervised and operates in accordance with the Project Specification and applicable Codes and Regulations.

2.2 **SYSTEM VERIFICATION**

.1 Make a detailed inspection of all components installed for the Fire Alarm, Emergency Voice Communication System to ensure the following:

.1 The completed installation is in accordance with:

(a) Project Specification and Drawings

(b) ULC requirements

(c) Manufacturer's recommendations and guidelines

.2 Wiring has been inspected at each device and that wire type, gauge and colour coding are in accordance with the Project Specification.

.3 Each manual pullstation, thermal detector, smoke detector, sprinkler flow switch, sprinkler supervisory switch and signalling device are in compliance with the ULC Standards, and that the installation details are in accordance with CAN/ULC-S524.

(a) each and every device has been inspected for apparent damage which may interfere with its operation

(b) every device has been tested for alarm situation and trouble initiation and circuit polarity

(c) the emergency firefighter's telephones have been tested and that two-way voice communication is clear and audible, and that indications at Communication Centre and applicable local control panels are correct.

(d) adjacent EVAC speakers have been connected to alternate circuits and that speakers are properly zoned.

(e) each zone has been tested for remote bypass "Activation" and "Restoration" from the fire alarm video terminal in the power plant.

.4 The most remote device on each circuit receives operating power. Also confirm that replaceable over-current protection devices are inspected for proper rating. Where new devices (i.e. door holders, magnetic locks, fan shutdown relay, EVAC speakers) are added to the circuit, ammeter load readings are taken and recorded for that circuit.

.5 Non-damaging tests shall be applied to all the new smoke detector(s) and rate of rise heat detector(s) to activate an alarm in the Communication Centre. In the event that new smoke detectors, heat detectors or pullstations are added to an existing zone, apply simulated test to one randomly-picked existing device in the same zone. Verify printout of the alarm on the Video terminal printer.

.6 Each alarm and trouble initiating device properly activates the Fire Alarm System such that the Communication Centre and all Annunciator Panels indicate the Zone(s) and the building from which the alarm or trouble originated. The zone description shall match the assigned zoning schedule.

PART - 3 EXECUTION

3.1 REPORTS

.1 Prepare and submit the following reports. Simultaneously submit one copy directly to the engineer and a further 6 copies to the contractor to be processed as a shop drawing:

.1 Site Verification Report for each area requiring partial occupancy within 5 working days of completion of site test.

.2 Site verification report(s) reflecting each significant phase of system completion.

.2 Complete and submit in binder form 6 copies of detailed inspection sheets including Appendix "C", Items "C1", "C2", "C3", "C4", "C5", "C6" and "C7" of the CAN/ULC-S537-97 Standard. In lieu of the ULC Appendix "C", the Verification Agent's own Standard forms, together with the completed Fire Alarm and Voice communication System Verification Report Summary will be accepted if in a comparable format. Information must be clearly defined and legible.

.3 Completed reports shall also be included as part of the project maintenance manuals / data books.

END OF SECTION

ACCESS CONTROL SYSTEM
28 23 10

PART - 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Electrical General Requirements.

.3 Materials and equipment described in each Section of the Specification are designed to establish standards of construction and workmanship.

.1 Where manufacturers or manufacturers products are identified in lists with phrase "Standard of Acceptance", these are manufacturers and/or products which meet standards with regard to performance, quality of material and workmanship

.2 Manufacturers and or products used are to be chosen from these lists.

.3 Where the Specification states “to match existing Hospital Standards” it is mandatory that the existing Standard be maintained and that the product must be as manufactured the identified manufacturer and must be the product identified. Quality Assurance.

1.2 WORK INCLUDED

.1 The Access Control, Security Systems involved in this project are as follows:

- Key-Scan System serving the Hospital Campus

.2 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete Access Control, Security Systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

.3 Provide equipment, wiring and other materials for a complete and operational Access Control, Security System. The system shall be modular and expandable as herein specified or as the Owner may direct up to full system capacity.

.4 The system shall consist of state-of-the-art controls.

.5 Provide low voltage power supplies where required.

.6 Provide all required mounting hardware and brackets.

.7 Provide suitable low voltage power and connect signal wiring to suit manufacturers’ recommendations.

.8 Provide and test for proper operation.

1.3 “KEY-SCAN” ACCESS CONTROL, SECURITY SYSTEM SUPPLIER

.1 The “Key-Scan” Access Control, Security System, to serve the new areas, shall be supplied, installed and commissioned by the following approved Security Contractor acting as a Sub Contractor to this Division. The approved Security Sub Contractor shall be:

Authen-Tech Security Integration
Attn: Lawrence Dorsey

Phone: 905-492-4282/ 647-880-4828
email: lawrence.authen-tech@rogers.com

1.4 **QUALITY ASSURANCE**

.1 The Access Control, Security Systems shall be designed in accordance with and conform to the requirements of:

.1 Canadian Standards Association (CSA)

.2 Electrical Safety Code

1.5 **SUBMITTALS: SUBMITTALS SHALL BE OF ADEQUATE DEPTH TO DEFINE FULLY THE SYSTEM OFFERED.**

.1 Shop Drawings: Submit complete sets of shop drawings following award of order. Shop drawings shall include copies of dimensional drawings completely describing installation that will be performed with relation to the space available for installation.

.2 Manufacturer's Data: Submit data in the form of catalogue cuts or special data sheets as prepared by the manufacturer.

.3 Maintenance Data: Submit copies of parts, lists and preventive maintenance requirements for systems to be installed.

.4 Training Data: Submit copies of the proposed employee training plan and documentation for the system.

1.6 **PRODUCT INSTALLATION AND HANDLING**

.1 Before and during installation care must be exercised to prevent damage to the sensitive parts and components of the system and be responsible for the storage and handling of all components until acceptance of the completed installation.

1.7 **WARRANTY:**

.1 Systems shall include a five (5) year warranty on parts forming part of this installation and a two (2) year warranty on labour. Any required system repairs which occur between the date of acceptance by the owners and the one year anniversary shall be provided without cost.

.2 Parts required to facilitate repairs in year two (2) through year five (5) shall be provided to the facility without cost.

.3 The necessary labour required to troubleshoot and remedy system problems which occur in years three (3) through year five (5) will be chargeable to the facility at a reasonable hourly rate.

.4 The supplier shall maintain a service department, necessary spare parts, after hours telephone answering services and call dispatching services required to implement the service standard stated below as part of this contract.

1.8 **1.8 SYSTEM VERIFICATION**

.1 Test and demonstrate the operation of the complete system to the Owner. This shall include, but not be limited to:

a) detailed test and demonstration of each operable device

b) detailed test and demonstration of overall system operation

c) interfacing of various components.

.2 On completion of the installation the manufacturer/supplier shall supply, to the Consultant and Commissioning Agent, a certificate, together with detailed inspection record sheets showing location of each device and certifying the test results per unit, confirming that the system is installed and operates in accordance with Specification.

1.9 **SCOPE, "KEY-SCAN" SYSTEM**

.1 The "Key-Scan" Access Control, Security System installation required for this installation incorporates:

.1 Card Readers to control entry to doors indicated

.2 Electric Strikes and Power Supplies

.3 Request to Exit Devices

.4 Magnetic locks including Magnetic Lock Permits

.5 Door alarm contacts for connection to Central Security System

.6 local power supplies as required

.7 Wire, conduit and connections to card reader, door alarms, electric strike, magnetic locks on doors and power supplies to controlled doors.

.8 Connection to Hospital Network System for connection to Central Security System

.9 Integration between the Security System and the CCTV System.

1.10 **THE ACCESS CONTROL SYSTEMS SHALL BE USED TO PROVIDE:**

.1 Access control to the protected doors

.2 Whenever a card is read by a card reader/ key-reader, the reader shall check for valid entry in the following manner:

.1 The card must be authorized.

.2 The priority/access level must match that of the card reader

.3 The time must fall within the access schedule for the card reader

.3 The information from the card reader shall include provision for transmission the Central Security Computer which shall (activate or deactivate by operator's command) display related information such as card number, employee name, department, reader number, time and date on the card access CRT display terminal. Alarm messages and transactions from assignable readers shall be displayed on the card access CRT display terminal and a hard copy printout initiated on the appropriate printer.

.4 If the card is valid, the electric locking devices shall be bypassed for a preset time. The preset bypass time will vary for each access controlled door which will be determined on site.

.5 Exit through card access doors shall be by free-exit through motion sensor.

.6 If the door is held open longer than the preset time, the door monitoring switch shall initiate an alarm to the Security Computer

.7 All invalid or unauthorized access attempts or alarm conditions shall initiate an alarm to the future Security Computer.

.8 All information shall be stored in disk form with the ability to retrieve information on a day, time, card number, employee name or reader number when requested by operator's command.

PART - 2 PRODUCTS

2.1 DOOR MONITORING:

.1 All doors as indicated on the Drawings shall be monitored

.2 Each door shall be capable of being monitored in one of three modes:

.1 Free access

.2 Secure

.3 Schedule controlled free access

.3 Selected (manual override) doors in the building to be manually controlled from the security office. Activation of associated code on the security terminal keyboard will release locking devices and by pass monitor switch.

.4 Activation of the fire alarm system or power failure shall cause the electro-magnetic locks on exit doors to release. Provide the necessary interconnection with the fire alarm system for system operation.

.5 The release shall be of the failsafe type ensuring unlocking of doors for any malfunction of the security system or if the fire alarm system alarms. The arrangement shall be on the approval of the local authorities having jurisdiction

2.2 "KEY-SCAN" INTELLIGENT PROXIMITY CARD READERS INCLUDING:

.1 Fully compatible with cards produced by the Hospital's "IdentiCam" photo card system.

.2 LCD back-lighted with EL lamp

.3 Each door shall be considered a separate security alarm point or zone.

.4 System shall include dry contacts for remote alarms.

2.3 SECURITY SYSTEM COMPUTER SOFTWARE:

.1 System must be compatible with existing photo imaging system "Identicam".

.2 Software must have ability to be integrated with the CCTV System.

.3 Computerized software shall monitor new doors or zones.

.4 The security system shall up-date/ provide any required automatic display of colour floor plan maps of the building (showing area in alarm) on the graphic CRT display terminal screen.

.5 An alarm condition shall be displayed on the graphics by a colour code change and the flashing of the standard symbol used to highlight the location of the device which initiated an alarm and identifying the current status of the device.

.6 Each time a map is displayed, the system shall determine and display the status of the monitored points represented in the map. The system shall be provided with all software and hardware required for an operator to create and maintain maps.

.7 The colour graphics display shall identify input circuit conditions such as circuit secure, circuit in alarm, circuit in trouble and circuit manually shunted (ie. difference colour codes).Create maps, with necessary active points including building or area outlines, symbols, stairs, elevators, corridors for areas in which security devices are shown. Mapping data base to be programmed by cursor or other approved method and have the capability of printing maps. Include all menus, charts, and symbols required for total system outline and hardware required to produce the graphics to the Consultant's approval.

2.4 **TAMPER OPERATION:**

.1 Tamper switches shall be provided on all control and equipment cabinets such as card reader controllers. Tamper switches shall include provision for future connection to Security System.

2.5 **SUBMITTALS AND INSTRUCTION:**

.1 The following data shall be forwarded upon award of Contract:

.1 cable schematic showing card reader controllers, alarm terminals, card readers, power supply locations and all other devices and associated wiring and power

.2 Technical specification data sheets of each system component and device.

.2 Provide complete system documentation at acceptance time, as specified herein.

2.6 **READER CONTROLLERS:**

.1 Controllers to be solid state microprocessor based and shall support and communicate with card readers employing a LCD display. The unit shall grant or deny access while including independent reporting system activity back to the CPU for report generation or alarm initiation.

.2 Provide battery backup for unit.

.3 Provide tamper switch alarmed to security console.

.4 The controller shall be capable of operating, connecting and communicating with proximity type readers

2.7 **REMOTE ALARM TERMINALS:**

.1 Provide wall mounted remote data terminals to be microprocessor based housing circuit modules capable of monitoring and connecting to alarm inputs of zones (ie. door monitor, switches, etc.) as required, power supply unit and standby battery.

.2 The terminal shall have LED indicators for AC power, alarm and trouble. The unit shall contain automatic self-checking program for processor and memory with self-diagnostics.

.3 Each remote terminal shall be loaded to 85% of its capacity with the field zone/point circuits. The remaining 15% capacity of circuit modules shall be used for future connections.

.4 Remote terminals shall have a key locked cabinet with tamper switch alarm to the security terminal if located outside of terminal cabinets.

.5 Unit to be fed from the nearest emergency power source at 120 V.A.C.

2.8 **POWER SUPPLIES:**

.1 Provide all necessary power supplies, 24 volt AC and/or DC including transformer and/or rectifiers required for operation of the system.120 volt AC power circuits will be connected from the nearest emergency power panel.

.2 Provide battery back-up to prevent loss of memory and loss of power. UPS system shall be retained for a power outage for a minimum of two (2) hours.

.3 Power supplies shall be in a separate enclosure, secured with a key lock.

2.9 **SYSTEM DEVICES:**

.1 "Key-Scan" Card Readers

.1 Provide flush mounted card readers. The card reader shall detect the code information on the card and shall include provision to transmit the information to the "Key-Scan" Central Security System.

.2 Card reader shall include an "EL" indicator lamp.

.3 The response time shall be within .5 seconds. The reader shall be mounted to any non-metal surface.

.4 Power to the reader and data cables shall be connected to the associated card reader controller.

.5 The reader shall be vandal-proof, dirt-proof, weatherproof and shock-resistant.

.6 Provide a backbox for mounting of card reader.

2.10 **CONNECTION TO ELECTRIC DOOR HARDWARE:**

.1 For doors with electric strikes, electric magnetic locks or electric locking devices provide all connections to electric door hardware at a voltage to suit hardware for proper operation.

.2 Provide transformers and rectifiers for the necessary power supplies (24 volts AC or DC) and sized as required to suit hardware equipment supplied.

.3 Coordinate with all suppliers of other equipment connected to security system.

.4 Conduit and wiring will be provided by the Electrical Contractor as specified by the security (card access) system manufacturer.

.5 The Security System Installer shall provide all door hardware (electric strikes, door monitoring contacts, motion exit device, power supplies etc.) that are to be installed on existing doors.

2.11 **DOOR MONITORING SWITCHES:**

.1 Door monitoring switches (ie. magnetic contacts) shall be provided.

.2 Provide the necessary points, wiring, conduits, boxes, and connections to the door monitoring switches for proper operation. Coordinate connections and installation with the door hardware contractor.

2.12 **MISCELLANEOUS REQUIREMENTS**

.1 Include in the Contract the cost of a qualified technician to test and verify the system and correct all wiring and installation faults. Test and demonstrate the operation of the system to the Owner. This shall include, but not be limited to a detailed test and demonstration of each operable device and a detailed test and demonstration of overall system operation.

.2 On completion of the installation the manufacturer/supplier shall supply a certificate, together with detailed inspection record sheets showing location of each device and certifying the test results per unit, confirming that the system is installed and operates in accordance with Specification.

.3 Provide all back boxes and plates, all wire and cable, complete with terminations if necessary and multi-prong female fittings for the complete installation of the intercom stations in the locations shown.

PART - 3 EXECUTION

.1 Provide “Key-Scan” Access Control, Security Systems as shown on Drawings and as specified.

.2 Install all equipment in accordance with the manufacturer's instructions.

.3 Readers shall be installed at least 6" away from metal surfaces.

.4 Readers to be mounted at 47" above finished floor.

.5 The manufacturer/supplier it to assist the Contractor in the installation and provide technical expertise required. Make final connections.

.6 Adjust system components as necessary to ensure complete system operation.

3.2 **WIRING**

.1 All wiring to be installed in conduit.

.2 All wiring to be in accordance with manufacturer's recommendations.

.3 All card access cables to be adequately shielded and are not to be run with power cables in same conduit.

3.3 **SECURITY SYSTEM - WARRANTY, MAINTENANCE, TESTING AND CERTIFICATION**

.1 Provide Warranty and Training as specified.

.2 Test all components of the system for proper operation as indicated in Specification.

.3 Acceptance procedures shall be in accordance with General Requirements and the following:

.1 Written certification shall be provided, on completion of a thoroughly tested installation, that the system has been pre-tested and is ready for acceptance testing. Written certification shall consist of a check list of operating features has been pre-tested and is functioning satisfactorily.

END OF SECTION

FIRE ALARM SYSTEM
28 31 13

PART - 1 GENERAL

1.1 GENERAL

.1 Conform with the requirements of Section 26 05 01 Basic Electrical Requirements.

1.2 PROGRAMMING CHANGES

.1 Include in the Bid Price for all programming changes required for the duration of the project and as required to obtain final acceptance by the Fire and Building Departments.

.2 Include in the Bid Price for all costs associated with Up-dating the existing Fire Alarm System Computer Floor Plan Graphics as required by the changes created by this renovation.

.3 Provide audibility testing of sound levels in each and every room and ensure Code required minimum levels are maintained. Adjust speaker transformer “taps” to ensure minimum/ maximum sound levels are maintained. Provide, in the final Verification Report, an indication of the exact sound pressure levels in each room.

.4 Care shall be taken when placing detectors to ensure that they are not in the direct air stream of a supply air diffuser. However, the preferred location of a smoke detector within any one bay would be in the air stream of a return air diffuser. Ensure smoke detectors are a minimum of 5'-0" from any supply air diffuser.

1.3 RELATED WORK

.1 Sprinkler systems: Section 21 13 13 Wet Pipe Sprinkler Systems

.2 Wiring: Section 26 05 19 Wires & Cables 0-1000 Volts

.3 Conduits: Section 26 05 33 Conduits Fastenings and Fittings

.4 Access Control System: Section 28 23 10 Access Control System

1.4 REFERENCES - CURRENT EDITION OF

.1 CAN/ULC-S524 Installation of Fire Alarm Systems

.2 ULC-S525 Audible Signal Appliances

.3 CAN/ULC-S527 Control Units

.4 CAN/ULC-S528 Manual Pull Stations

.5 CAN/ULC-S529 Smoke Detectors

.6 CAN/ULC-S530 Heat Actuated Fire Detectors

.7 CAN/ULC-S536 Inspection and Testing of Fire Alarm Systems

.8 CAN/ULC-S537 Verification of Fire Alarm Systems

.9 CAN/ULC-S548 Alarm Initiating and Supervisory Devices for Water Type Extinguishing Systems

.10 CAN/ULC–S533 Egress Door Securing and Releasing Devices

.11 CAN/ULC–S542 Speakers for Fire Alarm Systems

.12 CAN/ULC-S526 Visual Signal Appliances

1.5 **REQUIREMENTS REGULATORY AGENCIES**

.1 System

.1 Ontario Building Code

.2 System components: listed by ULC and CSA and complying with applicable provisions of Ontario Building Code, and meeting requirements of local authority having jurisdiction.

1.6 **SHOP DRAWINGS**

.1 Submit shop drawings in accordance with Section 26 05 01- Electrical General Requirements.

.2 Include:

.1 Details for devices.

.2 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.

.3 Battery capacity calculation.

.3 The Contractor in co-operation with the supplier of the system shall prepare a detailed riser diagram of the complete system showing all major components, devices and necessary interconnecting wiring.

.1 Diagram is to indicate wiring quantities, sizes and colour code and to indicate conduit sizes.

.2 Riser Diagram is to be produced on AutoCad and is to be submitted as a Shop Drawing.

.3 Riser Diagram is to be revised 'As-Built' at the completion of the project and submitted with Maintenance Manuals (submit both a copy of the Drawing and an AutoCad disc).

1.7 **OPERATION AND MAINTENANCE DATA**

.1 Provide operation and maintenance data for fire alarm system for incorporation into manual specified in Section 26 05 01 - Electrical General Requirements.

.2 Include:

.1 Instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.

.4 Copy of verification certificate, verification report and warranty certificates such as for fire alarm system, batteries, ancillary devices, and other similar items, including battery suppliers date coding for batteries.

1.8 **MAINTENANCE MATERIALS**

.1 Provide maintenance materials in accordance with Section 26 05 01 - Electrical General Requirements.

1.9 **TRAINING**

.1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

1.10 **WORK INCLUDED:**

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete Fire Alarm System as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

.2 Supply and install an expansion to the existing complete and operating two stage, zoned, fully supervised Fire Alarm System as shown, as specified and as otherwise required.

1.11 **DESCRIPTION OF SYSTEM**

.1 There exists a two stage, zoned complete and operating Fire Alarm System as supplied by Chubb Edwards. Scope of this renovation requires:

.1 Any expansion, modifications to the existing System to incorporate the revised/ added functions shown on the Drawings including:

.1 adding new detection, alarm sounding devices, strobe lights

.2 adding new Sprinkler and Pre-Action Sprinkler System alarm and supervisory Zones in the renovated as shown on the Drawings

.2 Provide new Trouble signal devices, Power supply facilities, Manual alarm stations, Automatic alarm initiating devices, connection to sprinkler system flow devices, connection to supervised valves (trouble signal only), Door release for doors with hold-open devices or magnetic locks, Audible signal devices, End-of-line devices, Visual alarm signal devices, Ancillary devices, Door release for doors with hold-open devices or magnetic locks, Fan shutdown,

.2 Additional Requirements

.1 Necessary circuitry for operation of supervised valves and loss of power alarms for sprinkler system and auxiliary booster or special service pumps.

.2 Smoke detectors installed in Operating Rooms shall be Photoelectric/thermal combination with contact to drive the over the door dome light.

.3 The smoke detectors in corridors shall be of equal numbers of ionization and photoelectric and alternated along the corridor or be combination type detectors.

1.12 **SYSTEM OPERATION**

.1 It is the intent to maintain the operation of the existing Fire Alarm System

1.13 **SPARE COMPONENTS**

.1 Include in the Bid the following additional components including installation (include an average of 20'0" of wire in conduit for each additional device and connection to an adjacent zone/ circuit). Assume, for bidding purposes, that these devices can be added at any time during construction including at the end of the construction and in any location as directed on site. Any devices not installed shall be turned over to the Hospital:

2 (two) addressable smoke detectors
2 (two) speakers
2 (two) addressable pull stations
2 (two) strobe lights

.2 Verification and any programming required by the installation of these components shall be included.

PART - 2 PRODUCTS

2.1 **INPUT (ALARM INITIATING) CIRCUITS**

.1 Provide alarm receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors, and water flow switches as indicated on schedules.

.2 Alarm receiving circuits shall be wired in a Class B, 2 wire configuration.

.3 All alarm receiving circuits shall be supervised for open, short or ground fault conditions by the use of an end of line resistor.

2.2 **OUTPUT ALARM CIRCUITS**

.1 Provide alarm output circuits for polarized audible signals such as speakers, horns and visual indicators as indicated.

.2 Provide necessary amplifiers and tone generator modules for electronic audible alarm devices as required.

.3 Alarm output circuits shall be wired in a class B, 2 wire configuration.

.4 All alarm output circuits shall be supervised for open, short or ground fault conditions by the use of an end of line resistor.

2.3 **AUXILIARY CIRCUITS**

.1 Provide contacts for fan shut-down as indicated. They shall be of normally closed type. Fan bypass switches shall be provided for each group of fans as indicated and coordinated on site.

.2 Provide contacts for pressurization system fans. They shall be arranged to start up the fans and shall be of normally closed type. By-pass switch shall be provided as indicated.

.3 Provide contacts for magnetic door locks and holders. They shall be arranged to release the doors upon actuation of fire alarm system. By-pass switches shall be provided to prevent doors from being released during test of fire alarm system.

.4 Provide contacts for smoke vents as indicated. They shall be of the normally closed type and shall release all smoke dampers upon actuation of fire alarm system. By-pass switches shall be provided indicated.

.5 Provide auxiliary contacts with 120 V AC/24 V DC, 2.5 A @ 0.5 power factor rating.

2.4 **VOICE COMMUNICATION CIRCUITS**

.1 Provide communication circuits for the 5th & 7th Floors as required

.2 All communication circuits shall be supervised for open, short or ground fault conditions.

.3 Amplifiers shall be solid state type compatible with the existing System

.4 Provide for interconnection to operate the system as specified.

2.5 **POWER SUPPLY**

.1 Provide an internal integrated power supplies, including surge suppression and circuitry for the System operation as required.

2.6 **MANUAL FIRE ALARM STATIONS**

.1 Manual pull stations shall be metal construction, open circuit, pull lever type and finished in red enamel. They shall be mounted in a 101 mm (4 in) square recessed box with plaster ring in finished areas and surface mounted in unfinished areas.

.2 Manual stations shall be suitable for insertion of an evacuation key.

.3 Each pull station shall be provided with an additional auxiliary contact(s) to allow direct connection to future magnetic locks {and for two stage operation}.

2.7 **AUTOMATIC FIRE ALARM DETECTORS (HEAT DETECTORS)**

.1 Automatic detectors shall be of the following types:

.1 57.2°C (135□F), fixed temperature and -9.4°C (15□F) per minute, rate of rise

.2 93.3°C (200□F), fixed temperature only

.2 Detectors shall have suitable mounting plates with finish ring.

2.8 **END OF LINE RESISTORS**

.1 Where Class B wiring is specified or permitted, the end of line resistors shall be located in outlet box with stainless steel cover plate.

2.9 **IONIZATION SMOKE DETECTORS**

.1 Ionization type smoke detectors shall be constructed of solid state components and operate on ionization principle to detect visible and/or invisible products of combustion.

.2 It shall be possible to check and change sensitivity of detectors. Smoke detectors shall be set for approved sensitivity.

.3 Detectors shall be ULC listed.

.4 Incorporate an LED or lamp latched circuit to indicate the signal operation of the unit.

.5 Smoke detectors shall operate on 24 volts DC and be protected against electrical transients and electromagnetic interference.

.6 Detectors shall be equipped with NO/NC contacts to operate ancillary devices where applicable.

.7 Detectors shall be equipped with a fine mesh bug screen to prevent contamination of the detection chamber by insects.

.8 The detector shall be a plug-in/twist lock unit which may be removed from its base with a special installation tool without disconnecting detector wiring.

.9 The detector shall filter out false alarms caused by intermittent aerosols or cigarette/pipe tobacco smoke.

.10 Recessed smoke detector shall be complete with necessary shroud and flush mounting hardware.

.11 Protect automatic smoke detectors during construction with a dust-bag, which shall be removed at the time of verification.

2.10 **PHOTOELECTRIC SMOKE DETECTORS**

.1 Photoelectric smoke detectors shall operate on the photoelectric (light scattering) principle of operation and be activated by visible or invisible products of combustion. Detectors shall be constructed of solid state components with the infrared light source for the photoelectric sensor emitted from a semiconductor diode.

.2 Detectors shall be ULC listed.

.3 Incorporate an LED or lamp latched circuit to indicate the signal operation of the unit.

.4 Smoke detectors shall operate on 24 volts DC and be protected against electrical transients and electromagnetic interference.

.5 Detectors shall be equipped with NO/NC contacts to operate ancillary devices where applicable.

.6 Detectors shall be equipped with a fine mesh bug screen to prevent contamination of the detection chamber by insects.

.7 The detector shall be a plug-in/twist lock unit which may be removed from its base with a special installation tool without disconnecting detector wiring

.8 The detector shall filter out false alarms caused by intermittent aerosols or cigarette/pipe tobacco smoke

.9 Recessed smoke detector shall be complete with necessary shroud and flush mounting hardware.

.10 Protect automatic smoke detectors during construction with a dust-bag, which shall be removed at the time of verification.

2.11 **DUCT MOUNTED SMOKE DETECTORS**

.1 Duct-mounted smoke detectors shall consist of an ionization type smoke detector as described above, and an air tight housing assembly, mounted on the side of the duct complete with sampling tubes and supporting framework.

.2 While fans are running, a continuous cross-sectional sampling of the air flows from the ventilation duct, through the detector, and then returned to the duct. Air stream velocity range from 2.5 m/sec minimum to 18 m/sec maximum be made to monitor, test and reset the detectors under actual air flow conditions. Unit shall be equipped with a test key switch and a reset key switch.

.3 Remote alarm lamps or LED shall indicate the signal operation of the detector. Install Remote LED in an easily visible location to someone standing on the floor without requiring the use of ladders to see it.

.4 Protect automatic smoke detectors during construction with a dust-bag, which will be removed at the time of verification.

.5 Manufacturer shall include site visits to direct detailed locations of duct-mounted smoke detectors.

2.12 **PERIPHERAL ALARM INITIATING DEVICES**

.1 Local control panels, interfaced with other equipment such as pre-action systems, kitchen hood extinguishing systems, or other Control panels, shall be a single zone capable of operating on 120 volt AC, 60 Hz and shall be complete with two isolated Form 'C' contacts and capability to initiate a fire alarm signal.

.2 Manufacturer shall examine drawings and specifications prior to award of contract to ensure that detectors, control panels and miscellaneous devices being supplied will provide a satisfactory working installation.

2.13 **ALARM SIGNAL APPLIANCES**

.1 Remote smoke detector alarm lamps shall be mounted in a single gang switch box with a brushed stainless steel cover, screw type terminals and electrically connected to heat or smoke detectors that require remote annunciation. Use only high intensity (200 med) LED lamps.

.2 Alarm strobe lamps shall be ULC listed and operate on 24 V DC. The strobe shall be able to flash at a rate of one flash per second in alarm mode. The words "FIRE" shall appear on the strobe lens. Strobes shall comply with ADA requirements.

2.14 **FIRE ALARM SPEAKERS**

.1 Speakers shall be complete with acoustically treated enclosure, line matching transformer, 203 mm (8 in) diameter, ULC approved permanent magnet type speaker and complete with flat white baked enamel square baffle.

.2 Speakers shall be flush mounted unless otherwise noted.

.3 Speakers shall produce a minimum gap flux density of 9500 gauss, have a voice coil impedance of 8 ohms, power rating of 20 watts, RMS according to EIA Standard RS-426A, a uniform frequency range from 80 - 13,000 Hz with minimum axial sensitivity of 94 dB at 4 feet with one watt input. The speakers shall have characteristics to produce a wide dispersion bandwidth in a hemispherical pattern in both horizontal and vertical plane.

.4 Speakers shall have line matching transformers with !/4 W, ½ W, 1 W and 2 W taps, initially set at 1 W. Verify suitability of sound levels in each area and adjust tap to suit.

.5 Speaker baffles shall be held in place with approved fasteners.

.6 Unit shall be complete with hook-up terminals with screw-type connection.

.7 Speaker enclosures in exterior areas shall be suitable for surface mounting. Speaker enclosures elsewhere shall be suitable for outdoor location.

2.15 **RISER DIAGRAM**

.1 The contractor in co-operation with the supplier shall prepare a riser diagram showing all major system components and inter-connecting wiring requirements. Riser to be submitted as a shop drawing.

2.16 **WIRING**

.1 Wiring shall be as recommended by fire alarm system manufacturer.

.2 Wiring for speaker circuits shall be twisted pair shielded sized as recommended by the manufacturer and it shall be installed in conduit.

.3 Wiring within the floor area from detection device to device shall be as recommended by manufacturer, and installed in EMT conduit.

.4 Provide line isolators where wiring crosses a different fire alarm zone.

2.17 **MATERIALS**

.1 Fire alarm systems and components shall be:

Standard of Acceptance
- **Chubb Edwards**

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Installation of the Fire Alarm system components shall be in accordance with latest edition and all amendments of CAN/ULC-S524-M91 Standard for the Installation of Fire Alarm Systems.

.2 The system shall be installed and wired by persons qualified and licenced to perform the installation of fire alarm systems.

.3 Wire alarm initiating, alarm output, auxiliary output and signal devices to local SCP's as indicated in the schedules.

.4 Wire alarm initiating circuits. Connect detectors and manual stations. Properly arrange and connect circuit wiring to their respective circuits as shown on the drawings.

.5 Provide a separate class A addressable Loop for each zone as indicated on the drawings, complete with line isolators where the loop enter the zone.

.6 Connect the pull stations, smoke detectors, flow switches, valves, zone alarm modules etc. to the addressable loops.

.7 Install wiring for the alarm signal, alarm initiating and speaker circuits in separate raceways.

.8 Wire signal circuits alternatively such that no two adjacent signal devices are on the same circuit.

.9 Arrange wiring to the speakers such that no two adjacent speakers are connected to the same circuit.

.10 Speakers shall be surface mounted in outdoor spaces.

.11 Equip all raceways with a separate ground conductor.

.12 Test each automatic detector to ensure correct wiring and zoning by setting off its rate of rise component and sounding the signals or by ringing it out. Test each smoke detector, sprinkler system and standpipe system valves to ensure correct wiring.

3.2 **DOOR HOLDERS/CLOSERS AND MAGNETIC LOCKS**

.1 Connect all door holders into the fire alarm system such that doors close automatically upon actuation of the fire alarm system.

.2 Connect all magnetic locks so that they are released by the fire alarm system and wire directly to be released by the adjacent pull station on First stage alarm in all area of the hospital except psychiatric areas. Mag locks in psychiatric areas will open on second stage alarm. Confirm this operation with local fire department prior to installation or programming.

3.3 **SPRINKLER/STANDPIPE SYSTEM CONNECTIONS**

.1 Connect contacts of sprinkler flow, supervisory and standpipe system switches to fire alarm zones indicated and verify correct zoning.

.2 Connect contact voltage sensitive relay of sprinkler pump, auxiliary booster or special service pump to fire alarm zone indicated, for trouble condition.

3.4 **WIRING**

.1 Install wiring in conduit using wire size and type in accordance with manufacturer's recommendations.

.2 Connect automatic detectors, smoke detectors and manual stations between red and black conductors at each outlet. Cut red and black conductors at each outlet and connect to terminal screws provided, red to red and black to black.

.3 Install wiring between fire alarm and each diesel-generator control panel to show "running" and "trouble" indications.

.4 Arrange wiring between existing and new fire alarm control system to achieve operation as specified.

.5 Entire installation shall be done under supervision of manufacturer. Upon completion of installation, check entire system to approval and correct any malfunction immediately.

3.5 **SYSTEM VERIFICATION**

.1 The fire alarm system shall be verified in accordance to ULC CAN 4-S537 Standard For the Verification Of Fire Alarm Systems.

.2 The manufacturer of the fire alarm and voice communication system shall make a complete inspection of all components installed for system, such as manual stations, speakers, smoke detectors, annunciators, sprinkler and standpipe valves to ensure the following:

.1 That the system is complete in accordance with Specifications.

.2 That the system is connected in accordance with Manufacturer's recommendations.

.3 That the regulations concerning the supervision of components have been adhered to

.4 That all equipment as part of the system is inspected for visible damage or tampering

.5 That adjacent speakers have been connected to alternate circuits.

.6 That the control functions have been tested for proper supervision, operation and annunciation of fan shutdown and all speaker control circuits

.7 That all speakers are properly zoned.

.8 That all valves are properly connected and displayed correctly on each annunciator.

.9 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the Manufacturer.

.10 That all thermal detectors, smoke detectors, manual pull stations and all sprinkler system and standpipe system valves have been operated and are in good working order.

.11 That all annunciators correctly pin-point the origin of any fire alarm.

.12 That actual test gas concentrations of sufficient density, have been applied to each new smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set. On completion of test, a letter shall be forwarded stating that tests have been completed and that system is operating correctly.

.13 All tests required by Local Authorities have been carried out and all existing zones have been verified.

.3 Verification records shall be maintained with the following minimum requirements:

.1 verification records shall list each device and show the date on which each device was verified and the initials of the person who verified it.

.2 verification records shall show the date on which all devices were verified.

.3 verification records shall show the date of all deficiencies encountered in the control equipment, wiring and field devices.

.4 verification records shall show the date when deficiencies were corrected and re-verified

.4 Provide any necessary equipment, test apparatus, ladders and scaffolding as required.

.5 Adjust system and components as required to ensure complete system operation.

.6 Only after the testing and verification task is completed, and all deficiencies rectified, notify the Engineers and representatives of the Fire Department and demonstrate the proper functioning of the system

END OF SECTION

WATER LEAKAGE DETECTION SYSTEM
28 28 36 00

PART - 1 GENERAL

1.1 General Requirements

.1 Conform to Section 26 01 01, Electrical General Requirements.

.2 Conform to Section 26 05 01, Electrical Basic Materials and Methods.

1.2 Shop Drawings and Product Data

.1 Submit shop Drawings and product data in accordance with Section 26 01 01 - Electrical General Requirements.

1.3 Standards

.1 The liquid leakage detection system shall be designed in accordance with and conform to the requirements of:

.1 Ontario Electrical Safety Code 2018

.2 Canadian Standards Association (CSA)

.3 Provincial and Local Bylaws and Regulations

1.4 Approvals and Information

.1 Manufacturer shall not commence final fabrication or erection of equipment until receipt of:

.1 Reviewed or "Reviewed as Noted" shop drawings from Consultant.

.2 Manufacturer shall supply:

.1 information to install and test equipment for complete installation.

.2 shop drawings for review, as specified in Article "Design and Shop Drawings".

.3 information for Owner, as specified in Article "Instruction Manuals".

1.5 Description of System

.1 System detects excess moisture, liquid spills and leakage in the following rooms:

.1 Third Floor UPS Electrical Room

.2 The detection system described herein shall consist of a solid state control unit, battery charger complete with metering devices, auxiliary relays and devices, control panel and liquid detection cable, and wall mounted passive graphic panel. The total integration of these devices, combined with the capability to generate local and remote audible and/or visual alarms, shall provide a continuous monitoring capability of liquid encroachment upon the protected area.

.3 Prior to fabrication, the manufacturer shall submit shop drawings showing control module, battery power supply, indicating lamps, switches and graphic panel, along with complete wiring diagram, to the Electrical Consultant for approval.

PART - 2 PRODUCTS

Liquid Detection Cable

.1 The cable shall consist of four wires braided into a rugged cable construction. Two wires shall be coated with a conductive polymer to form an active sensing element capable of detecting fuel oil liquids. The remaining two wires shall provide return current path and continuity sensing with the capability of measuring the distance from the control module to the fault.

.2 Liquid detection cable shall be TraceTek as manufactured by Raychem Canada Limited.

.3 Liquid detection cables to be provided in 50 foot modular lengths.

1.6 Control Module

.1 The control module shall be a solid state device capable of monitoring the status of the liquid detection circuit.

.2 The control module shall include the following:

.1 fault indication lamp (yellow)

.2 alarm indication lamp (red)

.3 power indication lamp (green)

.4 built-in alarm buzzer

.5 test, update and acknowledge buttons

.6 built-in Normally Open/Normally Closed relays activated by alarm and trouble conditions in the sensing circuit

.7 digital display to indicate distance to initial leak location.

.3 The control module shall be designed for automatic supervision of liquid detection and circuit continuity.

.4 A fault in the detection cable, or a leak detected by the cable, shall cause the appropriate LED to illuminate, the internal buzzer to sound, and the external device relays to change state.

.5 The control module shall include pushbuttons to turn off alarms, clear the digital display, and perform a manual check of the digital display, internal buzzer, the three LEDs, and the external device relay contacts.

.6 The detector cable voltage shall be 6 V DC. The control module shall operate from 120 VAC.

.7 Control module shall be semi-flush mounted with hinged locking door, Raychem #TTB-FLG.

1.7 Graphic Panel

.1 The graphic panel shall be a pictorial representation of the areas in which water detection cables are installed.

.2 The silkscreened Graphic panel shall be fabricated from 6 mm white polycarbonate material. The architectural outline, including columns, equipment locations and control panel location shall be silk-screened in black. All areas shall be identified with black lettering no less than 0.125 inches in size.

.3 Following the installation of the detection cable, increments of 20 feet, shall be mapped out to indicate cable length locations. This shall be done using a wet sponge as outlined in the system testing procedure.

.4 When testing procedures are completed and approved as outlined herein, drawings showing the graphic panel layout shall be submitted to the Electrical Consultant for approval prior to manufacture.

.5 The routing of the detection cable shall be silkscreened on the graphic panel in blue. The increments of 20 feet in distance along the cable shall be indicated. Labelling of increments shall be at intervals of no less than 100 feet and shall be in blue lettering no less than .125 inches in size.

.6 An arrow shall be silkscreened in red to indicate the location of the control panel. Lettering indicating "You Are Here" shall be silkscreened in red for orientation and shall be no less than .125 inches in size.

.7 All edges of the graphic panel shall be bevelled and all corners smoothed. The mounting screens shall be manufactured from machine finished material. The graphic panel shall be suitably sized to provide a scaled representation of the floor area at 1:100.

.8 The graphic panel shall be fabricated and installed depicting the proper directional sense of the room. The location of the control panel shall be as shown on the drawings.

1.8 System Operation

.1 Alarm Condition: If an alarm condition is sensed by the liquid detection cable the red indicator LED on the control module shall glow steadily, the built-in buzzer shall sound, the external device contacts on the control module shall change state (System is to be connected to the Building Automation System under the Mechanical Division), the remote indicating devices shall be activated, and the digital display shall indicate the distance to the leak.

.2 The alarm buzzer, red LED, and remote indicating devices shall be deactivated by depressing the 'ACKNOWLEDGE' button. The digital display shall continue to indicate the distance to the leak.

.3 When the alarm condition is corrected, the 'UPDATE' pushbutton shall be depressed to clear the digital display and restore the system to normal protection operation, or indicate any other presence of liquid.

.4 Fault Conditions

.1 During normal operation, the control module shall continuously monitor the detection cable. If a trouble condition is detected, e.g., a break in the detection cable, the yellow continuity LED, internal buzzer, and remote indicating devices shall be activated.

.5 Depressing the 'ACKNOWLEDGE' button shall deactivate the continuity LED, internal buzzer and remote indicating devices.

.6 When the fault condition is corrected, depressing the 'UPDATE' pushbutton shall restore the system to normal protection operation.

.7 Testing Sequence

.1 System shall be supplied complete with a 'TEST' button which shall automatically check system features and indicators.

.2 Activation of 'TEST' button shall automatically cause the following to occur:

(a) digital display to indicate 1888
(b) acoustic alarm to activate
(c) three L.E.D.'s to light
(d) dry contacts to change state

.3 Upon release of the 'TEST' button the digital display will indicate the overall liquid detection cable length for a period of 3 to 5 seconds and then will return to a normal 'blank' state. Other indicators will return to normal.

PART – 3 EXECUTION

1.9 Installation

.1 Provide all equipment, wiring, conduit and other materials for a complete and operational liquid detection system.

.2 Avoid contamination of cable by solder flux, metal shavings, paint, floor sealants, thread cutting oil, and other liquid or metallic contaminants. Clean and dry floor prior to installation of detection cable.

.3 Cable shall be placed in the path of any potential liquid intrusions in areas under the access (raised) floors where indicated.

.4 Cable shall be applied as indicated around air conditioning units and associated piping, main frames and rainwater down pipes.

.5 Each cable run shall not exceed 2000 feet.

.6 Cable shall be installed on the floor securely attached using hold down clips. Tape or chemical adhesives shall not be used.

.7 Cable shall be in contact with the floor and shall not be routed over other power or communication cables.

.8 Where the possibility of a metallic short circuit due to armoured cables or other metallic objects contacting the detection cable occurs, a suitable insulator shall be provided.

.9 Wiring from the control panel to the detection cable shall be "TraceTek 100 Jumper Cable #TT100-MJC" as manufactured by Raychem Canada Ltd. Cable shall be installed in conduit, unless otherwise specified.

.10 Provide 2 #14-1/2" conduit from each Control Panel Summary Alarm Contact to the Building automation system alarm interface panel. Co-ordinate this connection with the Mechanical Contractor

.11 Provide two spare 50 foot liquid detection cables complete with connectors to Owner.

1.10 System Testing and Verification

.1 The detection system shall be tested and inspected to ensure correct operation and performance as specified herein. The testing procedure shall include complete operation and testing of all individual components, including, but not limited to, the following functions:

.1 All control panel functions

.2 All control module functions

.3 All relay functions

.4 Audible and visual alarm functions

.5 Detection cable

.2 Test Procedures

.1 Prior to full operation, a complete demonstration of all components shall be performed in the presence of Consultant. This demonstration, having satisfactorily met all specifications herein, shall allow commissioning of the detection system.

.2 When the control panel is energized the following shall occur:

(a) The control module power LED should light.

.3 The control module continuity monitoring function shall be tested by disconnecting the end terminals of the cable. The following shall occur:

(a) the module will enter alarm activating the continuity LED and audible alarm.
(b) internal relay will change state thus indicating an alarm at remote monitoring devices.
(c) digital display will indicate the distance to the fault, in this instance the total length of detection cable.
(d) Depressing the 'ACKNOWLEDGE' bottom will cancel the audible alarm.
(e) Restoration of end terminations and depressing the 'UPDATE' button will reset the system and cancel all alarm indications.
(f) Depress the test button. The module will alarm, the 3 LED's will light and the digital display will read '1888'. The internal relay will change state.

.3 The manufacturer shall correct any faults found during testing of the system in order to ensure complete operational reliability as indicated.

END OF SECTION

MUSIC SYSTEM
27 41 20

PART 1 - GENERAL

1.1 GENERAL OVERVIEW

.1 Provide music system capable of playing music in the Hybrid Operating Room as soon and as required

1.2 General Requirements

.1 The Music system will be capable of connecting to all existing audio technologies such a portable music players, cellular phones and other devices via a hard wire connection.

.2 The music system will be able to connect via Bluetooth technology

1.3 Work Included

.1 Provide equipment, wiring and other materials for a complete and operational music system.

.2 Individual volume and source selection control

.3 Bluetooth and hard wire audio connection in Control Rooms

.4 Speakers as shown on layout

.5 DSP, Amplifier, Network Switch, Cabling, Rack, Install, Commission & Training

.6 Engineered Drawings

1.4 Music System Objectives

.1 The music systems shall meet the following objectives:

- .1 Provide music into the Operating Room from an external area.
- .2 Music system will be muted during overhead paging or FA annunciation.
- .3 Music system will not utilize existing Public Address or Fire Alarm speakers.
- .4 Music system will have volume control and ON/OFF controls.
- .5 Music system will include docking for available and current technologies.

1.5 Shop Drawings and Product Data

.1 Include:

- .1 Detail assembly and internal wiring diagrams for control unit.
- .2 Overall system riser wiring diagram identifying control unit, circuits; identifying terminations, terminal numbers, conductors and raceways.
- .3 Details for devices.

.4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.

.5 Step-by-step operating sequence, cross referenced to logic flow diagram.

.2 Prepare a detailed riser diagram of the complete system showing all major components, devices and necessary interconnecting wiring.

.1 Diagram is to indicate wiring quantities, sizes and color code and to indicate conduit sizes.

.2 Riser Diagram is to be submitted as a Shop Drawing.

1.6 Operating and Maintenance Manuals

.1 Provide Operating and Maintenance Manuals as per the Electrical General Requirements.

1.7 Operating and Maintenance Instructions

.1 Provide Operating and Maintenance Instructions as per the Electrical General Requirements.

1.8 As-Built Drawings

.1 The Contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the Music system to be used for as-built drawings

.2 Final As-Built drawings shall be submitted as per the Electrical General Requirements.

.3 If the final system work is not complete, the Contractor will be so advised and shall complete the work as required.

1.9 Product Installation and Handling

.1 Before and during installation care must be exercised to prevent damage to the sensitive parts and components of the system and be responsible for the storage and handling of all components until acceptance of the completed installation.

.2 All wiring shall be concealed in walls and shall not be accessible to the occupants of the crisis room.

PART 2 - PRODUCTS

1.1 General

.1 All system hardware and software components shall be produced by manufacturers regularly engaged in the production of music annunciation equipment.

.2 Units of the same type of equipment shall be products of a single manufacturer.

.3 All material and equipment shall be new and currently in production.

.4 Each major component of equipment shall have the manufacturer's name address, and the model and serial number in a conspicuous place.

.5 **Contractor shall work with and engage services of existing hospital service providers for specific services:**

- **System supplied by Aatel Communications:** Contact Mike Moore: mikem@aatel.com 905-526-2393.

PART 3 - EXECUTION

1.2 General:

.1 Provide a complete operational Music system as shown on drawings, as specified and as intended.

.2 Speakers provided in the room shall be flush mounted and suitable for hospital grade applications.

1.3 Installation:

.1 Install all system components including appurtenances in accordance with the manufacturer's instructions and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system. Provide cable management hardware at all equipment locations to insure that cable management best practices are employed. Cables shall be neatly routed and bundled with suitable strain relief and radius using cable managers and “Velcro” style cable management straps and nylon straps where permitted. Provide grommets and protective bushings on all cables entering conduits, raceways.

.2 Provide power and signal wiring at music system components to suit manufacturer’s requirements.

.3 Provide system wiring as required

.4 Provide all system wiring in conduits/raceways, J-hooks where raceway is not available

.5 Install all equipment in accordance with manufacturers’ instructions.

.6 Provide necessary mounting accessories.

.7 Test each system component and feature to prove the system performance and response under normal conditions.

.8 Test each system component and feature to prove the system performance and response under alarm conditions.

1.4 Warranty, Maintenance, Testing and Certification

.1 Warranty shall be provided as required by Hospital procedures, commencing at system acceptance.

.2 Acceptance procedures shall be in accordance with Hospital Procedures.

END OF SECTION

Sunnybrook
HEALTH SCIENCES CENTRE

ICN Cabling Standards
Information & Telecommunication Services
Revised : January 11, 2017

General Overview

Sunnybrook has an extensive Ethernet network extending throughout four campuses:

1. Sunnybrook (SB) – 2075 Bayview Ave. (north of Eglinton)
2. Holland Centre (HC) – 43 Wellesley St. (east of Yonge)
3. St. John Rehab (SJR) - 285 Cummer Avenue (west of Bayview)
4. CNIB - 1929 Bayview Ave. (north of Eglinton)

There are approximately 74 wiring closets cabled with Cat5/5e/6/6a UTP cables across the four campuses, with the majority of 61 at Sunnybrook campus.

The implementation of an Intelligent Campus Network (ICN) began in 1995 at the SB campus. This involved moving from a token-ring to an ethernet wide facility and included the implementation of new hub rooms, backbone fibre and horizontal UTP cabling installed to Nordx/CDT IBDN certification. Backbone fibre type will be type OM4 MMF or SMF where required. Standard horizontal UTP will be Category 6 with any new construction or large area renovation project.

Majority of the hub rooms have their own dedicated pathway which serves those floors assigned to that specific room. The pathway may be either zone and distribution conduit or a J-hook design.

The telephone infrastructure (Cat3) consists of a riser closet or terminal located in every wing on every floor of our buildings. The majority of our terminals follow the industry BIX standard. Some of our terminals are in shared locations with the ICN network hub rooms.

Scope of Work for Data Cabling

The extent of the MAC work includes but is not limited to the following:

1. Place data cabling in existing horizontal pathway from the offices requiring MAC work to their associated ICN hub room.

2. Terminate both the patch panel or the BIX block and the workstation ends of each cable drop as specified in the EIA/TIA T568A wiring standard.

3. Label both the workstation faceplate and the hub room patch panel as per ICN labeling standards provided by Sunnybrook.

4. Provide a 7 ft stranded patch cord (for the hub room end) and a 10 ft. solid station cord (for the user end) for each new drop.

5. Patch each new data drop into an available switch port in the hub room and document port info. If no available switch port, I.S. is to be notified immediately.

6. Test each cable drop to EIA/TIA TSB67 Category 6/6a standards with a Microtest "PentaScanner" LAN tester or equivalent.

7. Install wire raceway or ceiling access panels if required.

Scope of Work for Voice Cabling

The extent of the MAC work includes but is not limited to the following:

1. Place Voice cabling in existing horizontal pathway from the offices requiring MAC work to their associated terminal.

2. Terminate the BIX block and the jack ends of each cable drop as specified by the BIX wiring standard.

3. Label both the phone jack faceplate and the terminal BIX block (with the next available cable number) as per labeling standards provided by Sunnybrook.

4. Tone each cable drop to BIX to confirm connectivity.

5. Install wire raceway or ceiling access panels if required.

Installation Requirements

Data Cable

- Cable shall be Belden/CDT IBDN Flex Category 6 or 6a, FT4 or FT6 where required, 4 pair UTP.
- Cables shall not exceed the EIA/TIA T568A wiring standard of maximum 90 meters in length. Every effort has been made to centrally locate the hub rooms to facilitate the length limitations. Any drop that may exceed the 90 meter limit will require I.S. approval.

Voice Cable

- Cable shall be Belden/CDT IBDN Category 3, FT4 or FT6 where required, 4 pair UTP.
- Cables shall not exceed distance to nearest telephone terminal.

Data Jacks

- Data jacks shall be Belden/CDT MDVO, 8p8w, orange for Category 6 and turquoise for Category 6a.

Voice Jacks

- Voice jacks shall be Belden/CDT MDVO, 8p8w, white for digital phone/FAX, or yellow for emergency phones.

Patch Panels and Horizontal Wire Management

- Belden/CDT 48 Port MDVO and CableTalk 2M Managers **(Empty MDVO panels and wire managers installed as a part of the hub room setup)**.

Wall Plates / Surface Boxes

- Belden/CDT MDVO 4-port faceplate (white) with surface box where required **(use alternate port of existing plate where temporary ethernet cables are terminated)**. Faceplates and surface boxes shall be mounted using screws.

Wire Raceway

- Panduit, Wiremold or equivalent. Large enough to accommodate 4 – Cat6 or Cat6a UTP cables and white in colour.
- Use existing raceway where possible.

Ceiling Access Panels (approved by I.S.)

- In rooms without T-bar ceilings where distribution conduit has been installed (floors H2, H3, H4 only), the conduit stubs into the room above the solid ceiling. A permanent access panel (18" x 18") shall be strategically installed near the conduit stub to allow for the cable installation to the room.

Patch cords

- 1 Belden/CDT stranded Cat6 (for Cat6 cabling) or Cat6a (for Cat6a cabling) 7 feet wired T568A modular cord for each hub room connection.
- 1 Belden/CDT solid Cat6 (for Cat6 cabling) or Cat6a (for Cat6a cabling) 10 feet wired T568A modular cord for each workstation connection.
- Patch cords for Cat6 shall be orange and for Cat6a shall be light green.

Labels

- All labels shall be mechanically printed permanent self adhesive **(no hand written labels will be accepted)**. See the last page for labeling standards.

Testing

- Cable testing shall be to EIA/TIA TSB67 standards and include the following information:

    a. Cable Identification (Workstation Room # / Hub Room # / Port #)
    b. Cat6 or Cat6a test parameter results
    c. Hub Port Identification (Hub I.D. # / Port #)
    d. Project ID and description, date of installation, company etc.

- All test results shall be submitted to Sunnybrook Information Services Department in an electronic file.

Pathway

An ICN cabling pathway has been installed throughout the SB campus to allow for isolation and management of ICN cable drops.

Most wings have been fitted with a pathway consisting of CaddyCat J-hooks from Erico Industries. The pathway generally follows both sides of each corridor on their respective floors. In areas where ceiling congestion did not allow for j-hook installation, EMT conduit has been installed in sections with gaps to allow for cabling to enter rooms where required.

All cabling in T Wing (OCC – Odette Cancer Centre) should be dropped through the wall. The OCC is a modern building with drywall walls and drop ceiling. All cable drops in the OCC to be set as inside wall drops only (where circumstances allow).

Since each hub room will typically service 3 floors, vertical access to adjacent floors has been done using vertical conduits from the ceiling space of one floor to the ceiling space of the other.

Where a cable or cables leave the pathway to enter a room, a conduit sleeve (3/4" for 1 - 2 cables or 1" for 3 - 6 cables) must be installed to access the room and properly fire stopped after the cabling has been installed.

Several wings or partial wings have had a network of zone and distribution conduit installed for ICN cabling. From the hub room, 2" EMT conduit has been install to a pull box in each predetermined zone. From each pull box there has been installed a 1" EMT pipe to rooms in that specific zone deemed as requiring an ethernet connection. Cabling shall be installed through the proper zone and distribution conduit to each room.

Conduit fill ratios have been considered and should be met. If an exception exists, Information Services is to be notified for consultation.

Conditions

1. No ceiling space shall be accessed without a valid Ceiling Access Permit (CAP) received from the Occupational Health and Safety Coordinator and properly displayed.

2. Most of the work can be done during normal business hours with the understanding that corridor traffic flow must not be compromised.

3. Access to all locked doors will be through Fire and Security Services. Be prepared to wait at times for access to any given room. All doors MUST be locked upon completion of work.

4. All individuals working on the cabling projects must have valid picture I. D. provided by the Fire and Security Department of Sunnybrook.

5. MAC work should be completed within 10 business days from the day of assignment or as scheduled (Projects).

6. Most projects/installations (marked as matrix III and IV) will require medical contamination control due to sensitive areas in the hospital. The cabling vendor should own professional construction equipment/material such as mobile cubicles equipped with hepa vacuum cleaner, asbestos masks and plastic sheets for manual tenting.

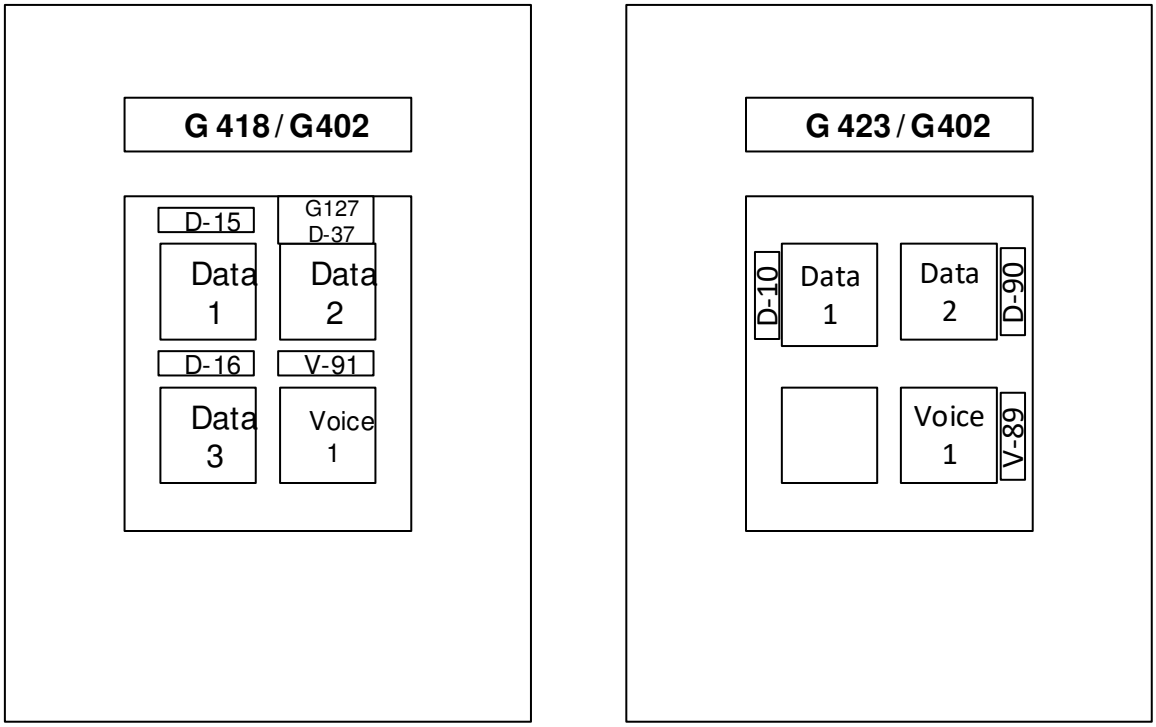
7. All persons to be employed as Cable Installers at Sunnybrook are required to attend a minimum ½ day Asbestos Awareness Training Session by an outside consultant. Acceptable training programs are offered by Pinchin Environmental, T. Harris Environmental, Jacques Whitford Environmental, and some labour unions. Certificates of training must be copied and given to the Occupational health and Safety Coordinator at Sunnybrook. The accepted contractor must also meet with the Safety Coordinator to review their work and sensitive asbestos areas prior to starting work. The contractor needs to be aware that they must report unsafe conditions to Occupational Health and Safety Coordinator.

8. All persons to be employed as Cable Installers at Sunnybrook are required to attend awareness session provided by Infection Prevention & Control, hosted on-site at Sunnybrook.

Appendix A: Cable Labeling Standard

The following is the cable labeling standards used at Sunnybrook, for horizontal Cat6/6a UTP cables.

Station End Location



Station end wall plates

The Sunnybrook cable labeling standards requires that the label(s) at the station end wall plate identify the 'station end room number', 'hub room number', and 'device patch panel port number' of where the cable terminates to. The station end wall plate labels comprise of a top label and one or more side labels. If only a port number is listed then it is assumed that the hub room is read from the top label. Otherwise the hub room must be listed in addition to the port number.

Top label **G418 / G402**

where: - G418 is current station end room location where this wall plate is
- G402 is the ICN Hub Room that the cable(s) runs to

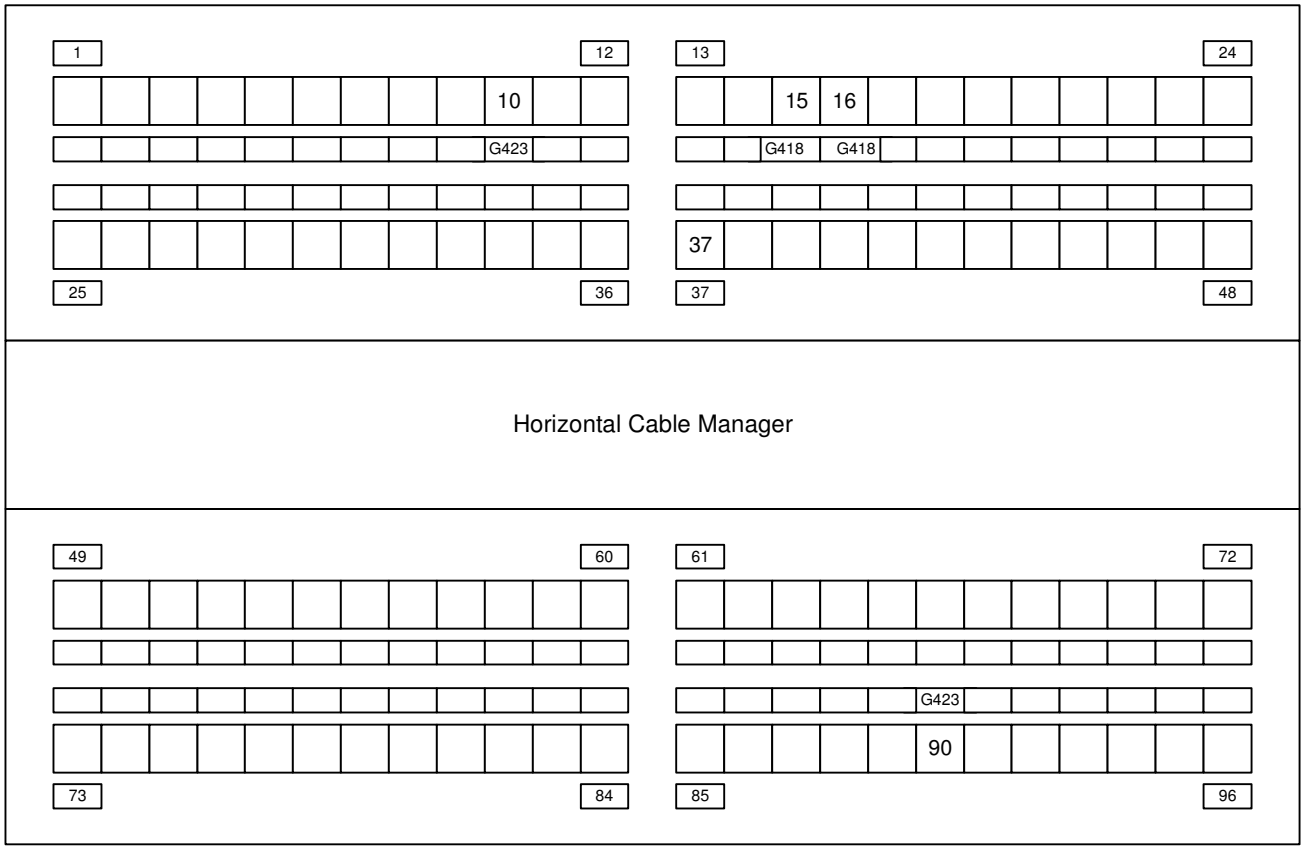
Side Labels **D-15** **D-16** **G127 D- 37** **V-91**

where - 'D-15' is data cable terminating on patch panel port 15 in hub room G402
- 'D-16' is data cable terminating on patch panel port 16 in hub room G402
- 'G127 D-37' is data cable terminating on patch panel port 37 in hub room G127 (exception cable to a different hub room)

- V-91 is voice cable terminating on BIX panel port 91 in nearest Bell voice closet
Note: if only a number is provided then it is assumed to be a data cable.

Equipment End Location – ICN Hub Room

Each hub room will have data cables terminated on a patch panel. All patch panel ports will be consecutively numbered such that all ports will be uniquely identified regardless if there are several panels on several network racks. The end ports will be labeled at top/bottom consecutively starting from 1 to nnn as illustrated in the following diagram. The centre labels will indicate the device room number where the cable comes from



Equipment end Patch Panels - ICN Hub Room G402

Sunnynet

Data Centre and Hub Room Access Policy

Sunnybrook Health Sciences Centre		Policy No:	ICS-025
Title	Data Centre and Hub Room Access Policy	Original: *(mm/dd/yyyy)*	06/11/2012
Category	Information and Communication Services	Reviewed: *(mm/dd/yyyy)*	06/11/2012
Sub-Category	Network & Security	Revised: *(mm/dd/yyyy)*	10/05/2012
Issued By:	IT Operations Committee		
Approved By:	Sam Marafioti		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

Data Centre and Hub Room Access Policy

Policy

It is Sunnybrook's policy to permit only authorized access to data centre and hub rooms in accordance with Sunnybrook Information Services security policies and procedures in order to ensure the integrity and availability of services dependent on these mission critical resources.

Definitions

Agent means any authorized Sunnybrook person accessing a data centre or hub room.

Visitor means any authorized non-Sunnybrook person seeking access to a data centre or hub room.

Purpose

This policy outlines Information Services standards for access to and maintenance of all Sunnybrook data centres and hub rooms ("facilities"). The policy is intended to enable secure access to facilities and to ensure that these facilities are maintained and operated in a safe, clean and effective manner in order to provide continuous service for dependent systems and infrastructure. All persons accessing data centres or hub rooms must abide by this policy. Failure to comply may result in loss of facility access privileges and/or removal

of equipment.

Applicability

This policy applies to:

- All authorized Information Services administrators and their authorized agents who maintain equipment owned and operated by Information Services in a data centre or hub room; and
- Any other Sunnybrook person who owns or maintains equipment housed in or accessed via any Sunnybrook data centre or hub room.
- Any Visitor for any purpose whatsoever.

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Procedures

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1 - Authorized Data Centre and Hub Room Activities

Hub rooms are intended to be single purpose rooms for accommodating Information Services network systems (network cabling and equipment), servers and storage systems and may include associated cables, monitors, power, air conditioning units, temperature monitoring units, humidity monitoring, tape drives, backup media, etc.

In addition, other Sunnybrook authorized corporate systems or infrastructure services may be housed within or accessible through a data centre or hub room, including patient monitor network systems, Medical Imaging PACS network equipment, Research network equipment, etc. Other rooms may have been built as multipurpose rooms which have other corporate systems installed such as fire alarm panels, Coax video systems, etc.

Note: installation of any non-IS owned or operated system or service in a data centre or hub room must receive prior written approval from Sunnybrook's CIO.

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2 – Administrator Responsibilities:

It is the responsibility of each Information Services system administrator to ensure that all data centres and hub rooms and all associated equipment therein are maintained and operated in a safe and effective manner, including the performance of on-going maintenance and monitoring for any unusual conditions, e.g. overheating, flooding, etc.. All non-normal operating conditions must be reported to the Manager of Information Technology at the

earliest opportunity.

- All data centres and hub rooms must be kept in a safe, clean and professional manner at all times. All waste must be immediately disposed of by the respective Administrators and the waste deposited into proper containers.
- All entrances to data centres and hub rooms must kept clear as per fire/security regulations.
- All non-normal operating conditions must be reported to the Manager of Information Technology at the earliest opportunity.
- Staff failing to adhere to this policy will be reported to Director of Information Technology who will take applicable disciplinary action where required.

3 – Access

Access to a Sunnybrook data centre or hub room by any person requires
1) authorization from Information Services; and
2) either an IS escort or a personally issued KeyScan–enabled Sunnybrook ID badge.

- KeyScan-enabled access does not require an Information Services escort. Those persons accessing a data centre or hub room who have not been issued a KeyScan-enabled card must be escorted.
- Escort, where required, must be provided by either an authorized Sunnybrook Information Services or Security Services representative.
- KeyScan-enabled card access will generally be provided to authorized Sunnybrook staff (agents) and 3rd parties (visitors) requiring routine, non-escorted access on an individual, case-by-case basis.
- Individuals must only use a personally issued KeyScan-enabled card and all individuals must either scan in or be escorted to enter a room (all tailgating is strictly prohibited).
- Access (whether by escort or KeyScan) will be logged and routinely audited by information Services.

Sunnybrook Information Services Purposes

Sunnybrook agents (IS and non-IS departmental server admins) requiring temporary or permanent access to data centres and hub rooms must send a request to the IS Network team and receive written authorization prior to access.

Temporary access to these rooms will be granted on a short-term basis for 3rd

party vendors or other visitors performing work on behalf of Information Services (e.g. for software or hardware installation or maintenance).

Sunnybrook Non-Information Services Purposes

Access to data centres and hub rooms rooms for non-IS purposes must be authorized by the Director of Information Technology or designate. Temporary access to these rooms will be granted on a short-term basis for 3rd party vendors (visitors) requiring access to service or install non-IS systems in the room (e.g. renovations to the room, service or installation of air conditioning, etc.), including but not limited to:

- Installation or service of any non-IS systems such as Patient Monitor, PACS or Research, fire alarm panels, security system panels, electrical service panels, coax TV systems, etc.
- For construction work near or in these rooms requiring access, including installation of conduit or cables that will pass through the rooms; etc.
- Access by other non-IS Sunnybrook project managers, maintenance and service personnel or their agents (e.g. for Facilities Planning or Maintenance personnel, vendors or contractors) who may require access to these rooms to implement projects, install systems or maintain and service essential systems such as on an ongoing basis or in emergencies.

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4 - Security:

Authorized Access Only

Access to data centres and hub rooms is absolutely restricted to authorized individuals as documented in this policy and as identified by the Manager, Information Technology in the IS Network Team Data Centre and Hub Room Access access control list.

- All data centres and hub rooms must be kept locked at all times.
- Access to data centres and hub rooms will be logged and audited by the Manager, Information technology
- All persons requesting access will be required to supply identifying information (name, company name or department, room number and phone number/local) and the purpose for entry before being granted access.
- Access is permitted for those activities required for the indicated purpose and under no circumstances shall other activities occur for any other purpose without written approval of the Manager, Information Technology.

- Security badges must be worn at all times.

Visitors

- All Visitors must be escorted at all times by an authorized SB Information Services staff or member of Sunnybrook's Security staff unless they have been issued a KeyScan-enabled Sunnybrook ID badge (see Appendix 1).
- Authorized Visitors who may require continuous access for greater than 5 days may be provided with a temporary Visitors' badge enabling KeyScan access at their cost or at the cost of their sponsor at the discretion of the Manager, Information Technology.
- Visitors are not permitted to have possession of any data centre or hub room access lock key other than an authorized KeyScan-enabled Sunnybrook ID badge which has been assigned to them personally.

Enforcement:

- Any person found to have violated this policy may be subject to disciplinary action, up to and including termination of employment and/or legal action at the sole discretion of Sunnybrook Health Sciences Centre.

Contact Information:

George Lee	x4219	page 7308
David Chong	x7232	page 8101
Myles Leicester	x4377	page 8137
Wilfred Yan	x85322	page 5416

IS Help Desk	x4159
Fire and Security	x4589

Appendix 1

Requesting Access to ICN Data Centres and Hub Rooms

The following procedures must be used for requesting access to any Sunnybrook data centres or hub room.

Requesting access during business hours:

1) Users requiring access to data centres or hub rooms must email the IS Network team for access. The IS Helpdesk can also be called and will, in turn, email and page the ICN Network team. Users are to identify themselves and indicate the reason they require access to this room as well as date and time required.
2) The IS Network team will review the request and access may require further management approval without prior notice.

3) The IS Network team may personally provide access to the room or submit a request to Sunnybrook Security Services to authorize access.

4) The IS Network team will log all access, including identity of user, data centre or hub room number, date, start and stop times and reason for access.

Requesting access after business hours:

1) Users requiring access to hub room must call the Security office (ext. 4589) to request access. Users must identify themselves and indicate the reason they require access.

2) Security will only provide access to persons appearing on a list of pre-approved personnel provided by the IS Network team or based on prior written permission of a member of the IS network Team or the manager, Information Technology.

   a) If a person is authorized for entry, Security will open the door to permit user access to the room.

   b) If user is not authorized for entry then Security will deny access and advise the user to contact IS the following day.

      i) If the user cannot wait then Security may contact the IS Helpdesk for assistance in contacting an authorized IS representative.

      ii) If Security contacts the IS Helpdesk, the Helpdesk personnel will assess the request and, if necessary, email and page the ICN Network Team for directions.

5) Security will log all access, including the identity of user, data centre or hub room number, date, start and stop times and purpose for access.

Requesting KeyScan Access

Note: Some rooms are equipped with KeyScan access. Visitors may be a assigned KeyScan-enabled Sunnybrook ID badge as noted above, however only escorted Visitor access can be granted to rooms without KeyScan pads.

The following procedure is used for requesting KeyScan access to data centres:

1. User submits request by email to IS Helpdesk or IS Network team. Name, department, phone number and pager number of person(s) requiring access, data centre(s) to be accessed and reason for access must be provided. Pre-approved requests may be provided by IS management on behalf of the user.

2. All requests will be forwarded to IS Network team. If the request is questionable then it will be forwarded to IS management for approval. (e.g. to install non-IS systems or allow departmental servers to be installed in the ICN data centres).

3. If a request is approved and accepted then the IS Network team will forward an e-mail to Security to authorize access via KeyScan.

> **Note:** Security will not accept requests directly from users and will only accept requests from the IS Network team.

If short term temporary access is requested then the IS Network team will specify the number of days for which access has been granted.

4. Security will create a KeyScan-enabled Sunnybrook ID badge for the approved access and confirm back to ICN Network team and/or directly to the user(s) requiring access. Vendors requiring a temporary ID badge can pick it by visiting the Security office (CG03) only after providing proper identification. Prior email notification of access approval must be received by Security from the IS Network team.

> **No person may use a KeyScan-enabled Sunnybrook ID badge which has not been assigned to them personally to access a data centre or hub room.**

5. If temporary access was issued, at the completion of the access period, IS Network team will issue a follow-up email to Security to remove access.
6. If IS Network team is informed of a user leaving the hospital who no longer requires access to a room, IS will issue an email to Security to remove any KeyScan access which may have been previously assigned to that individual.
7. The IS Network team will maintain a spreadsheet of users that have been granted Keyscan access. Date of request and room accesses granted as well as the date of request or access code removal will be recorded.

SUNNYBROOK HEALTH SCIENCES CENTRE HEALTH AND SAFETY RULES

(to be posted at job site)

1. Smoke tobacco in designated areas only. Never smoke in any location that contains a combustible or explosive condition or atmosphere.

2. No person who is impaired by alcohol or drugs shall enter and/or remain on the grounds.

3. Follow instructions; don't take chances. If you don't know, ask.

4. Immediately report to your supervisor any condition or practice you think might cause injury to employees or damage to equipment.

5. Put everything you use in its proper place. Disorder causes injury and wastes time, energy, and material. Keep your work area clean and orderly.

6. Any personnel operating equipment is to be duly authorized and instructed (licensed where practical) in the safe method of operation.

7. Whenever you, or the equipment you operate is involved in an accident, regardless of how minor, report it to your supervisor immediately. Get first aid promptly.

8. Repairs are to be made by authorized, licensed personnel only. Need for repairs must be reported to your immediate supervisor, and are not to be undertaken by non-qualified personnel.

9. Wear approved personal protective equipment as directed. Keep it in good condition.

10. All authorized visitors on the property are required to wear and use appropriate safety equipment.

11. Don't horseplay; avoid distracting others.

12. When lifting, bend your knees, grasp the load firmly, then raise the load, keeping your back as straight as possible. Get help for heavy loads.

13. Obey all rules, signs, and instructions.

14. In the event of an accident, the Occupational Health and Safety Clinic is located in H Wing, Ground Floor, room HG46.

SUNNYBROOK HEALTH SCIENCES CENTRE HEALTH AND SAFETY RULES
(to be posted on site)

15. A full report of any accident is to be submitted in writing to the Consultant's representative, within 24 hours of the occurrence.

16. The *Contractor* shall provide to the *Owner's* Safety Coordinator, the name and phone number of their health and safety delegate.

17. Before work begins, the *Contractor* shall deliver to the Sunnybrook Occupational Health and Safety Department - Safety Coordinator, a list of the chemical substances to be used in all work, and a Material Safety Data Sheet for each chemical substance (this is a WHMIS requirement).

18. The *Contractor* shall also provide a list of physical or biological agents produced by its work.

19. The Contractor, before the work commences, shall arrange a meeting where the *Contractor* and its workers are informed of the following:

    1. the requirement to comply with the general health and safety rules required by Sunnybrook;
    2. the requirement to comply with the *OHSA*;
    3. the name and telephone number (both home and office) of the Contractor's supervisor; and the health and safety representative, or members of the Subcontractors committee at the job site, whichever is applicable;
    4. the areas of the location to which the *Contractor* and the Contractor's workers are allowed access;
    5. any special hazards at the job site of which the *Contractor* and/or its workers normally would be expected to be aware (for example, what to do in case of a fire);
    6. the requirements imposed upon the *Contractor* in the event that one of the *Contractor* workers is injured at work.

20. As the work progresses, planned inspections are to be made of areas/places where the *Contractor* and his workers are working to ensure the following:

    1. the *Contractor* and his workers comply with health and safety laws;
    2. the and his workers comply with the *Owner's* general health and safety rules;
    3. the Contractor's work is not creating an unacceptable health and/or safety hazard for the *Owner's* employees.

21. Comply with the attached Contractor Safety Requirements document.

WHMIS
WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM REQUIREMENTS

1. Comply with Workplace Hazardous Materials Information System in accordance with the Occupational Health and Safety Act (*OHSA*) requirements.

2. Before commencement of Work and during full term of the Contract, provide a list with current Materials Safety Data Sheets (MSDS) of all hazardous materials proposed for use on Project. List and data sheets shall be delivered to Sunnybrook Occupational Health and Safety Department - Safety Co-ordinator.

3. Label hazardous materials used and/or supplied on the Project in accordance with WHMIS requirements.

4. Provide detailed procedures for safe handling storage and use of hazardous materials. List special precautions and safe cleanup and disposal procedures. Conform to Environmental Protection Act for disposal and cleanup requirements.

5. Obtain from the Owner, where applicable, a list and MSDS of hazardous materials that may be handled, stored or used by Owner's employees and/or Other Contractors retained by Owner at location where work of this Contract will be performed.

6. Ensure that those who handle, and/or are exposed to, or are likely to handle or to be exposed to hazardous materials, are fully instructed and trained in accordance with WHMIS requirements.

SUNNYBROOK HEALTH SCIENCES CENTRE

CONTRACTOR'S ACKNOWLEDGEMENT

Sunnybrook Health Sciences Centre ("Sunnybrook") has included in the Tendering information for this contract a copy of the list of any designated substances present at the Project or Work site. The Notice of Designated Substances included in the Tendering Information is attached to this Acknowledgement.

If awarded this contract, the Contractor, as *Contractor* within the meaning of the *OHSA*, undertakes:

- to inform other contractors and all subcontractors retained to perform services on the Project or the Work of the existence of the designated substances, if any, which are present at the Project, and to provide to other contractors and all subcontractors a copy of the list of designated substances which is attached to this Acknowledgement, prior to entering into any contracts with those other contractors or subcontractors for the supply of services;

- to notify Sunnybrook of the presence of any potentially hazardous materials or toxic substances which will be bought to the Project or the Work by the Contractor, or Contractor's employees and to provide all applicable MSDS sheets, if any, to Sunnybrook;

- to ensure that other contractors and all subcontractors retained to supply services for the Project or the work notify Sunnybrook of the presence of any potentially hazardous materials or toxic substances they bring to the Project or the Work and ensure that they provide all applicable MSDS sheets, if any, to the Contractor, other contractors and all subcontractors to so comply.

Contractor:

Contract to be performed:

The Contractor acknowledges that he has received the List of Designated Substances attached to the Tendering Information, and agrees to be bound by the undertakings set out above.

_____ _____

Date Contractor's Signature

Note: This Acknowledgement is an integral element of the Tender Documents. This Acknowledgement must be signed and returned with the Tender Bid documents.

SUNNYBROOK HEALTH SCIENCES CENTRE

NOTICE OF DESIGNATED SUBSTANCES

The following Designated Substances are present at Sunnybrook Health Sciences Center:

Designated Substance	Location
Asbestos on Construction Projects and in Buildings and Repair Operations	Can be expected in varying states in all wings except L, M, S, and T
Ethylene Oxide	Regional Processing Centre; Receiving – M-Wing Basement; only present during a spill
Isocyanates	SCIL – possible in other areas in small quantities
Mercury	Used in older instruments – only present during a spill
Benzene	Principally found in laboratories but may be found elsewhere
Lead	Used in many locations as lead shielding, or in lead paint.
Arsenic	Possible in laboratories

SUNNYBROOK HEALTH SCIENCES CENTRE

NOTICE OF BIOLOGICAL, CHEMICAL AND PHYSICAL HAZARDS

Biological:

Sunnybrook Health Sciences Centre (Sunnybrook) is a fully functioning hospital and medical research facility. As such any biological hazard that could infect a person outside the facility can be expected within the facility. This includes any communicable or non-communicable disease.

Physical Hazards:

Sunnybrook also contains physical hazards common to all public buildings. Contractors, their employees, and subcontractors must be aware of the general hazards associated with any kind of work in a full service public facility with residential living.

In addition to "normal" physical hazards there are also specific departmental hazards. Contractors must make their employees and subcontractors aware of the hazards they may encounter and the safety precautions to take. Contractors are required to contact SHSC departmental managers, and/or the safety office, and/or the Corporate Planning and Development or maintenance project manager regarding any specific hazards.

Chemical Hazards:

In addition to the designated substances mentioned under The Notice of Designated Substances there are approximately 5000 WHMIS regulated chemicals at Sunnybrook and several thousand chemicals covered by The Food and Drug Act, The Pest Control Act, The Atomic Energy Control Act, and the Explosives Act. All contractors are required to have their workers WHMIS trained to work on the premises. Contractors are required to contact SHSC departmental managers, and/or the safety office, and/or the Corporate Planning and Development or maintenance project manager regarding any specific hazards.

SUNNYBROOK HEALTH SCIENCES CENTRE SAFETY RULES APPLICABLE TO OUTSIDE CONTRACTORS AND THEIR EMPLOYEES ENGAGED TO WORK AT SUNNYBROOK

(A) ALL CONTRACTOR'S PERSONNEL

1. Work in compliance with the provisions of the Occupational Health and Safety Act and the regulations, and in compliance with the employer's health and safety rules;

2. Use or wear any equipment, protective devices or clothing required by the Owner or by the employer;

3. Report missing or defective equipment or protective devices to the employer;

4. Report any known workplace hazard to the employer;

5. Report violations of safety legislation or safety rules to the employer;

6. Do not remove or make ineffective any protective device required by legislation, by SHSC or by the employer;

7. Do not use or operate any equipment or work in a way that might endanger oneself, or any other person;

8. Do not engage in any prank, contest, feat of strength, unnecessary running or rough or boisterous conduct.

(B) SUPERVISORY PERSONNEL (Person(s) having charge of the workplace or authority over the Contractor's employees)

1. Ensure that supervised employees work in compliance with the Occupational Health and Safety Act and regulations, these rules and the employer's health and safety rules;

2. Ensure that safety equipment, protective devices or clothing is used or worn by employees and visitors to the work site;

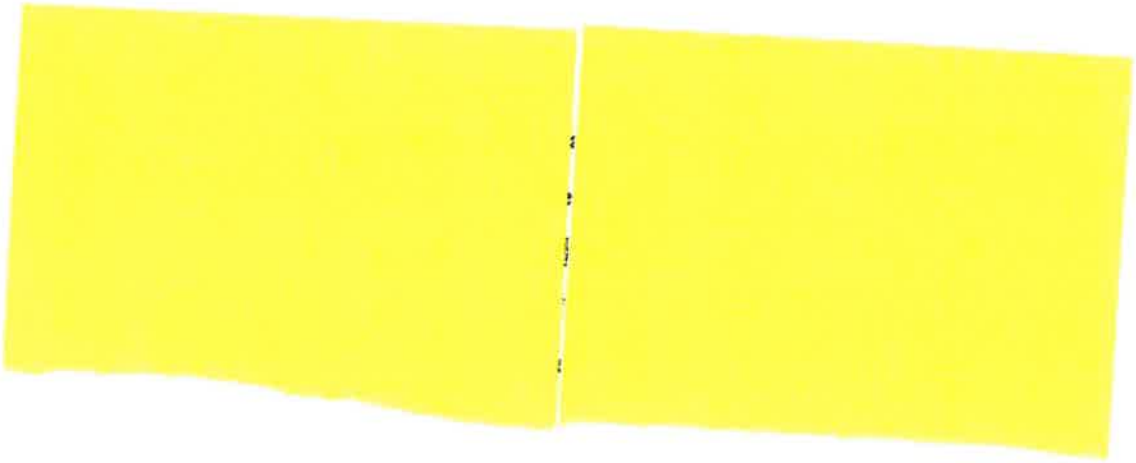
3. Advise employees and visitors to the work site of any potential or actual health or safety dangers known to exist;

4. Ensure appropriate training is given to employees about measures and procedures to be taken for their protection including, as required, (but not necessarily limited to): asbestos awareness training and WHMIS training);

5. Take every precaution reasonable in the circumstances for the protection of employees and any other persons at the work site.

END OF SECTION

SHSC CONSTRUCTION POLICIES



1. General Instructions

1.1 *General Requirements*

Read and be governed by conditions of the Contract:

1.2 *Contractor's Use of Site*

SHSC will designate working areas sufficient for the work of the Project. Confine all operations to designated areas.

Do not unreasonably encumber the place of the Work with materials and equipment

Move stored products or equipment which interferes with operations of SHSC and other contractors.

Obtain and pay for the use of additional storage and staging/work areas required for construction operations that exceed the areas indicated in the appendix attached to this Schedule.

PharmaLogic will control the designated areas Storage at the Place of the Work within designated areas, if available, or other space will be allocated by PharmaLogic Relocate stored Products (as defined in Section 4.1 below) which interfere with construction operations, as directed by PharmaLogic.

1.3 *Handling and Delivery and Storage*

Handle and deliver and store Products in accordance with manufacturers' and suppliers' recommendations and in such a manner that no damage will be done to the Products, the Work and the environment

If available SHSC will designate limited storage areas at the site. Store products, materials and equipment so as to ensure the preservation of their quality and fitness for the work. Store

products on wooden platforms or other hard, clean surfaces raised above the ground or in watertight storage sheds of sufficient size for the storage of all materials and equipment which might be damaged by storage in the open Locate stored Products so as to facilitate prompt inspection. Do not use private property for storage purposes without the written permission of the property owner.

Deliver and store packaged Products undamaged, in their original wrappings or containers, with manufacturer's labels and seals intact

Keep Products free from debris, ice, snow and other foreign matter

Store paints, coatings, thinners, solvents and other volatile materials in ventilated and lockable separate shed containing no other materials.

Carefully organize prior delivery of materials to the Place of the Work to permit continual progress of the Work without delay.

Immediately remove rejected Products, from the Place of the Work.

1.4 ***Workmanship***

The work of each section shall be carried out safely, in accordance with the *Apprenticeship and Trades Qualification Act* (Ontario) and applicable regulations, by skilled and experienced workers employed by a firm having a record of satisfactory completion of similar work

Workmanship shall be of highest quality in accordance with best standard practice for type of work specified, except where specified more precisely.

1.5 ***Disposal of Wastes***

Burying and burning of rubbish and waste materials at the Place of the Work is not permitted.

Disposal of waste or volatile materials such as mineral spirits, paint or paint thinner into waterways, storm or sanitary drains is prohibited.

Comply with all environmental legislation which is applicable.

1.6 ***Pollution Control***

Wherever possible, cover or wet down dry materials to prevent blowing dust and debris.

Provide all means necessary to ensure dust control during all demolition work and during any excessive dust producing work during work of this project.

Comply with all the environmental legislation which is applicable.

1.7 ***Protection of Property - General***

Keep floors and walls free of oil, grease and other materials likely to discolour them and/or affect bond of applied finishes.

Each Subcontractor shall protect the work of other Subcontractors from damage during the execution of their work. Damaged work shall be repaired or replaced by the appropriate Subcontractor, but at the expense of those causing such damage

Provide protection required to enable existing building, equipment, services and utilities to remain in continuous and normal operation, and to maintain the Construction schedule

Indemnify SHSC from and against all claims and losses resulting from the above operations.

Provide curb cuts, making good of existing property to provide fully paved and finished approaches, and other required work, to requirements of authorities having jurisdiction.

Include making good of existing curbs, walks, paving and soft landscaping on municipal property or on SHSC's adjacent property

1.8 ***Noise Protection***

Provide full cooperation and protective measures in minimizing all excessive noise due to construction operations.

No pneumatic tools and other excessively noisy and disrupting tools, machinery and equipment will be permitted without written approval of SHSC

Where required, the Contractor shall ensure that workers wear noise protection.

1.9 ***Employee Control***

Workers are permitted into existing buildings only where their work is affected.

All entrances to existing buildings from new additions, whether through existing doors or through doors in temporary partitions, shall be kept locked Submit duplicate keys for locks to SHSC

SHSC will provide identification badges to Contractor for all Subcontractor employees who must wear them attached to their clothing in a conspicuous location throughout the duration of this project when at the Place of the Work. If damaged or lost and not returned to SHSC, a nominal charge of $10 00 per damaged or lost badge will be assessed against the Contractor. Contractor shall obtain the badges from the SHSC security office.

Contractor, Subcontractors, Suppliers and anyone employed either directly or indirectly by them, will not be permitted to use SHSC's cafeteria and washroom facilities during work of this contract. Furthermore, the consuming of food and beverages will be restricted to the Place of the Work.

1.10 ***Missing Patient Search***

In the event that the SHSC is required to do a "missing patient" search, the Contractor will be obliged to carry out a detailed search of the Place of the Work, under the direction of SHSC.

1.11 ***Security***

Due to existing collective agreements, contracted security groups are not permitted on SHSC property, except within the confines of the Place of the Work.

2. Infection Control during Construction

2.1 ***Policy Subject: Construction and Renovation***

Contractor shall provide staff, subcontractors, suppliers, workers, own forces or anyone for whom the Contractor may be responsible, with training in infection prevention and control procedures. Prior to commencement and during the course of the work, as required, the Contractor shall promptly provide SHSC with written confirmation of such training by way of a certificate.

SHSC's Infection Prevention Control Services (IPCS) will investigate and advise on the risks of organisms that exist in the Project area. The goal will be to eliminate infectious risks where possible and minimize those risks that cannot be eliminated.

During the course of the Work, IPCS will assess the risks related to the Project utilizing the risk assessment and preventive measures checklist (Appendix A) The determination of risk will guide the need for barriers during the Project. SHSC will communicate the assessment to the Contractor.

SHSC's Project Manager will provide an Environmental Assessment and Scope or Work pertaining to identifying and rectifying Infectious activity

2.2 ***Pre-construction***

The Contractor will work with IPC, SHSC's Project Manager and Environmental Consultant to address the following:

General Information on infection prevention measures is articulated

Patient populations that may be at risk are identified.

Prevention measures for essential services (e.g. water, ventilation systems, electricity) that may be disrupted are provided.

The integrity of the SHSC facility's exterior structure, spatial separations, ventilation and water supplies for any infection control problems are reviewed and assessed.

Methods for dust containment and removal of construction debris are outlined.

Traffic patterns for construction workers and supply delivery routes will be established to minimize risks to patients, staff and visitors per the SHSC's requirements and as indicated.

The need for increased filter changes during construction.

The need to close down dampers temporarily to reduce circulation of contaminated air or fumes is assessed.

The systems can provide the correct air exchange rate and pressure relationships in critical areas near construction activity

2.3 ***Construction***

Breaches in infection prevention measures that place staff and/or patients of the SHSC's facilities at risk will result in "stop" construction orders to the Contractor by IPCS.

Cleaning will be provided as categorized by IPCS within the initial stages of the Project. The Place of the Work must also be cleaned prior to and at completion of Work as follows:

1 Undertaken by Contractor and included in the Contract price:
   a. Construction cleaning prior to reopening a supply air duct during construction;
   b. Construction cleaning prior to removal of any barriers;
   c Construction cleaning after the removal of any barriers; and
   d. Construction cleaning immediately after completion of minor work performed after the removal of barriers.
2. Undertaken by SHSC and not included in Contract price
3. Final cleaning by Environmental Services prior to occupancy
4. Cleaning as required by Environmental Services during Commissioning as required.

Construction cleaning is defined as the complete removal of all debris and vacuuming the entire area with a HEPA filter unit. Area is to be inspected and approved as clean by IPCS.

Final cleaning is defined as post construction cleaning as provided by SHSC's workforce or SHSC's contracted cleaning service.

Construction Personnel: Protective clothing is to be removed when exiting through patient areas or vacuumed when exiting through other areas as categorized by IPCS with the initial stages of the Project.

Surveillance: IPCS personnel will enhance surveillance as appropriate. Field review of the Work will be conducted on a regular basis with the Contractor as necessary.

2.4 ***Water and Ventilation Systems:***

The Place of the Work will be maintained under negative pressure at all times in relation to the occupied areas of SHSC's plant and facilities to prevent dust and airborne pathogens from entering the occupied areas of SHSC's plant and facilities. Negative pressure shall be achieved through the use of dedicated (window or otherwise) exhausts units or, if direct access cannot be achieved, by HEPA filtered recirculation units that the exhaust air from the Place of the Work is not affecting pedestrian routes and is not re-entrained back into SHSC's plant and facilities through fresh air intakes. Construction exhaust/HEPA units shall be provided by the Contractor and removed at the completion of the Work.

Air systems serving only the Place of the Work will be shut down and all supply, return and exhaust openings shall be sealed to prevent dust and construction debris from entering the air system. As a further precaution, the air system will be reviewed at the end of the Project to determine if cleaning is required.

Supply and return air ducts entering the Place of the Work are to be fitted with a pre-filter unit and sealed within the Place of the Work near point of entry or exit prior to the start of disruptive activity to prevent dust and construction debris from entering the air system. As a further precaution, the air system will be reviewed at the end of the Project to determine if cleaning is required.

During construction the seal only on the supply air duct may be removed after demolition and clean up to permit ventilation within the construction area provided no other means are available.

Areas adversely affected by changes in air flows outside the construction areas are to be re-balanced to comfortable levels as advised by SHSC.

3. Fire Safety Precautions during Construction

3.1 *General Requirements*

Read and be governed by conditions of the Contract

3.2 *Closing of Exits*

All exits, including stairways and exterior doors to the outside, serving existing building must be maintained. Where an exit is blocked off or deleted due to construction activities, an acceptable alternative exit must be provided. In all cases, adequate means of egress shall be provided to permit the emergency evacuation of workers during an emergency.

Where it is absolutely necessary for access to be gained through the construction area to exit, access must be clearly defined and protected so that it is separated from the construction area by a reasonable smoke tight fire separation, equivalent to ¾ hour fire resistance rating.

3.3 *Intersecting Corridors*

Temporary fire separations of steel studs and gypsum board construction, equivalent to ¾ hour fire resistance rating, must be erected.

Where access is desired, the doorway must be protected by a door of solid core wood or hollow steel construction.

Should temporary fire separations cut-off or eliminate required access to exits, alternative access must be provided

3.4 *Fire Department Access*

Location of building addition and construction activities must not obstruct access roadways designated for fire department equipment.

If it is necessary that existing access be obstructed or deleted, alternate access, acceptable to fire department must be pre-planned and provided prior to commencement of construction, Ontario Building Code provides design criteria for required access routes.

3.5 ***Control of Combustible Materials***

Stockpiling of construction materials adjacent to the existing building must be carefully controlled.

Control of combustibles on construction site is regulated under Occupational Health and Safety Act.

3.6 ***Exposure of Construction in Progress to Existing Occupied Areas***

Existing exterior windows of plain glazing when exposed to construction in progress must be protected by 15.9mm thick cement bonded particle board on suitable framing for the duration of construction.

Other openings in existing exterior walls such as doors, louvers, etc. must be similarly protected or replaced with doors of solid core wood or hollow steel construction.

3.7 ***Openings Created Through Floors or Other Fire Separations***

Openings in existing floor assemblies and vertical fire separations necessitated by installation of equipment systems or construction in general must be temporarily sealed with fire barrier materials such as mineral wool or other non-combustible insulation

3.8 ***Modification and Extension to Existing Fire Alarm Systems***

Maintaining the fire alarm system in operating condition throughout the Work will require careful planning, especially when extension to the fire alarm system in carried out in phases.

A technical representative from the fire alarm manufacturer shall be assigned by SHSC to the Project to coordinate different stages of the extension Contractor to coordinate this work with SHSC.

Whenever a changeover time occurs, which is an outage time of at least a portion of the fire alarm system, the municipal fire department must be notified by Contractor of the temporary shut down and alternative measures must be devised. Contractor to coordinate this work with SHSC

3.9 ***Shutdown of Fire Protection System***

Where temporary a shut-down of sprinkler systems, standpipe systems or other fire protection systems is necessary due to alterations, repairs or extensions, the appropriate requirements in Ontario Fire Code, as well as SHSC's requirements, must be observed

Contractor is responsible for any costs incurred for the fire alarm false alarms caused by its work SHSC's plant and facilities are fully protected with smoke detection equipment that will be activated by numerous construction procedures

SHSC will, with a written request of a minimum of 2 working days in advance, arrange to put any fire alarm zone in bypass to permit construction. Any Contractor working in SHSC's plant and facilities will be assessed $1,500.00 fine per alarm payable to SHSC by certified

cheque. Any Contractor causing false alarms and not paying such costs will not be permitted to continue work until said cheque is received.

Requests shall identify the following information:

1. Name of Contractor
2. Where the Contractor will be working
3. Telephone numbers of persons responsible
4. Type of work being conducted.
5. Identify if fire/smoke/dust/vibration/flood will occur
6. Indicate the start and stop times

Shutdown period will only be from 0800 hours until 1430 hours each day, unless special arrangements are made through SHSC in advance of the notice time specified above.

To avoid unnecessary alarms during testing, disconnect only those zones being worked on. Zones shall be re-enabled by 1430 hours at the latest.

Contractor shall ensure that main control panel is manned at all times during shutdown period.

3.10 *Additional Life Safety Measures*

Generally, additional life safety measures should include the following additional requirements:

1. Contractors should obtain alternate fire safety plan from SHSC
2. Submit and obtain written approval from local fire department for alternate Fire Safety Plan and Training Procedure. Contractor to coordinate work with SHSC.

4. Products and Workmanship

4.1 *Products*

Products, materials, equipment and articles (referred to as **"Products"** throughout the Contract documents) incorporated in the Work shall be new, not damaged or defective, and of the quality standards specified If requested, furnish evidence as to type, source and quality of Products provided.

Defective Products, whenever identified prior to completion of the Work, will be rejected, regardless of previous reviews. Review of the work by the SHSC or inspection and testing companies does not relieve the Contractor of the responsibility of executing the Work in accordance with the requirements of Contract documents, but it is a precaution against oversight or error. Remove or replace defective Products and be responsible for delays and expenses caused by rejection at no increase in the Contract price

SHSC retains the right to select from choices available within specified Products for colours, patterns, finishes or other options normally made available. Submit full range of Product options.

4.2 *Workmanship*

1. Execute the work using workers experienced and skilled in the respective duties for which they are employed.

2. Do not employ an unfit person or anyone unskilled in their required duties.
3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with SHSC's Project Manager whose decision is final.
4. Submit proof of qualifications of Subcontractors upon request by SHSC's Project Manager to verify subcontractor's qualifications and experience meet the requirements of the Contract documents, Submit such proof in the form of a Subcontractor's qualification statement.

5. Contract Closeout Procedures and Submittals

5.1 *General*

The procedures for completing Contract and acceptance by SHSC shall be in accordance with requirements described below:

5.2 *Environmental controls:*

1. Conduct cleaning and disposal operations to comply with local ordinances and antipollution laws.
2. Store volatile wastes in covered metal containers, and remove from Place of the Work daily
3. Prevent accumulation of wastes which create hazardous conditions.
4. Provide adequate ventilation during use of volatile or noxious substances.

5.3 *Materials*

Use only cleaning materials recommended by manufacturer of surface to be cleaned and as recommended by cleaning material manufacturer.

5.4 *Final cleaning:*

Immediately prior to SHSC's review to determine if Substantial Performance of the Work has been achieved, remove surplus Products, tools, construction machinery and equipment not required for the performance of the remaining Work.

Remove waste products and debris other than that caused by SHSC, and leave the Work clean and suitable for occupancy by SHSC.

When the Contract is completed, remove surplus Products, tools, construction machinery and equipment.

Clean and polish glass, mirrors, hardware, wall tiles, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass. Leave in condition equivalent to existing.

Remove stains, spots, marks and dirt from decorative parts of the Work, electrical and mechanical fixtures, furniture fittings, walls, and floors.

Vacuum clean and dust building interiors, behind grilles, louvers, and screens. Thoroughly vacuum clean interior of electrical equipment

Polish, seal, shampoo or prepare floor finishes to recommendations of manufacturer. Clean and seal concrete floor surfaces with non-skid, matte sealer.

Inspect finishes, fittings and equipment and ensure specified workmanship and operation.

Broom clean and wash exterior walks, steps and surfaces.

Remove dirt and other disfigurations from exterior surfaces.

Clean and sweep roofs, gutters, areaways, downspouts, and drainage systems.

Sweep and wash clean paved areas at the Place of the Work.

Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment

Remove seal wrap on mechanical and electrical Products and materials and clean as required.

Clean and/or replace lamps, light fixtures, lenses and grilles.

Remove protective covering from lamps, hardware, and specialty items.

Under the direction of the Consultant, aim adjustable luminaries except for theatrical lighting instruments.

5.5 ***Closeout Submittals***

Request for SHSC's Project Manager review to determine if Substantial Performance of the Work has been achieved, submit to SHSC the closeout submittals, including, but not limited to, reviewed shop drawings, Product data sheets, samples, operating instructions, as-built records, fully executed warranties and guarantees, reports recording demonstration and instruction provided to SHSC for operation and maintenance of building systems, software required for operation and maintenance of building systems, maintenance materials, and keys, as determined by the SHSC's Project Manager.

As-built records:

1. Submit 2 sets of hard copy and CAD drawings in 2 CDs to SHSC before the application for substantial completion.
2. Final billing must be submitted within 45 days of substantial completion.

Project data book shall include the following information supplemented by additional required data specified elsewhere in the Contract documents:

1. Maintenance instruction for finished surfaces and materials.
2. Copy of hardware and paint schedules
3. Description, operation and maintenance instructions for equipment and parts list. Indicate nameplate information such as make, size, capacity and serial number
4. Names, addresses and phone numbers of Subcontractors and Suppliers, as applicable.
5. Additional material used in the Work listed under various sections showing name of manufacturer and source of supply
6. Charts, diagrams and reports.

7 Report recording demonstration and instruction provided to SHSC for operation and maintenance of building systems as described below in this section.
8. Key construction photos.
9 Permits and forms:
  a Occupancy permit; statutory declarations.
  b. Workplace Safety & Insurance Board certificate of clearance.
  c. Certificates of approval of the Work by local building department (if available)
  d. Electrical authority certificate of inspection.

6. Fire Stopping & Smoke Seals

6.1 *General Requirements*

Comply with the General Conditions of the Contract, Supplementary Conditions, and Basic Mechanical Requirements.

6.2 *System Description*

Work of the section comprises firestopping materials and/or systems to provide closures to fire at openings around penetrations, at un-penetrated openings, at projecting or recessed items, and at openings and joints within fire separations and assemblies having a fire-resistance rating, including openings and spaces at perimeter edge conditions.

Work of this section also comprises smoke sealants applies over firestopping materials or combination smoke seal/firestop seal material to form air tight barriers to retard the passage of gas and smoke

The installed firestopping/smoke sealant system shall provide and maintain a fire-resistance rating equivalent to the rating of the adjacent floor, wall or other fire separation assembly to the requirements of and as acceptable to the authorities having jurisdiction and to the Consultant.

Firestopping and smoke seals within mechanical assemblies (i.e. between sleeve and pipe/wire/duct) shall be provided as part of the Work of Division 15. Firestopping and smoke seals around the outside of such mechanical and electrical assemblies (i.e. sleeve and wall) where they penetrate fire-rated separations shall be part of the work of this section unless otherwise indicated by SHSC.

Confirm locations of exposed/non-exposed fireproofed surfaces with the Consultant prior to application.

Penetrations will have single or multiple conduits passing through and Work will consist of firestopping all penetrations with pre-approved Underwriters Laboratories of Canada ("ULC") assemblies.

6.3 *Quality Assurance*

Provide experienced and competent installers, trained by material or system manufacturer.

Applicator Qualifications:

1 Applicator shall have at least three years experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.

2. Applicator shall be approved for this work by SHSC or as listed below:
   (a) Profirestop (Tel: 416-293-0993)
   (b) Custom Insulation Systems (Tel: 905-669-0002)
   (c) Beverly F.S (Tel 905-659-3367)
   (d) Dominion Caulking (Tel: 905-883-8355)
   (e) RILI Firestopping (Tel: 905-349-3779)

3. Single Source Responsibility for Firestopping materials:
   (a) Obtain firestop materials from single manufacturer for each different product required.
   (b) Manufacturer shall instruct applicator in procedures for each material.
   (c) Refer to note on drawings for additional information, instructions and clarifications.

4. Regulatory Requirements:
   (a) Firestop system installation must meet requirements of CAN/ULC-S 115-95 tested assemblies that provide a fire rating equal to that of construction being penetrated.
   (b) Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

Fire Protection Consultant will test (review) up to 2% of completed work (Penetrations) Contractor to provide installer and enclosures at Consultant's discretion.

Consultant may or may not require destructive testing to be done. Contractor shall cover costs of repairing fire separations after destructive test are performed.

6.4 ***Delivery, Storage and Handling***

Deliver the materials to the job site in the manufacturer's unopened containers, containing the classification label, with labels intact and legible at time of use.

Store materials in accordance with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.

Before handling, read product data sheet and material safety data sheets Do not use damaged or expired material.

6.5 ***Identification***

Identify through-penetration fire stopping and smoke seal system with pressure sensitive, self adhesive, printed vinyl labels. Attach labels permanently to surfaces of penetration construction on both sides. Labels must be visible from 5'-0" above the floor. Labels must show the following information:

1. The words "Warning: through-penetration firestopping system, Do Not Disturb"
2. The applicator's name, address and telephone number
3. Designation of applicable testing and inspection agency

4. Date of installation
5 Manufacturer's name for materials

Appendix 1

SHSC's Rules and Regulations (to be posted at job site)

1 Smoke tobacco in designated areas only. Never smoke in any location that contains a combustible or explosive condition or atmosphere.

2. No person who is impaired by alcohol or drugs shall enter and/or remain on the grounds.

3. Follow instructions; don't take chances If you don't know, ask.

4. Immediately report to your supervisor any condition or practice you think might cause injury to employees or damage to equipment

5. Put everything you use in its proper place. Disorder causes injury and wastes time, energy and material. Keep your work area clean and orderly.

6. Any personnel operating equipment is to be duly authorized and instructed (licensed where practical) in the safe method of operation.

7. Whenever you, or the equipment you operate is involved in an accident, regardless of how minor, report it to your supervisor immediately. Get first aid promptly.

8. Repairs are to be made by authorized, licensed personnel only. Need for repairs must be reported to your immediate supervisor, and are not to be undertaken by non-qualified personnel

9. Wear approved personal protective equipment as directed. Keep it in good condition.

10. All authorized visitors on the property are required to wear and use appropriate safety equipment

11. Don't horseplay; avoid distracting others

12 When lifting, bend your knees, grasp the load firmly, and then raise the load, keeping your back as straight as possible. Get help for heavy loads.

13 Obey all rules, signs, and instructions

14 In the event of an accident, the Occupational Health and Safety Clinic is located in H Wing, Ground Floor, room HG46

15. A full report of any accident is to be submitted in writing to SHSC, within 24 hours of the occurrence.

16 The Contractor shall provide to SHSC's Safety Coordinator, the name and phone number of their health and safety delegate.

17. Before work begins, the Contractor shall deliver to the SHSC Occupational Health and safety department – Safety Coordinator, a list of the chemical substances to be used in all work, and a Material safety data sheet for each chemical substance (this is a WHMIS requirement).

18 The Contractor shall also provide a list of physical or biological agents produced by its work.

19. The Contractor, before the work commences, shall arrange a meeting where the Contractor and its workers are informed of the following:

(a) requirement to comply with the general health and safety rules required by SHSC;

(b) the requirement to comply with the OHSA

(c) the name and telephone number (both home and office) of the contractor's supervisor; and the health and safety representative, or members of the Subcontractors committee at the job site, whichever is applicable.

(d) The areas of the location to which the Contractor and the Contractor's workers are allowed access;

(e) Any special hazards at the job site of which the contractor and/or its workers normally would be expected to be aware (for example, what to do in case of a fire);

(f) The requirements imposed upon the contractor in the event that one of the contractor workers is injured at work.

20 As the work progresses, planned inspections are to be made of areas/places where the Contractor and his workers are working to ensure the following:

(a) The Contractor and workers comply with health & safety laws;

(b) The Contractor and workers comply with the SHSC's general health and safety rules;

(c) The Contractor's work is not creating an unacceptable health and/or safety hazard for the SHSC's employees.

Appendix 2

WHMIS (Workplace Hazardous Materials Information System) Requirements:

1. Comply with Workplace Hazardous Materials Information System in accordance with the Occupational Health and Safety Act (OHSA) requirements.

2. Before commencement of Work and during full term of the Contract, provide a list with current Materials Safety Data Sheets (MSDS) of all hazardous materials proposed for use on Project. List and data sheets shall be delivered to SHSC Occupational Health and Safety Department – Safety Coordinator

3. Label hazardous materials used and/or supplied on the Project in accordance with WHMIS requirements.

4 Provide detailed procedures for safe handling storage and use of hazardous materials. List special precautions and safe cleanup and disposal procedures. Conform to Environmental Protection Act for disposal and cleanup requirements.

5. Obtain from SHSC, where applicable, a list and MSDS of hazardous materials that may be handled, stored or used by SHSC's employees and/or Other Contractors retained by SHSC at location where work of this contract will be performed.

6. Ensure that those who handle, and/or are exposed to, or are likely to handle or be exposed to hazardous materials, are fully instructed and trained in accordance with WHMIS requirements.

Appendix 3

Notice of Designated Substances

The following Designated Substances are present at Sunnybrook Health Sciences Centre:

Designated Substance - Location

Asbestos on Construction Projects and in Buildings and Repair Operations – Can be expected in varying states in all wings except L, M, S, and T.

Ethylene Oxide – Regional Processing Centre; Receiving – M- Wing Basement; only present during a spill.

Isocyanates – SCIL – possible in other areas in small quantities

Mercury – Used in older instruments – only present during a spill

Benzene – Principally found in laboratories but may be found elsewhere

Lead – Used in many locations as lead shielding, or in lead paint.

Arsenic – Possible in laboratories

Appendix 4

Notice of Biological, Chemical and Physical Hazards

Biological:

Sunnybrook Health Sciences Centre (SHSC) is a fully functioning hospital and medical research facility As such any biological hazard that could infect a person outside the facility can be expected within the facility This includes any communicable disease.

Physical Hazards:

SHSC also contains physical hazards common to all public buildings. Contractors, their employees, and subcontractors must be aware of the general hazards associated with any kind of work in a full service public facility with residential living.

In addition to "normal" physical hazards there are also specific departmental hazards. Contractors must make their employees and subcontractors aware of the hazards they may encounter and the safety precautions to take. Contractors are required to contact SHSC departmental managers, and/or the safety office, and/or the Corporate Planning and Development or maintenance project manager regarding any specific hazards.

Chemical Hazards:

In addition to the designated substances mentioned under The Notice of Designated Substances there are approximately 5000 WHMIS regulated chemicals at SHSC and several thousand chemicals covered by The Food and Drug Act, The Pest Control Act, The Atomic Energy Control Act, and the Explosives Act. All contractors are required to have their workers WHMIS trained to work on the premises. Contractors are required to contact SHSC departmental managers, and/or the safety office, and/or the Corporate Planning and Development or maintenance project manager regarding any specific habits.

Appendix 5

Sunnybrook Health Science Centre Safety Rules Applicable To Outside Contractors and Their Employees

All contractors' personnel:

1 Work in compliance with the provisions of the Occupational Health and Safety Act and the regulations, and in compliance with the employer's health and safety rules;

2. Use or wear any equipment, protective devices or clothing required by SHSC or by the employer;

3. Report missing or defective equipment or protective devices to the employer;

4 Report any known workplace hazard to the employer;

5. Report violations of safety legislation or safety rules to the employer;

6. Do not remove for make ineffective any protective device required by legislation, by SHSC or by the employer;

7. Do not use or operate any equipment or work in a way that might endanger oneself, or any other person;

8 Do not engage in any prank, contest, feat of strength, unnecessary running or rough or boisterous conduct.

Appendix 6

Supervisory Personnel
(Person(s) having charge of the workplace or authority over the Contractor's employees)

1 Ensure that supervised employees work in compliance with the Occupational Health and Safety Act and regulations, these rules and the employer's health and safety rules;

2. Ensure that safety equipment, protective devices or clothing is used or worn by employees and visitors to the work site;

3. Advise employees and visitors to the work site of any potential or actual health or safety dangers known to exist;

4 Ensure appropriate training is given to employees about measures and procedures to be taken for their protection including, as required, (but not necessarily limited to): asbestos awareness training and WHMIS training):

5. Take every precaution reasonable in the circumstances for the protection of employees and any other persons at the work site.

Appendix 7

SHSC Occupational Health & Safety Policies And Requirements

Last Accessed (date of last update)

Title: Contractor Safety Requirements Policy No: IV-C-375

POLICY STATEMENT:

It is SHSC's policy to ensure that contractors and service providers performing work on hospital property follow applicable legislation and hospital policies related to safety, infection prevention and control, security and the environment.

Contractors must also follow all provisions of the contract agreement.

DEFINITION(S):

Designated substances: a biological, chemical or physical agent or combination thereof prescribed as a designated substance (by the Act) to which the exposure of a worker is prohibited, regulated, restricted, limited or controlled e.g. asbestos, mercury, lead. Occupational Health & Safety Act, S 1.

RELATED POLICIES:

Construction & Renovation, II-i-200R, Infection Prevention & Control
Mould Response, II-Q-1430, Infection Prevention & Control
Asbestos Management, IV-A-1800
Restricted & Confined Space, IV-R-1860

POLICY:

Planning & Contractor Selection Phase

- All project work or work performed by an external contractor must have an assigned project manager.
- As part of the bidding process, contractors must provide health and safety documentation as well as previous accident/incident experience.
- SHSC's Project Manager must consider health, safety and environmental criteria as part of the pre-qualification or tendering process to select a contractor for a project. Certifications, training records, previous hospital experience, health and safety performance, WSIB CAD-7 Rating, and company policies should be reviewed and considered in the selection process
- During the tendering process, SHSC's Project Manager must provide the contractors with a list of any designated substances in the work area, including the location and condition of any asbestos as well as the location of any other designated substances. Occupational Health will provide information from the building survey

- SHSC's Project Manager must notify the contractor if the project involves work in a restricted or confined space. SHSC's Project Manager and the contractor are responsible for following all requirements of the Restricted and Confined Space policy, IV-R-1860

Prior to Project Start Date

- The contractor should provide copies of the MSDS for products that could impact the health of safety of building occupants particularly those products that produce odours.
- Contractors must carry comprehensive liability insurance and automobile liability insurance as per the contract agreement.
- SHSC's Project Manager must advise Infection Prevention & Control of the upcoming project and involve them during the planning stage. The requirements of the Construction & Renovation policy, II-I-200R must be followed and IPC will review the containment strategies, debris removal, traffic patterns, impacts on ventilation and water systems as well as cleaning procedures. As required for Class III or IV work, Infection Prevention & Control will complete the checklist: Risk Assessment & Prevention Measures for Healthcare Facilities Construction & Renovation.
- As part of mould, dust & asbestos management, SHSC's Project Manager must notify Occupational Health and Infection Prevention & Control of the project and obtain Ceiling, Wall & Floor Access Permits and for any work that disturbs these structures. The permit must be displayed in the work area for the duration of the work. This applies to capital or facility renewal projects.
- Occupational Health will review procedures for asbestos work including containment, ventilation, air monitoring and final clean-up. Occupational Health should also be consulted for MSDS review, confined space permits and a review of any other potential health or safety issue with the project e.g. air quality.
- The departments that will be affected by the project must be consulted in the planning process to address health and safety concerns as well as logistics planning to minimize work disruptions.
- SHSC's Project Manager must provide contractors with the appropriate SHSC policy requirements e.g. Asbestos Management, Mould Response, Construction & Renovation, Restricted & Confined Space as determined by the nature of the work.
- Contractors must be provided with information on Code Brown and Code Red procedures at the hospital so that they are able to report and respond to any floods or fires in the construction area.
- SHSC's Project Manager is responsible for ensuring that construction areas are secure at all times to prevent unauthorized entry and must ensure contractors follow procedures to comply with this requirement
- Infection Prevention & Control, Occupational Health or a designated third-party environmental consultant will inspect containment barriers prior to and during the work.

Policies & Training

- Contractors must follow the Occupational Health and Safety Act Regulations, all environmental protection legislation as well as the requirements of applicable SHSC Infection Control and Health & Safety policies.

- All contracted workers must have WHMIS training as well as any other safety training relevant to the work, e.g. Asbestos Awareness training, Confined Space procedures, Infection Prevention & Control procedures

Requirements for Onsite Work

- Contractors must ensure that onsite workers are supplied with and use appropriate safety equipment and follow safe work procedures

- Contractors are encouraged to get flu shots particularly if they will be working in patient areas.

- All scaffolding must comply with applicable standards.

- A contractor shall ensure that any tools or equipment brought on hospital property are safe to use, meet applicable standards, and the equipment along with any safety devices are in good condition and functioning properly.

- The contractor is responsible for maintaining a clean work area free of debris. Once the work is finished, all equipment, tools, supplies and debris shall be removed by the contractor following infection control, environmental, and asbestos procedures as required.

- Contractors requiring storage for flammables exceeding daily volumes must obtain permission from SHSC's Project Manager who will consult with the Fire Prevention Coordinator as required.

- Infection Prevention & Control will inspect renovated or newly-constructed patient care areas prior to occupancy.

- For projects with an asbestos abatement, Occupational Health and/or a third-party environmental consultant will evaluate clean-up and/or clearance sampling prior to occupancy Environmental Consultants for asbestos abatements must follow the requirements of Section 6 0 of the Asbestos Management policy (IV-A-1800) pertaining to containment inspections and air monitoring.

Incidents

- A contractor shall immediately notify SHSC's Project Manager of any employee incident that resulted or may have resulted in an injury or property damage. SHSC's Project Manager will follow-up with Occupational Health as required.

- A contractor shall immediately notify SHSC's Project Manager of any breach in infection control or asbestos containment structure. The Project Manager will contact Infection Control and/or Occupational Health.

- If Contractors find an errant sharp e.g. needle during their work, they should notify their SHSC contact to arrange for proper disposal Contractors who have a needlestick injury should

immediately seek medical care at Occupational Health or the Emergency department if after hours.

Project Completion

- For any project work involving construction, installation or modification of new equipment or systems, SHSC's Project Manager must ensure that all appropriate start-up testing, commissioning or certifying is completed before final sign-off.

REFERENCES:

1. Ontario Ministry of Labour. Occupational Health and Safety Act and Regulations for Industrial Establishments. 1990.

Appendix 8

Patient Care Policy Manual
Section II: Infection Prevention and Control
Title: Mould Response Policy (IP&C and OHS) Policy No: II-Q-1430
The SHSC Intranet version of this document is considered the most current

Issued by: Infection Prevention and Control **Original Issued:** April 2005
Approved by: Medical Advisory Committee Revision(s):

POLICY STATEMENT:
It is a SHSC's policy to establish procedures to ensure airborne mould is minimized through safe work practice. Procedures developed will assist to identify mould sites and the source, so that an appropriate plan of action can be put in place to assure the safety of our employees, patients and volunteers is maintained. Exposures will be kept to a minimal with respect to environmental pathogens such as moulds and other fungi. These environmental pathogens, such as *Aspergillums and Stachybotrys* can be harmful to patients with already compromised immune systems

DEFINITION(S):
Fungus:
Any of a major group (Fungi) of saprophytic and parasitic spore-producing organisms usually classified as plants that lack chlorophyll and include moulds (filamentous fungi), rusts, mildews, smuts, mushrooms, and yeasts.
Immune Compromised:
A reduced or lacking ability for the body to defend against pathogens (bacteria, virus, and fungi). Examples of immune compromised individuals include oncology patients, HIV/AIDS patients, dialysis patients, and patients in Intensive care units (ICU) (e g. critical care unit, burn unit, neurosurgical ICU, Neonatal ICU, etc.).
Mould:
A growth of filamentous fungi, with a portion growing into damp or decaying organic matter and a visible surface growth, which usually assumes a fluffy appearance Examples of filamentous fungi include Aspergillums and Stachybotrys.

PROCEDURE: If mould is suspected:
1. For an affected area greater than 10 ft 2, Facilities Services is to contact Infection Prevention & Control (IP&C) and Occupational Health & Safety (OHS) for direction and confirmation of the presence of mould.
2. If the presence of mould is confirmed, the affected area is to be hoarded off with 2 layers of 6 mil polyethylene sheeting. This is to prevent any further dissemination of fungal spores.
3. If the presence of mould is confirmed, and the **affected area is a ceiling tile or is less than 10 ft2** (Small-Scale), Facilities Services may remediate the mould following appropriate standards.
4 If the presence of mould is confirmed and the **affected area is greater than 10 ft2**, Facilities Services (or Corporate Planning) must contact an external Mould Abatement Contractor. The abatement must follow appropriate remediation standards
5. Project Manager or Project Lead must retain an incident report in the building mould record and forward copies to IPC and OHS.

REFERENCES
1. Mould guidelines for the Canadian construction industry. Canadian Construction Association, 2004
2. Guidelines for the investigation, assessment and remediation of mould in workplaces. Workplace Safety and Health Division, Manitoba Department of Labour & Immigration, March 2001

Infection Control during Construction, Renovation and Maintenance

Sunnybrook Health Sciences Centre		Policy No:	IP&C-0006
Title	Infection Control during Construction, Renovation and Maintenance	Original: *(mm/dd/yyyy)*	01/01/2001
Category	Infection Prevention & Control	Reviewed: *(mm/dd/yyyy)*	09/01/2007, 03/09/2010, 03/08/2012
Sub-Category	Construction & Renovation	Revised: *(mm/dd/yyyy)*	09/01/2007
Issued By:	Infection Prevention and Control		
Approved By:	Medical Advisory Committee		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

POLICY STATEMENT:

It is a Sunnybrook Health Sciences Centre (Sunnybrook) policy to ensure that infection prevention and control guidelines and standards are adhered to with all health care facility planning, design, construction, renovation, maintenance and repair. The goal is to eliminate any infectious risks where possible and minimize those risks that cannot be eliminated from agents released or augmented because of actions undertaken within the health care facility.

DEFINITIONS: (as per CSA Standard Z317.13-03)

Construction:
Minor or major building activities that disturb or modify building structures and systems; Includes new construction, renovation, maintenance, and repair work within or adjacent to the facility.

Construction Cleaning:
The complete removal of all debris and vacuuming the entire area with a HEPA equipped unit. Wet mopping of area is permitted, dry sweeping is not.

Contractor:
A person who undertakes a construction or renovation project for an owner; May be a contractor, subcontractor, construction manager, consultant, or tradesperson.

Fungus:
A diverse group of saprophytic and parasitic spore-producing organisms usually classified as plants that lack chlorophyll and include moulds (filamentous fungi), rusts, mildews, smuts, mushrooms, and yeasts.

HEPA (High-Efficiency Particulate Air) filter:
An air filter with an efficiency of 99.97% in the removal of airborne particles 0.3*u* or larger.

Mould:
A growth of filamentous fungi, with a portion growing into damp or decaying organic matter and a visible surface growth, which usually assumes a fluffy appearance. Examples of environmentally significant filamentous fungi include *Aspergillus* and *Stachybotrys*.

Nosocomial Infection:
Infections that originate in a healthcare setting.

Project Manager (PM):
The lead representative from Corporate Planning and Development, Facilities Services and Others, responsible for the maintenance, construction or renovation project. The PM will advise I of any scheduled construction/renovation projects and ensure that IP&C requirements are addressed and adhered to from the start of the project.

Negative Pressure Differential:
Use of HEPA filtration units within the work zone to direct air flow from the corridors, or any adjacent area, into the work zone, ensuring that contaminated air cannot escape from the negative pressure room to other parts of the facility. Negative pressure differential with respect to all adjacent building areas is not less than 7.5 Pa (0.03 in wc).

PROCEDURE:

1. **Planning and Design Phase:**
   An interdisciplinary design team shall be assembled early on in the design process and must include an infection prevention and control representative. Designs shall incorporate the latest guidelines for design and construction of health care facilities (e.g. AIA, CSA). Subjects to be reviewed during the design phase include, but are not limited to, the following:
   - Number, location and type of airborne infection isolation rooms
   - Air-handling and ventilation needs in special areas such as operating theatres, critical care units, laboratories, etc.
   - Water systems to limit exposure to opportunistic water-borne organisms
   - Minimum spacing requirements
   - Sink selection and placement (see **Sink Standards**)
   - Finishes and surfaces
   - Assessment of risks related to the project utilizing the Risk Assessment and Preventative Measures Checklist. The determination of risk will guide the need for barriers during the construction/renovation project, and will allow for the associated costs to be incorporated into the appropriate budgets/tender documents
2. **Pre-Construction Phase:**
   At project start-up meeting, at meetings convened prior to the start of each Stage of the Work, at pre-installation meetings, and at regular progress meetings, infection prevention and control procedures are to be reviewed. The designated infection prevention and control representative shall attend such meetings. Subjects to be reviewed include, but are not limited to, the following:
   - General outline of infection prevention and control requirements
   - Identification of patient populations that may be at risk
   - Prevention measures required during disruption of essential services (e.g. water, ventilation systems, electricity)
   - The integrity of the facility's exterior structure, spatial separations, ventilation and water supplies for any infection control problems are reviewed and assessed
   - Methods for dust containment and removal of construction debris are outlined
   - Traffic patterns for construction workers and supply delivery routes will be established
   - Needs assessment for increased filter changes during construction
   - The need to close down dampers temporarily to reduce circulation of contaminated air or fumes is assessed
   - Impact of air systems (correct air exchange rates and pressure relationships) in critical areas near construction activity
   - Site inspection checklist
   - Provisions for ceiling/wall access
3. **Construction Phase:**
   a. **Dust Control**
      Risk assessment of work zone shall be undertaken by IP&C, in conjunction with Project Manger at beginning of project. Preventative measures will be implemented to control the migration of dust particles from the work zone to adjacent areas. Methods will vary depending on the location, type of construction activity and population at risk.
   b. **Heating, Ventilation, Air Conditioning (HVAC)**
      All intake and exhaust vents/grills within work zone must be identified prior to

construction. Where dust will be produced these vents/grills must be sealed off prior to construction to prevent contamination of HVAC system. At completion of project the HVAC system must be inspected for evidence of dust/water contamination and cleaned if necessary prior to user hand off.

If the HVAC was turned off for the project then it must be re-commissioned prior to user hand off. Documentation shall be provided to Infection Prevention and Control regarding cleaning of HVAC system, viability of HEPA filters (if applicable), air balancing and direction of air flow. Occupied spaces adjacent to the work zone must have functioning HVAC systems throughout the project. All shutdowns affecting occupied areas must be communicated to IP&C in advance to determine if alternative means of air are required.

At the beginning and for the duration of construction/excavation outside/adjacent to the facility all intake grills will be identified and covered with a filter to prevent contamination. The internal pre-filter and primary filter for these air intakes will be monitored throughout the project and changed as required. IP&C and the Project Manager will monitor the HVAC system and determine if air monitoring is necessary.

c. **Plumbing**
IP&C is to be notified in advance of all water and steam shutdowns. Appropriate procedures must be followed throughout the project to ensure the potability of the water in the health care facility.

d. **Risk Reduction**
High risk populations must be moved to an area away from the construction zone if air quality cannot be ensured during construction. Do not transport any patients through the construction zone. Staff, patients and visitors are not permitted to enter the construction work area. Provisions will be made throughout the project to ensure that fire/emergency exits are not compromised.

Breaches in pre-specified infection control preventative measures, as outlined in **Appendix I**, that place staff and/or patients at risk will result in "stop" construction orders to the Project Manager and Site Foreman by Infection Prevention and Control. An Infection Prevention and Control Inspection Report shall be provided by IP&C outlining the deficiencies.

e. **Surveillance**
IP&C will perform regular site inspections to ensure continued compliance with assigned preventative measures and barrier integrity. The **Monitoring Checklist** that will be used for these inspections is provided in ***Appendix II***, (to follow) and will be provided to the contractor at the start of the project.

f. **Contractor Duties**
It is the responsibility of the contractor to ensure that all personnel on-site are trained and compliant with the IP&C preventive measures. Contractors are not permitted to use elevators in use by visitors/staff/patients. Where separate elevators are not available for use by the contractor specific times will be designated. Prior to construction IP&C, Project Manager and the Project Team will establish paths, times and procedures for the transportation of clean/sterile supplies, equipment and construction materials, including removal of construction debris. Contractors are required to follow the designated routes for entry/exit to and from the work zone to the outside.

g. **Mould**
If mould is discovered during construction IP&C and Occupational Health and Safety must be notified and they will report to the Joint Occupational Health and Safety Committee. Please refer to Mould Response Policy for further information.

4. **Post-Construction Phase:**
   a. Stages of Cleanin
   Contractor is responsible for cleaning the work zone and adjacent zone on a regular basis throughout the project as per **Appendix I.** The work zone must be cleaned prior to and at completion of work prior to user hand off and before the following:
      - Prior to reopening a supply air duct (to be completed by Contractor)
      - Prior to removal of containment barriers (to be completed by Contractor)
      - After the removal of containment barriers (to be completed by Sunnybrook Environmental Services)

   b. Inspection/Sign-off
   At the completion of construction, prior to containment barrier removal IP&C is to be notified to inspect

APPENDICES AND REFERENCES:

REFERENCES:

1. Bartley JM and the 1997, 1998 and 1999 APIC Guidelines Committee. *APIC state-of-the-art report: the role of infection control during construction in health care facilities.* Am J Infect Control 2000;28(2):156-69
2. American Institute of Architects Academy of Architecture for Health. *Guidelines for design and construction of hospital and health care facilities, 1996-97.* Washington: American Institute of Architects Press, 1996.
3. Canadian Standards Association. *Infection Control during Construction or Renovation of Health Care Facilities (Z317.13-03).* Etobicoke: Canadian Standards Association, 2003.
4. Canadian Standards Association. *Special Requirements for Plumbing Installations in Health Care Facilities (Z317.1-98).* Etobicoke: Canadian Standards Association, 1998.
5. Canadian Standards Association. *Special requirements for Heating, Ventilation, and Air Conditioning (HVAC) Systems in Health Care Facilities (Z317.2-01).* Etobicoke: Canadian Standards Association, 2001.
6. N.Y. City Dept. of Health. 2000. *Guidelines on assessment and remediation of fungi in indoor environments.* New York City Dept. of Health, New York, NY.

Appendix I (Click here for Print copy)

Infection Prevention and Control
Risk Assessment and Preventative Measures Checklist for Health Care Facility Construction & Renovation

Construction/Renovation Project Name/Identifier			
Project Manager and Contact Number			
Infection Prevention and Control Representative and Contact Number			
Contractor(s)			
Contractor's Contact Information			
Construction Activity Type		Population Risk Group	
Matrix Value		Proposed Project Start Date	

Part One: Types of Construction Activity

DEFINITIONS OF CONSTRUCTION ACTIVITY	
Type A	Inspections and General Upkeep Activities. Includes but is not limited to: removal of ceiling tiles for visual inspection (limited to 1 tile per 50 square feet); painting (but not sanding); installation of wall covering; electrical trim work; minor plumbing; and activities, which do not generate dust or require cutting into walls or access to ceilings other than for visual inspection
Type B	Small scale, short duration activities, which create minimal dust. Includes, but is not limited to, installation of telephone and computer cabling, access to chase spaces, cutting into walls or ceiling where dust migration can be controlled.
Type C	Any work that generates a moderate to high level of dust. Includes, but is not limited to, demolition or removal of built-in building components or assemblies, sanding of wall for painting or wall covering, removal of floor covering/wallpaper, ceiling tiles and casework, new wall construction, minor ductwork or electrical work above ceilings, major cabling activities.
Type D	Major demolition and construction projects. Includes, but is not limited to, heavy demolition, removal of a complete ceiling system, and new construction.

Part Two: Classification of Population Risk Group

Population Risk Group Breakdown			
GROUP 1 LOW	GROUP 2 MEDIUM	GROUP 3 MEDIUM to HIGH	GROUP 4 HIGHEST
• Private/Office areas • Areas operating outside or void of patient care	• Patient Care areas not identified in Group 3 or 4 • Laundry • Cafeteria • Dietary • Materials Management • PT/OT/Speech • Admission/Discharge • Echocardiography Laboratories not specified as Group 3 • Public Corridors through which patients, supplies, linen pass)	• Emergency Rooms • Radiology/Medical Imaging • Post-anaesthesia Care units or Same Day Surgery (MG, M2) • Labour and Delivery • Newborn Nurseries • Medical laboratories (Microbiology (B1), Transfusion Science (B2), Chemistry (CG), Pathology (E4, M2, B1), Haematology lab (CG), etc.) • Post Surgical/Trauma Patient Care Units (D5, C5, D3) • Oncology Units (C2, C6, D6) • General Medicine Units (D2, D4, B4, C4, CGMU)	• Ross Tilley Burn Centre (D7) • Critical Care Unit (M2) • Cardiovascular Intensive Care Unit (M2) • B5 Intensive Care Unit • Operating rooms (M2, D7, MG, M3) • Reprocessing Centre (MB) • Newborn Intensive Care Unit • Pharmacy Admixture • Cardiovascular Care Unit (C3) • Cardiac Catheterization Suites (B3) • Intensive Care Unit (D4ICU)

Part Three: Construction Activity and Risk Group Matrix

A copy of the Risk Assessment and Preventive Measures Checklist must be sent to the Infection Prevention and Control Department to determine the matrix and determine the preventive measures required Adaptations to the prevention measures can only be made after approval has been provided by the infection control personnel.

-	Construction/Renovation/Maintenance Activity			
Risk Group	**Type A**	**Type B**	**Type C**	**Type D**
Group 1	I	II	II	III/IV
Group 2	I	II	III	IV

Group 3	I	III	III/IV	IV
Group 4	I-III	III/IV	III/IV	IV

Part Four: Recommendations for Infection Control Preventive Measures

Matrix Class I Requirements

Ia) C/R Activities - Dust Control

1. After visual inspection replace displaced tiles and close access panels
2. Work area HEPA vacuumed if dust created during activity
3. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet

Ib) C/R Activities - Plumbing

4. Schedule water interruptions during periods of low user activity
5. Faucet aerators, gaskets and items made of materials that support the growth of Legionella are not installed or used
6. Water temperature meets standards set by Sunnybrook Health Sciences Centre
7. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
8. Water lines flushed prior to re-use

Matrix Class II Requirements

IIa) C/R Activities - Dust Control

1. All contractors and subcontractors must follow the assigned traffic route to and from the C/R zone
2. After visual inspection replace displaced tiles and close access panels
3. Active means provided to minimize dust generated and migrated into the atmosphere
4. Use drop sheets and water misting during cutting to control dust
5. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
6. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
7. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
8. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
9. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group

IIb) C/R Activities – HVAC

10. Ventilation system disabled in the C/R area until project completed (where possible)
11. Need to change and/or clean filters in C/R area monitored
12. Air intake and exhaust vents in C/R zone sealed off with polyethylene

IIc) C/R Activities - Plumbing

13. Schedule water interruptions during periods of low user activity
14. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
15. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*
16. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
17. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

Matrix Class III Requirements

IIIa) C/R Activities – Dust Control

1. IP&C consultation completed and IP&C dust control measures approved
2. Impermeable solid dust barrier, from true ceiling to floor erected and inspected by IP&C before start of project (drywall/sheetrock/gypsum board)
3. Double layer of 6 mil fire retardant polyethylene is an alternative dust barrier, but IP&C must be consulted to determine optimal choice based on location, type and duration of project
4. Upper seals must be installed above the false ceiling to the true ceiling around all penetrations to complete the dust barrier
5. Sticky mat placed and maintained outside C/R zone to trap dust from workers shoes, equipment and debris that leaves the C/R zone
6. Contractors vacuum themselves with HEPA-filtered vacuum before leaving work site (alternatively contractors can wear cloth/paper coveralls that are removed each time they leave the work site)
7. Use drop sheets and water misting during cutting to minimize dust generated and migrated into the atmosphere
8. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
9. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
10. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
11. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
12. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group
13. Holes in walls repaired within 8 hours or temporarily sealed
14. Dust barrier shall remain in place until project complete, area has been thoroughly cleaned and inspected by IP&C
15. Dust barriers removed carefully to minimize the spreading of dust and other debris particles associated with the C/R project

Matrix Class III Requirements (cont'd)

IIIb) C/R Activities – HVAC

16. High-Efficiency Particulate Filters (HEPA) shall be used to obtain a negative pressure differential. Contractor responsible for providing appropriate number of units based on square footage of C/R zone
17. Filters shall be monitored and replaced if clogged or functioning below the manufacturer's specifications
18. Negative pressure differential with respect to adjacent areas is no less than 7.5 Pa (0.03 in wc)
19. Intake and exhaust vents/grills within C/R zone to be sealed off with poly for the duration of the project
20. Where possible air is to be exhausted directly outside and way from intake vents, alternatively air is to be filtered through HEPA filter before being re-circulated
21. Ventilation systems working properly in adjacent areas
22. Ventilation system is cleaned if contaminated by soil, water or dust after C/R project completion

IIIc) C/R Activities – Plumbing

23. An alternate source of potable water must be provided for users during prolonged plumbing shutdowns and/or after major plumbing installation/repairs until potable water has been cleared for signs of *Legionella*
24. Schedule water interruptions during periods of low user activity
25. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
26. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*

27. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
28. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

IIId) C/R Activities – Risk Reduction

29. High risk patients in/adjacent to C/R areas moved
30. Cleaning frequency of areas adjacent to C/R zone by cleaning by Hospital Environmental Services to be increased while project is underway
31. Traffic pattern designated for clean or sterile supplies and equipment that avoids C/R zone
32. Hospital medical allied health staff are not permitted to enter to then C/R zone for the duration of the project

Matrix Class IV Requirements

IVa) C/R Activities – Dust Control

1. IP&C consultation completed and IP&C dust control measures approved
2. Impermeable solid dust barrier with anteroom erected and inspected by IP&C before start of project
3. Upper seals must be installed above the false ceiling to the true ceiling around all penetrations to complete the dust barrier
4. Sticky mat placed and maintained fresh outside and inside anteroom to trap dust from workers shoes, equipment and debris that leaves the C/R zone
5. Construction workers leave C/R zone through anteroom to be vacuumed with HEPA-filtered vacuum before leaving work site (alternatively contractors can wear cloth/paper coveralls that are removed each time they leave the work site)
6. Impermeable solid dust barrier, from true ceiling to floor erected and inspected by IP&C before start of project (drywall/sheetrock/gypsum board)
7. Use drop sheets and water misting during cutting to minimize dust generated and migrated into the atmosphere
8. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
9. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
10. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
11. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
12. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group
13. Holes in walls repaired within 8 hours or temporarily sealed
14. Dust barrier to remain in place until project complete, area has been thoroughly cleaned and inspected by IP&C
15. Dust barriers removed carefully to minimize the spreading of dust and other debris particles associated with the C/R project

Matrix Class IV Requirements (cont'd)

IVb) C/R Activities – HVAC

16. High-Efficiency Particulate Filters (HEPA) shall be used to obtain a negative pressure differential. Contractor responsible for providing appropriate number of units based on square footage of C/R zone
17. Filters shall be monitored and replaced if clogged or functioning below the manufacturer's specifications
18. Negative pressure differential with respect to adjacent areas is to be maintained no less than 7.5 Pa (0.03 in wc)
19. Intake and exhaust vents/grills within C/R zone to be sealed off with poly for the duration of the project
20. Where possible air is to be exhausted directly outside and way from intake vents,

alternatively air is to be filtered through HEPA filter before being re-circulated
21. Ventilation systems working properly in adjacent areas
22. Ventilation system is cleaned if contaminated by soil, water or dust after C/R project completion

IVc) C/R Activities – Plumbing

23. An alternate source of potable water must be provided for users during prolonged plumbing shutdowns and/or after major plumbing installation/repairs until potable water has been cleared for signs of *Legionella*
24. Schedule water interruptions during periods of low user activity
25. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
26. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*
27. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
28. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

IVd) C/R Activities – Risk Reduction

29. High risk patients in/adjacent to C/R areas moved
30. Cleaning frequency of areas adjacent to C/R zone by cleaning by Hospital Environmental Services to be increased while project is underway
31. Traffic pattern designated for clean or sterile supplies and equipment that avoids C/R zone
32. Hospital medical and/or allied health staff are not permitted to enter to then C/R zone for the duration of the project

Sunnynet
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Recommended Sink Standards for New Construction and Renovation

Sunnybrook Health Sciences Centre		Policy No:	IP&C-0007
Title	Recommended Sink Standards for New Construction and Renovation	Original: *(mm/dd/yyyy)*	05/01/2002
Category	Infection Prevention & Control	Reviewed: *(mm/dd/yyyy)*	10/15/2007, 03/09/2010, 03/08/2012
Sub-Category	Construction & Renovation	Revised: *(mm/dd/yyyy)*	
Issued By:	Infection Prevention and Control Committee		
Approved By:	Medical Advisory Committee		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

POLICY STATEMENT:

It is a Sunnybrook Health Sciences Centre policy to provide guidelines for evidence-based sink design in new construction and renovation projects to decrease and prevent the transmission of pathogens to patients, staff and visitors.

In addition to consulting all applicable regulations, codes, and standards when selecting sinks and/or related plumbing fixtures, *Infection Prevention & Control* considerations must be reviewed in order to determine the type of sink, fixture and options that may be installed in a specific location as defined below.

These recommendations do not apply to utility sinks (e.g. clean/soiled rooms).

IP&C should be consulted for sink specifications and requirements in facility areas not specifically outlined in this document.

For manufacturer fixture specifications, refer to Corporate Planning & Development's Master Specifications.

DEFINITION(S): (if any. If not type N/A)

Handwashing station:
An area providing a sink with hot and cold water supply and a faucet that facilitates easy on/off/mixing capabilities. The station includes provision of cleansing agents and drying capabilities." *[AIA Guidelines 2001: Glossary p.166]*

Scrub Sink:
A sink used for scrubbing of the hands and forearms during the preparation for surgical procedures.

Utility Sink:
A sink, used by facility staff, to clean instruments/articles, or to be used for general purposes by staff in routine unit cleaning, not used for handwashing

Manual Washing Sinks:
Sinks used within food premises or food preparation facilities for the manual cleaning and sanitizing of multi-service articles and utensils differing from Handwash stations and mechanical washing (dishwashers).

Backsplash:
Impermeable material mounted behind sink area measuring a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level to prevent rotting and deterioration of the wall from water/chemicals splashing behind the sink causing mould and bacterial contamination.

PROCEDURE:

1. **Critical Care, Emergency Rooms, Reprocessing Centres[1]/Areas**
   Apply general design from AIA Guidelines, 2001: Section 7.3
   Design Parameters: (AIA, 2001: section 7.3.A8)
   - Single patient room: 1 sink near entrance *in addition to sink in washroom*
   - Open plan room with more than one patient: 1 sink near entrance per three beds *in addition to sink in washroom* (1 sink : 3 beds ratio)
   - Conveniently-located near nurses' station and patient bed areas

   Fixture Specifications:

   - Sink: Stand-alone with sufficient slope for adequate drainage to prevent pooling
   - Deep sink. Sufficient depth to contain/prevent contamination (minimum of 8 inches clearing from spout to sink top)
   - Type: porcelain or enamel preferred
   - Traps: all metal with no rubber gaskets at sink/drain connection – i.e. can be plastic or neoprene
   - Faucet: gooseneck types (to be defined)
   - No aerators
   - Hands-free, ergonomically designed foot operated control. No single lever wrist blades. No ultrasonic controls or automatic temperature control
   - Impermeable backsplash installed behind sink: material easily cleaned and maintained to prevent growth and transmission of organisms – measuring a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level
   - Mounted Paper towel dispensers. No knob or lever
   - Liquid dispensers (soap, alcohol handrinse, or lotion): non-refillable bottle, placed to prevent splash-up contamination

2. **Operating Rooms & Delivery Suites**
   Apply general design from AIA Guidelines, 2001: Section 7
   Design Parameters: (AIA, 2001: section 7)
   - Two scrub positions provided near the entrance to each Operating Room – can be shared between 2 OR's if located in between the two rooms. [AIA, 2001: Section 7.7.C5]
   - Scrub sinks recessed into an alcove out of the main traffic areas [AIA, 2001: Section 7.7.C5]
   - Scrub sinks located outside the sterile core, with alcove located off the semi-restricted or restricted areas of the surgical suite [AIA, 2001: Section 7.7.C5]

   Fixture Specifications:

   - Sink: deep scrub sink (minimum 23 inches depth), stand-alone with sufficient slope for adequate drainage to prevent pooling
   - Deep sink. Sufficient depth to contain/prevent contamination
   - Type: corrosion resistant material, stainless steel
   - Traps: all metal with no rubber gaskets at sink/drain connection

- Faucet: gooseneck types
- No aerators
- Hands-free, ergonomically designed foot or knee operated control. No single lever wrist blades. No ultrasonic controls or automatic temperature control
- Impermeable backsplash installed behind sink: material easily cleaned and maintained to prevent growth and transmission of organisms – measuring a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level
- Mounted Paper towel dispensers. No knob or lever
- Liquid dispensers (soap, alcohol handrinse, or lotion): non-refillable bottle, placed to prevent splash-up contamination

3. **General Patient Areas (Including Nurses' Stations, Medication Rooms, & clinical areas, etc...)**
   Apply general design from AIA Guidelines, 2001: Section 7.2 Design Parameters: (AIA, 2001: section 7.2.A4, & 7.2.B.4)
   - Single patient room: 1 sink near entrance in addition to sink in washroom
   - Open plan room (semi-private room): 1 sink near entrance per three beds in addition to sink in washroom (1 sink : 3 beds ratio)
   - Conveniently-located near nurse station and patient bed areas
   - Soiled and clean utility rooms must contain at least one dedicated handwash basin in addition to dedicated utility sinks. (AIA, 2001: section.7.9.D16
   - One handwash station for staff use within or at each treatment space [AIA, 2001: Section 7.13.C2]

   Fixture Specifications:

   - Sink: deep sink, stand-alone with sufficient slope for adequate drainage to prevent pooling
   - Deep sink. Sufficient depth to contain/prevent contamination (minimum of 8 inches clearing from spout to sink top –flood level)
   - Type: porcelain or enamel preferred to reduce noise
   - Traps: all metal with no rubber gaskets at sink/drain connection
   - Faucet: gooseneck types
   - No aerators
   - Long wrist/elbow lever:
   - Handwashing station blade handles not exceed 4 ½ inches or 114.3 mm in length
   - Clinical sink handles be at least 6 inches in length or 152.4mm) or long single lever. [AIA, 2001: Section 7.31.E1c]
   - No ultrasonic controls or automatic temperature control
   - Impermeable backsplash installed behind sink: material easily cleaned and maintained to prevent growth and transmission of organisms - measuring a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level
   - Mounted Paper towel dispensers. No knob or lever
   - Liquid dispensers (soap, alcohol handrinse, or lotion): non-refillable bottle, placed to prevent splash-up contamination

4. **Food Preparation Areas**
   (Same standards as general areas if not contraindicated in *FPR 652/90*)
   - Must adhere to *Food Premises Regulations 562/90 [R.R.O. 1990, Reg.562, s.20(1 & 2), s.72(1 & 3);* O.Reg.586/99, *s.7(1)*]

   Note 1: *FPR 562/90* has been amended as *O.Reg 502/01.*

   Note 2: *FPR 562/90* Handwash basins and manual utensil washing stations requirements are not the same as those defined under the *AIA*

   a. **Handwash Stations** for food premises to be used for *washing of the hands only*.
      Handwash Station Design Parameters: (FPR 562/90)

- Minimum of 1 dedicated handwash station per food preparation area

Handwash Station Fixture Specifications:

- Sink: corrosion resistant material (stainless steel) or porcelain/enamel material
- Type: stand-alone with sufficient slope for adequate drainage to prevent pooling
- Deep sink. Sufficient depth to contain/prevent contamination
- Traps: all metal with no rubber gaskets at sink/drain connection
- Faucet: gooseneck types
- No aerators
- Handwashing station blade handles not exceed 4 ½ inches or 114.3 mm in length [AIA, 2001: Section 7.31.E1c]
- No ultrasonic controls or automatic temperature control
- Impermeable backsplash installed behind sink: material easily cleaned and maintained to prevent growth and transmission of organisms - measuring a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level
- Mounted Paper towel dispensers. No knob or lever
- Hot and cold running water under pressure
- Liquid dispensers (soap, alcohol handrinse, or lotion): non-refillable bottle, placed to prevent splash-up contamination

b. **Sinks to be used for the manual cleaning and sanitizing of multi-service utensils (Manual Washing)** must meet the following standards as set out in the *FPR 562/90*:

Manual Washing Design Parameters: *(FPR 562/90)*

- Minimum of one 3-compartment sink per food premises utensil washing area (sink 1 = cleaning, sink 2 = rinsing, sink 3 = sanitizing) for the cleaning and sanitizing of utensils and instruments
- A 2-compartment sink can be installed only if the cleaning and rinsing of the utensils can be adequately achieved within the first of the two sinks, leaving the 2nd sink for sanitizing only.
- These manual cleaning sinks are not to be used for handwashing.

Manual Washing *Fixture Specifications*: *(FPR 562/90)*

- Sinks to be made of corrosion-resistant material and of sufficient size for the purpose – stainless steel industrial size[R.R.O. 1990, Reg.562, s.72 (1), s.74. s.75(1)]
- Traps: all metal with no rubber gaskets at sink/drain connection
- Faucet: gooseneck types
- Hot and cold running water under pressure, with mechanism for addition of liquid detergent and utensil sanitizer
- Mounted Paper towel dispensers. No knob or lever
- Impermeable backsplash installed behind sink: material easily cleaned and maintained to prevent growth and transmission of organisms - measuring a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level

Note 3: Although this section outlines sinks required for the manual washing of multi-use food service utensils, it is strongly recommended, where available, that mechanical washing is provided for multi-service utensils.

5. **Laboratories**
   Apply general design of AIA Guidelines, 2001: section 7.12.A, C
   Design Parameters: (AIA, 2001: section 7.2.A4, & 7.2.B.4)
   - Conveniently-located/accessible to each laboratory station area
   - (minimum of 1 sink : 2 benches)
   - Hopper in which chemicals and laboratory materials to be disposed, separate

from handwash station

Fixture Specifications:

- Sinks with water and access to vacuum, gases, and air, and electrical services as needed (AIA, 2001: section 7.12.A)
- Sink: deep sink, stand-alone with sufficient slope for adequate drainage to prevent pooling
- Deep sink. Sufficient depth to contain/prevent contamination (minimum of 8 inches clearing from spout to sink top)
- Type: corrosion resistant material
- Traps: all metal with no rubber gaskets at sink/drain connection
- Faucet: gooseneck types
- Hands-free, ergonomically designed foot operated control. No single lever wrist/elbow blades. No ultrasonic controls or automatic temperature control
- Impermeable backsplash installed behind sink: material easily cleaned and maintained to prevent growth and transmission of organisms - measuring a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level
- Mounted Paper towel dispensers. No knob or lever
- Liquid dispensers (soap, alcohol handrinse, or lotion): non-refillable bottle, placed to prevent splash-up contamination

6. **Staff Washrooms**
   Apply general design of AIA Guidelines, 2001: section 7
   Design Parameters:
   - # to be specified to meet project/area requirements
   - Location: within washroom facilities

   Fixture Specifications:

   - Sink: deep sink, stand-alone with sufficient slope for adequate drainage to prevent pooling
   - Deep sink. Sufficient depth to contain/prevent contamination (minimum of 8 inches clearing from spout to sink top)
   - Type: porcelain or enamel preferred
   - Traps: all metal with no rubber gaskets at sink/drain connection
   - Faucet: gooseneck types
   - Handwashing station blade handles not exceed 4 ½ inches or 114.3 mm in length [AIA, 2001: Section 7.31.E1c]
   - No ultrasonic controls or automatic temperature control
   - Impermeable backsplash installed behind sink: material easily cleaned and maintained to prevent growth and transmission of organisms - measuring a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level
   - Mounted Paper towel dispensers. No knob or lever, no electric hand dryers
   - Liquid dispensers (soap, alcohol handrinse, or lotion): non-refillable bottle, placed to prevent splash-up contamination

7. **Public Washrooms**
   - Apply general design of AIA Guidelines, 2001: section 7

   Design Parameters:

   - # to be specified to meet project/area requirements
   - Location: within washroom facilities

   Fixture Specifications:

   - Sink: deep sink, stand-alone with sufficient slope for adequate drainage to prevent pooling
   - Deep sink. Sufficient depth to contain/prevent contamination (minimum of 8 inches clearing from spout to sink top)

- Type: porcelain or enamel preferred
- Traps: all metal with no rubber gaskets at sink/drain connection
- Faucet: gooseneck types
- Handwashing station blade handles not exceed 4 ½ inches or 114.3 mm in length [AIA, 2001: Section 7.31.E1c]
- No ultrasonic controls or automatic temperature control
- Impermeable backsplash installed behind sink: material easily cleaned and maintained to prevent growth and transmission of organisms - a minimum of 20 inches above sink level, and a minimum of 10 inches below sink level
- Mounted Paper towel dispensers. No knob or lever, no electric hand dryers
- Liquid dispensers (soap, alcohol handrinse, or lotion): non-refillable bottle, placed to prevent splash-up contamination

[1] Reprocessing Centres' standards include the *Fixture Specifications*, however the *Design Parameters* do not apply.

APPENDICES AND REFERENCES:

REFERENCES:

1. AIA. *Guidelines for Design and Construction of Hospital and Health Care Facilities, 2001 Edition*. The American Institute of Architects Academy of Architecture for Health, & The Facility Guidelines Institute, 2001 (7)
2. The Government of Ontario. Health Protection & Promotion Act, R.S.O., 1990, Chapter H7: Food Premises Regulation, Ontario Regulation 562/90, amended to O.Reg. 502/01. Queen's Printer 2001.

Contractor Safety Requirements

Sunnybrook Health Sciences Centre		**Policy No:**	HR-0090
Title	**Contractor Safety Requirements**	**Original:** *(mm/dd/yyyy)*	11/01/2007
Category	**Human Resources**	**Reviewed:** *(mm/dd/yyyy)*	03/13/2019
Sub-Category	**OccHealth & Safety**	**Revised:** *(mm/dd/yyyy)*	03/27/2017
Issued By:	Occupational Health & Safety		
Approved By:	Senior Leadership		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

POLICY STATEMENT:

It is a Sunnybrook Health Sciences Centre (Sunnybrook) policy to ensure that the contractor shall also comply with all federal, provincial and municipal governmental laws and regulations which are applicable to its business, and in particular, those affecting health and safety, workers' compensation and environmental matters.

This policy applies to all contracted work including capital projects, renovation and service contracts. Sunnybrook or its agent or delegate is the owner of all projects and will select a constructor for all projects.

DEFINITION(S):

Constructor: a person who undertakes a project for an owner and includes an owner who undertakes all or part of a project by himself or by more than one employer. Occupational Health & Safety Act, s.1.

Contractor: refers collectively to constructors, employers, sub-contractors, service companies hired by the owner to perform project or service work.

Designated Substances: A biological, chemical or physical agent or a combination thereof prescribed as a designated substance (by the Act) to which the exposure of a worker is prohibited, regulated, restricted, limited or controlled e.g. asbestos, mercury, lead. Occupational Health & Safety Act, s.1.

Employer: a person who employs one or more workers or contracts for the services of one or more workers, and includes a contractor or subcontractor who performs work, supplies services, or undertakes with the owner, constructor or another contractor or subcontractor to perform work or supply services. Occupational Health & Safety Act, s.1.

Owner: includes a trustee, receiver, mortgagee in possession, tenant, lessee, or occupier of any

lands or premises used or to be used as a workplace, and a person who acts for or on behalf of an owner as an agent or delegate. Occupational Health & Safety Act, s.1.

Project: means a construction, renovation or maintenance project.

Project Manager: and individual or firm designated by Sunnybrook to manage a project. It includes a manager who hires a contractor for service work.

RELATED POLICIES:

Capital Project Management policy, (FIN-087)

Infection Control during Construction, Renovation and Maintenance, ***(IPC-006)***

Mould Management ***(HR-178)***

Asbestos Management ***(HR-0089)***

Restricted & Confined Space ***(HR-109)***

POLICY:

1.0 Responsibilities

Owner

- **Appoint a project manager.**

Constructor

The constructor shall ensure the following for projects they undertake:

- **The measures and procedures prescribed by the Occupational Health & Safety Act (OHSA) and regulations are carried out.**
- **Every employer and worker performing work on the project complies with the OHSA and regulations.**
- **The health and safety of workers on the project is protected.**
- **Provide proof of WSIB coverage for all workers.**
- **Comply with Sunnybrook's sign in procedure.**
- **Ensure that all required communication is provided to all workers so they are also aware of Sunnybrook's policies and procedures.**
- Ensure workers familiarise themselves with emergency equipment (i.e. fire extinguishers, pull stations, etc.) located in the immediate work area to facilitate a quick response in the event of an emergency. Monthly alarm tests are performed that require everyone to

comply with evacuation procedures outlined for individual areas.

- **The contractor shall abide by and shall ensure that each of the contractor's employees and sub-contractor's employees (if applicable) abide by Sunnybrook's health and safety policies and procedures. The contractor will also be able and willing at such times as recommended by Sunnybrook to provide additional precautions as deemed necessary by Sunnybrook for safeguarding employees and equipment. The contractor further acknowledges and agrees that any violation of safety policies and procedures is justification for the immediate termination of its Contract with Sunnybrook, without any further obligation on the part of the Sunnybrook.**

Visitor (delivery personnel, inspectors, vendors etc. with an ongoing and/or established professional relationship with Sunnybrook)

- **Must contact appropriate Sunnybrook personnel on arrival and be informed of and adhere to applicable Sunnybrook health and safety policies and procedures related to their visit.**

Employer (constructor, contractor or sub-contractor)

- **Employers are responsible for complying with all employer duties under the OHSA and regulations.**
- **Ensure workers are qualified for the work performed.**

Project Manager (The person responsible for hiring the contractor and who the contractor will sign in with upon arrival at Sunnybrook)

- **Is responsible for ensuring completion of the** Contractor Policy Sign-Off Form:
- **Provide contractor with relevant hospital policies and information including designated substance surveys, confined or restricted spaces, as well as information on any other hazard inherent to the work area.**
- **Act as the contractor's contact person for the duration of the contract.**
- **Notify contractor that performance will be monitored and failure to follow legislative requirement or hospital policies may result in a "stop work" order or removal from the workplace.**
- **Notify occupant of project work.**
- **Involve Infection Prevention & Control (IP&C), Occupational Health and Safety (OHS), Fire Prevention and Security, Environmental Services, and Plant Operations and Maintenance as required to ensure hospital policies and procedures are followed.**
- **Ensure contractor(s) are properly identified by a Sunnybrook ID badge at all times**
- **Advise Sunnybrook Managers/Supervisors if work is being done in their area with the expected time frame and impact on the department.**

2.0 Planning & Contractor Selection Phase

a. All project work or work performed by an external contractor must have an assigned project manager.
b. As part of the bidding process, **contractors** must provide health and safety documentation as well as previous accident/incident experience.
c. The **Project Manager** must consider health, safety and environmental criteria as part of the pre-qualification or tendering process to select a contractor for a project. Certifications, training records, previous hospital experience, health and safety performance, WSIB CAD-7 Rating, and company policies should be reviewed and considered in the selection process.
d. During the tendering process, the **Project Manager** must provide the contractors with a list of any designated substances in the work area, including the location and condition of any asbestos as well as the location of any other designated substances. For asbestos, the **OHS** department will provide information from the building survey.
e. The **Project Manager** must notify the contractor if the project involves work in a restricted or confined space. The Project Manager and the contractor are responsible for following all requirements of the ***Restricted and Confined Space Policy*****.**

3.0 Prior to Project Start Date

a. The **contractor** must provide copies of the SDS' for products that could impact the health and safety of building occupants.
b. **Contractors** must carry comprehensive liability insurance and automobile liability insurance as per the contract agreement.
c. The **Project Manager** must advise **IP&C** of the upcoming project and involve them during the planning stage. The requirements of the Construction & Renovation Policy must be followed and IP&C will review the containment strategies, waste removal, traffic patterns, impacts on ventilation and water systems as well as cleaning procedures. As required for Class III or IV work, **IP&C** will complete the checklist: *Risk Assessment & Prevention Measures for Healthcare Facilities Construction & Renovation.*
d. As part of mould, dust & asbestos management, the **Project Manager** must notify **OHS** and **lP&C** of the project and obtain a *Construction, Renovation and Maintenance Permit* for any work that disturbs building materials or includes ceiling entry. The permit must be displayed in the work area for the duration of the work. This applies to capital or facility renewal projects.
e. **OHS** will review procedures for asbestos work including containment, ventilation, air monitoring and final clean-up. **OHS** should also be consulted for MSDS/SDS review, restricted and confined space permits and a review of any other potential health or safety issue with the project (e.g. air quality).
f. During the planning process, the **Project Manager** must consult departments that will be affected by the project to address health and safety concerns as well as logistics planning to minimize work disruptions.
g. The **Project Manager** must provide contractors with the appropriate Sunnybrook policy

requirements (e.g. Asbestos Management, Mould Response, Construction & Renovation, Restricted & Confined Space, etc.) as determined by the nature of the work.

h. The **Project Manager** must provide the c**ontractors** with information on Code Brown and Code Red procedures at the hospital so that they are able to report and respond to any floods or fires in the construction area.
i. The **Project Manager** is responsible for advising the contractor that construction areas must be secured at all times to prevent unauthorized entry and must ensure contractors follow procedures to comply with this requirement.
j. **IP&C, OHS or a designated third-party environmental consultant** will inspect containment barriers prior to and during the work on a regular basis and advise the project manager of any concerns.

4.0 Policies & Training

a. **Contractors** must follow the OHSA and regulations, all environmental protection legislation as well as the requirements of applicable Sunnybrook IP&C and OHS policies. Any violation of safety rules or regulations is justification for the immediate termination of a contract without further obligation on the part of Sunnybrook.
b. All **contracted workers** must have WHMIS training as well as any other safety training relevant to the work (e.g. Asbestos Awareness, Confined Space training, Infection Prevention & Control procedures, etc).

5.0 Requirements for Onsite Work

a. **Contractors** must ensure that onsite workers are supplied with and use appropriate safety equipment, personal protective equipment, and follow safe work procedures.
b. **Contractors** are encouraged to get flu shots, particularly if they will be working in patient areas.
c. All scaffolding must comply with applicable standards.
d. A **contractor** shall ensure that any tools or equipment brought on hospital property are safe to use, meet applicable standards, and all equipment along with any safety devices are in good condition and functioning properly.
e. The **contractor** is responsible for maintaining a clean work area free of debris. Once the work is finished, all equipment, tools, supplies and debris shall be removed by the contractor following IP&C, environmental, and asbestos procedures as required.
f. **Contractors** requiring storage for flammables exceeding daily volumes must obtain permission from the **Project Manager** who will consult with the Fire Prevention Coordinator as required.
g. **IP&C** will inspect renovated or newly-constructed patient care areas prior to occupancy.
h. For projects with asbestos abatement, OHS and/or a third-party environmental consultant will evaluate clean-up and/or clearance sampling prior to moving forward after the abatement. Environmental Consultants for asbestos abatements must follow the requirements of Section 6.0 of the *Asbestos Management* policy pertaining to containment inspections and air monitoring.
i. **Project Managers** and **contractors** must ensure pedestrian safety and access control in and around construction or renovation projects as per the *Falls Prevention* policy.

j. **Project Managers** must notify contractors of required performance standards and enforce as necessary by warnings, "stop work" orders and removal from workplace.
k. **Contractors** must adhere to the no smoking policy.

6.0 Incidents

a. A contractor shall immediately notify the Project Manager of any employee incident, including potential critical injuries or fatalities to any person on hospital property that resulted, or may have resulted, in an injury, illness or property damage. The Project Manager will follow-up with OHS as required. For critical injuries or fatalities, the Project Manager or Contractor Representative must page Sunnybrook Safety On-Call (7437 via locating). As there are dual responsibilities following a critical injury to a contractor, OHS will coordinate with the Project Manager and Contractor Representative regarding Ministry of Labour notification, investigations and reports.
b. A contractor shall immediately notify the Project Manager of any breach in infection control or asbestos containment structure. The Project Manager will contact IP&C and/or OHS.
c. If Contractors find an errant sharp e.g. needle during their work, they should notify their Sunnybrook contact to arrange for proper disposal. Contractors who have a needlestick injury should immediately seek medical care at the Occupational Health Clinic or the Emergency department if after hours.

6.0 Project Completion

a. For any project work involving construction, installation or modification of new equipment or systems, the Project Manager must ensure that all appropriate start-up testing, commissioning or certifying is completed before final sign-off. This includes reviewing and documenting that project building materials and equipment meet pre-construction/renovation specifications and arranging required testing to verify materials and equipment are functioning properly.

APPENDICES AND REFERENCES:

REFERENCES:

1. Ontario Ministry of Labour. Occupational Health and Safety Act and Regulations for Industrial Establishments. 1990.

APPENDICES:

Forms listed below are available under Contractor Sign offs

- **Appendix A - Sunnybrook Contractor Safety Form**

- **Appendix B - Contractor Safety Checklist**

Sunnybrook Contractor Safety Form

By signing below, the Contractor representative certifies that the Contract Company has received copies of all Policies and Procedures required for safe practice while providing a service to Sunnybrook Health Sciences Centre (SHSC). The Contractor further agrees to communicate the required information embedded in these policies and procedures to all of its workers.

It is expected that the Contractor;

- Will maintain a safe workplace and work in accordance with safe work practices and house keeping
- The Contractor shall comply and cause all of its subcontractors to comply with all applicable provisions, requirements and safety standards of the Ontario Occupational Health and Safety Act and its regulations and all SHSC Safety Policies and Procedures. The Contractor will also be able and willing at such times as recommended by SCHC to provide additional precautions as deemed necessary by SHSC for safe-guarding employees and equipment. The Contractor further acknowledges and agrees that any violation of safety rules or regulations is justification for the immediate termination of its Contract with SCHC, without any further obligation on the part of SHSC.
- Comply with the sign in procedure and applicable SHSC policies and procedures.

We have read and understand the above information

_____ _____

Contractor (Signature)

_____

Name (Please Print) **Date**

_____

SHSC Project Manager (Name) **Contact Number** **Date**

WSIB Clearance Certificate Provided ☐

Certificate of Liability Insurance Provided ☐

Contractor Safety Checklist

Description of Work:					
Area(s) to be Affected:					
Approximate Duration (include dates):					
Contractors Name and Contact Number:					
Project Managers Signature:			**Date:**		
		YES	**NO**	**NA**	**Comments**
1.0	**ID Badges**	☐	☐	☐	
2.0	**Sign-in procedure and location**	☐	☐	☐	
3.0	**All applicable policies and procedures have been provided to contractor staff working at SHSC**	☐	☐	☐	
3.1	*Emergency Codes Quick Guide (pg. 4)*	☐	☐	☐	
3.2	*Respect Program (Corporate Code of Conduct) (pg. 8)*	☐	☐	☐	
3.3	*Asbestos Management (pg. 12)*	☐	☐	☐	
3.4	*Mould Response/Management (pg. 37)*	☐	☐	☐	
3.5	*Restricted and Confined Space (pg. 39)*	☐	☐	☐	
3.6	*Infection Control during Construction, Renovation and Maintenance (pg. 47)*	☐	☐	☐	

		YES	NO	NA	Comments
4.0	*Smoke-Free Environment (pg. 64)*	☐	☐	☐	
5.0	**Fire alarm bypass required**	☐	☐	☐	
6.0	**Aware of incident/accident reporting procedures**	☐	☐	☐	
7.0	**Contractor aware of required permits**	☐	☐	☐	
7.1	*Construction Renovation and Maintenance Permit (pg. 69)*	☐	☐	☐	
7.2	*Hot Work Permit (pg. 70)*	☐	☐	☐	
7.3	*Restricted/Confined Space Permit (pg. 71)*	☐	☐	☐	
8.0	**Record of training required? (i.e. Type 3 work as per O.Reg. 278/05)**	☐	☐	☐	
9.0	**MRI/Radiation Safety required (working in AG, SG, TB, M3)**	☐	☐	☐	
10	**Contractor has been made aware of all Designated Substances and other hazards within work area**	☐	☐	☐	

_____

Contractor (Signature)

_____

Name (Please Print) **Date**

_____

SHSC Project Manager (Name) **Contact Number** **Date**

Quick Guides to Emergency Codes

NAME OF CODE	MEANING OF CODE	WHO CAN INITIATE THIS CODE?	HOW TO INITIATE CODE	WHAT DO I SAY?	WHO RESPONDS?	WHAT DO I NEED TO DO DURING THIS CODE?
RED	FIRE	Any person discovering smoke or fire	Call 5555 Pull fire pull station found at Exits	"Code Red" Provide location using phonetic alphabet e.g., Code Red A-Alpha Wing, 1st floor, Room 119 AND the type of fire if known e.g., electrical, paper	Internal Fire Team Toronto Fire Services	Remove anyone in the room Alert - activate the alarm at the pull station & call 5555 Contain the fire Evacuate the area
BLUE **≥14 years** BLUE CHILD >30 days and < 14 years	CARDIAC ARREST or EMERGENT MEDICAL INTERVENTION REQUIRED CARDIAC ARREST or EMERGENT MEDICAL INTERVENTION REQUIRED IN A CHILD	Anyone who finds a non-responsive person or a person who requires emergent medical Intervention	Call 5555 Call 5555	"Code Blue" Provide location of patient using phonetic alphabet e.g., Code Blue, D-Delta 2, Room 279 "Code Blue Child" e.g., Code Blue Child M-Mike Wing 1st floor, inside main entrance	Code Blue Team Code Blue Team & Code Pink Teams	Assess if person not breathing/no pulse; call out for help; start BCLS / first aid if trained. Stay with person and await team Holland Centre call 911 for Code Blue Child
PINK Neonate **≤30 days of age** or infant cared for in NICU	NEONATAL CARDIAC ARREST or	Any staff member who finds non-responsive infant or an	Call 5555	"Code Pink" Provide location of arrest using phonetic alphabet e.g., Code Pink, M-Mike Wing, 4th floor, NICU, Room 446	Code Pink Team	Bayview Campus: Transport to ER if occurs in public area Holland Centre Call 911 as no Code Pink Team
WHITE	VIOLENT PERSON	Any staff member who is aware of an escalating violent situation	Call 5555	"Code White"	Code White Response Team	See actions in response plan. Care circle to initiate prescribed non-violent crisis interventions.

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				Provide location of incident using phonetic alphabet e.g., Code White C-Charlie 5, Room 543 State if a weapon is involved and if Police are required		Complete e-Safety report
YELLOW	MISSING PATIENT	Step 1: Patient Care Manager/ Nurse in Charge Steps 2 & 3: Administrator-on-Call	Call 5555	"Code Yellow" Provide name of missing patient & home unit using phonetic alphabet e.g., Code Yellow L-Lima Wing Third Street East Request that missing patient be paged on overhead to return to unit	Security All units/ departments SB: Bayview Pager 1400 SB: Holland Centre Admin/ Hospital Coordinator Toronto Police Services if required	Search your unit/department and call missing patient unit with outcome. Stand by for further instructions Complete e-Safety report
YELLOW: BABY	INFANT ABDUCTION	Any staff member discovering or being advised of a missing	Call 5555 AND Call 911 for Police	"Code Yellow – Infant Abduction" State the location from which the infant is missing using phonetic alphabet	Code Yellow Baby Group page All units/ departments Toronto Police Services	Secure units/ departments Women & Babies - hold all discharges Complete e-Safety report
BROWN: FLOOD	INTERNAL CRISIS	Any staff member who becomes aware of a flood of uncontained water or other	Call 5555	"Code Brown - FLOOD" State location of flood using phonetic alphabet and describe what is happening	Internal Flood Team	Ensure patient, visitor and staff safety – Remove from area if necessary. Protect equipment with plastic sheeting if possible. Try to contain the flood waters from spreading into adjoining areas. Complete e-Safety report

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BROWN: HAZARDOUS MATERIALS SPILL	INTERNAL CRISIS	Any individual with knowledge of the incident	Call 5555	"Code Brown - HAZARDOUS SPILL" State location using phonetic alphabet and type of problem encountered State the identity and volume of spill if known and if you smell fumes;	Designated Responders Security Plant Operations Environmental Services External Utilities Note: Hazmat Team attends if spill is significant (911)	Alert others nearby Let Manager know Evacuate area of patients, staff, visitors Assemble at a safe distance from flood or spill area Complete e-Safety report
BROWN: ELEVATOR	INTERNAL CRISIS	Anyone with	Alarm button	Code Brown elevator entrapment and	Security will contact	Stay calm Stay in communication with those inside. Notify unit if patient or staff. Complete e-Safety report
GREEN	EVACUATION	Manager at scene Security Risk Management Administrator on Call / Shift Manager / Hospital Coordinator Toronto Fire Services	Call 5555	"Code Green" Identify other codes related to incident requiring evacuation (i.e. Code Red, Code Black, etc.) Provide location using the phonetic alphabet	Security Risk Management Administrator-on-Call Affected units Toronto Fire Services (if required) Police & EMS if required	Organize patients / staff to move from unit in a safe, orderly fashion as per evacuation guidelines Assist other units / areas as required
ORANGE: MASS CASUALTY	MASS CASUALTY Surge in patient activity as a result of an external incident.	Steps 1 & 2: PCM/delegate in Emergency Department Step 3: Administrator-on-Call	Call 5555	"Code Orange Step 1" Provide nature of emergency and likelihood and number of incoming casualties.	Emergency/Diagnostic Imaging/Clinical Pathology/ OR/Critical	Assist as required. See detailed action list in plan.

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ORANGE: CBRN	CHEMICAL / BIOLOGICAL / RADIONUCLIDE CONTAMINATION	Emergency Department	Call 5555	"Code Orange CBRN":	Specially trained staff	When advised : set up decontamination structure and assemble team for casualty decon.
BLACK	BOMB THREAT- VERBAL A bomb threat has been received by telephone MAIL THREAT A suspicious letter or parcel has been received	Any staff member with knowledge of a Bomb Threat / suspected bomb	Call 5555	"Code Black" State information about bomb threat If suspicious object, give location using the phonetic alphabet and provide description.	Security Toronto Police Services	Record everything you can obtain from the caller - see resource checklist Do not touch any suspicious object Remove patients / staff from area of potential danger - do not allow anyone to access Complete the bomb threat checklist
PURPLE	HOSTAGE A hostage has been taken	Any staff member who becomes aware of a hostage-	Call 5555	"Code Purple" State location of hostage taking using the phonetic alphabet Provide all known relevant information esp. if a weapon is involved.	Security Administrator-on-Call Toronto Police Services	Remove patients / staff from area of potential danger Cooperate with Police & Security Complete Hostage Taker Description Report
OMEGA	Life threatening bleed requiring rapid access to blood in non-obstetrical patient	Staff Physician	Call 5555	"Code Omega" and state location using phonetic alphabet.	Blood Bank and predetermined team	Assume roles as identified in response plan
OMEGA OBSTETRICS	Life threatenting bleed requiring rapid access to blood in an obstetrical patient	Staff Physician	Call 5555	"Code Omega Obstetrics" and state location using phonetic alphabet	Blood Bank and predetermined obstetrical team including Rapid Response Team	Assume roles as identified in response plan
33	Obstetrical crisis requiring immediate	Obstetrician Obstetrical Nurse Midwife Emergency Dept MD Code Blue Team	Call 5555	"Code 33" and state location using phonetic alphabet Request available obstretician to attend scene	Obstetrical Team	Support patient and team

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The Respect Program (Corporate Code of Conduct)

Sunnybrook Health Sciences Centre		Policy No:	HR-0047
Title	The Respect Program (Corporate Code of Conduct)	Original: *(mm/dd/yyyy)*	11/01/2001
Category	Human Resources	Reviewed: *(mm/dd/yyyy)*	07/27/2010, November 2017
Sub-Category	Employee Relations	Revised: *(mm/dd/yyyy)*	02/16/2010, 10/22/2015, 09/01/2016
Issued By:	Vice President of Human Resources		
Approved By:	Senior Leadership Committee		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

THE RESPECT POLICY: SUNNYBROOK'S CODE OF CONDUCT

Please Note: This policy works in conjunction with any and all aligned collective agreements, professional regulatory or legislative requirements and The College of Physicians and Surgeons of Ontario;Managing Disruptive Physician Behaviour.

POLICY STATEMENT:

It is the policy of Sunnybrook Health Sciences Centre that together we will create working environments that welcome the diversity of our workforce and are built on a foundation of respectful behaviour. This will ensure staff, physicians, volunteers and students feel included, experience the reality of belonging, and are able to fulfill their potential here at Sunnybrook.

RATIONALE:

One of Sunnybrook's corporate goals is to be the healthcare workplace of choice. In order to achieve this, we must strive to live the values of Sunnybrook. Respect is one of our core values and is fundamental to the culture at Sunnybrook Health Sciences Centre.

The Respect Program and the Respect Policy is meant to give an appropriate focus to one of our most important values. Respectful behaviour will help us build and sustain respectful work relationships and work environments. It will improve our productivity, the delivery of the services we provide to our patients and visitors, and how we interact with each other.

This is a shared responsibility and everyone in the organization – staff, physicians, volunteers and students – must be accountable for their behaviour, actions and work relationships. We must work together as a team to promote respectful behaviour, respect work interactions, and build respectful work environments.

Our actions can make a difference in sustaining a culture of respect for each other.

GOALS:

1. Create a culture that honours and practices respectful behaviour.
2. Create working environments built on the foundation of respectful behaviour.

DEFINITION(S):

Included in the organization's Mission and Vision statements is a set of corporate values to influence and guide the behaviour of all staff:

Excellence
We celebrate excellent and innovative approaches to patient care, work life and research and education.

Collaboration:
Our work is accomplished through partnerships, communication and teamwork.

Accountability:
We are responsible for the commitments we make. We are accountable to our communities for the human and fiscal resources entrusted to us.

Respect:
We protect and promote diversity of opinions, traditions and experiences.

Engagement:
We are all active members of the Sunnybrook team and therefore integral to the hospital's success. By engaging others and being invested in our work, we all contribute to achieving our mission and vision.

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Unprofessional Disrespectful Behaviour:

There are many types and forms of unprofessional or disrespectful behaviour. This list is not inclusive, but is meant to illustrate only a few:

- yelling at someone
- sarcastic and hurtful comments, jokes, innuendos or taunts
- malicious gossip or remarks about someone
- lying or withholding important information
- being intolerant, lack of patience that leads to temper tantrums
- attending work under the influence of alcohol and/or dugs
- racial slurs or using racial slang words
- bullying behaviour (including cyber bullying - the use of the Internet and related technologies to harm other people, in a deliberate, repeated, and hostile manner)
- using swear words in the work environment

These behaviours constitute Violence or Sexual Assault in the Workplace

- pushing, shoving, slapping or hitting with an open palm, punching with a fist, hitting with an object, pinching, squeezing, kicking, biting or scratching. or any unwanted physical contact
- threatening someone with personal harm
- Workplace Harassment – verbal or psychological abuse
- Sexual Harassment and Sexual Violence/Assault – can include but not limited to fondling, kissing or any unwanted physical contact.

See Harassment, Discrimination and Violence Policy (HR-0049)

Use of English In The Workplace While Performing Work or Discussing Patient Care

It is important when at work and in the working environment where work is being performed, that all staff speak English to each other on a consistent basis, as well as written communication in English. In a patient care setting communication is critical to the delivery of patient care and the safety of our patients depends on the sharing of important information. Good communication is also important in serving patients' family members and other members of the public who visit the Hospital, as well as in all working relationships among our staff and physicians.

As we all are accountable to contribute and build an inclusive working environment, speaking English consistently where work is being performed helps to build a work environment whereby everyone can feel included and everyone is communicating in a common language. This is particularly important in patient care and public areas, but is also important in less public areas, in terms of inclusiveness and mutual respect.

To be clear, staff should continue to speak to patients and their loved ones in the patient's own language and to translate for other health care workers when that facilitates patient care. Staff may also continue to speak in languages other than English when on breaks or other personal time, or otherwise engaged in purely private, non-work-related conversations.

POLICY:

Corporate Respect Agreement:

By redeveloping our corporate code of conduct, we reinforce to staff, physicians, volunteers and students that respectful behaviour produces respectful work environments. In building respectful work environments we must be committed and share the responsibility to:

RESPECT: the diversity of our staff and their cultural backgrounds.
RESPECT: how we communicate and how we listen to each other.
RESPECT: our differences; in opinion, lifestyle & lifestyle choices.
RESPECT: the needs of different generations.
RESPECT: the value of each and every job and role at Sunnybrook.
RESPECT: the vast array of different personalities that we encounter every day.
RESPECT: that good working relationships builds good work environments.
RESPECT: that good behaviour, respectful behaviour, can make a difference.

R - RESPECTFUL behaviour is everyone's responsibility.
E - ENGAGE yourself and others to build a respectful work environment.
S - SUPPORT your co-workers; their success is your success.
P - PATIENCE is a virtue, practice it often.
E - EMPATHY towards others will help us understand our differences.
C - COMMUNICATE with care, learn when to talk, learn when to listen.

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T - THOUGHTFUL and tactful behaviours will improve work relationships.OUTCOMES:

1. Respectful behaviour builds good work relationships and work environments.
2. Respectful behaviour will improve our customer service. (Delivery of our services to patients, visitors and to each other.)
3. Respectful behaviour will improve productivity.
4. Respectful behaviour will strengthen our culture and organization resiliency.
5. Respectful behaviour will help us achieve our goal, *"To Be The Healthcare Workplace Of Choice".*

RESPONSIBILITIES/ACCOUNTABILITIES:

The Respect Policy is a shared responsibility; we all have a role in maintaining professional respectful work relationships, we all have a role in conducting ourselves within the spirit and intent of this program/policy and for contributing towards a respectful workplace.

Everyone must be accountable for their workplace behaviour and take the responsibility necessary to correct and eliminate unprofessional behaviour.

Senior Leadership:

1. Senior leaders are held to a higher level of accountability to role model professional behaviours; live the values of Sunnybrook and support the actions and principles found in the Corporate Respect Agreement.
2. Senior leadership is accountable to build and sustain good working environments built on a foundation of respectful behaviour.
3. Senior leadership must hold others accountable for their professional behaviour and take action when appropriate to assist others to comply with the requirements of this policy and exhibit professional respectful behaviour.

Administrative, Clinical and Medical Leaders:

1. All administrative, clinical and medical leaders in the hospital are accountable to role model professional behaviours; live the values of Sunnybrook and support the actions and principles of the Corporate Respect Agreement.
2. Leaders are expected to build and sustain working environments built on the foundation of respectful behaviour.
3. Leaders are expected to set expectations for professional behaviour in their areas of responsibility, hold staff and others accountable for their behaviour and follow up with appropriate investigation and remedial actions when required.

Staff, Physicians, Volunteers and Students:

1. All staff, physicians, volunteers and students are accountable to role model professional behaviours, live the values of Sunnybrook and support the actions and principles found in the Corporate Respect Agreement.
2. All staff, physicians, volunteers and students are expected to engage themselves in actively building and maintaining respectful work relationships which will contribute to respectful work environments.

PROCESS TO MANAGE DISRESPECTFUL BEHAVIOUR

There are many avenues available to effectively manage and seek assistance for workplace conflicts, difficult relationships and addressing disrespectful behaviour.

Administrative, Clinical and Medical Leaders:

1. If you experience unprofessional behaviour or witness unprofessional behaviour in an area of your responsibility, please respectfully ask the person to stop.
2. If workplace conflict, unprofessional disrespectful behaviour is witnessed by you or reported to you, you are required to investigate the situation and take action to address the situation.
3. For workplace conflicts or unprofessional behaviour, you are able to seek assistance from the leader you report to, Human Resources for guidance, Organizational Development for guidance and learning and many other staff or leaders depending on your set of circumstances.
4. Leaders should document carefully the actions taken to mediate and resolve the conflict or bad behaviour.

Staff, Physicians, Volunteers and Students:

1. If you experience unprofessional behaviour, please respectfully ask the person to stop.
2. Try to engage the other person in a discussion to resolve the issue using professional respectful behaviour.
3. If unsuccessful, and the disrespectful behaviour continues, please report the incident to your manager or leader to whom you report.

CONSEQUENCES OF DISRESPECTFUL BEHAVIOUR

All staff, administrative, clinical and medical leadership, physicians, volunteers and students will be held accountable for maintaining professional respectful behaviour in the workplace.

If someone exhibits disrespectful behaviour they will be asked to take whatever action is necessary to improve and sustain professional respectful

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behaviour in the workplace.

Progressive Discipline:

As leaders effectively manage unprofessional disrespectful behaviour in the workplace, there are several options available:

- If someone exhibits unprofessional disrespectful behaviour, they may be required to take a course, for example in managing conflicts, handling difficult conversations or being able to have respectful confrontations;
- one on one coaching;
- verbal warning and coaching;
- verbal and written reprimand(s);
- suspension without pay from work;
- termination of employment.

RELATED POLICIES OR DOCUMENTS:

- Harassment, Discrimination and Violence Policy (HR-0049)
- Human Rights, Abuse of Patients by Staff: HR-0041
- Gifts and Gratuities: HR 0040
- Conduct – Solicitation: HR 0057
- Fragrance Free Work Environment: ADM-108
- Quality of Worklife – Providing a Healthy Work Environment: ADM 107
- Conflict of Interest: ADM 0008
- Smoke Free Environment: ADM 0034
- The College of Physicians and Surgeons of Ontario: Managing Disruptive Physician Behaviour

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Asbestos Management

Sunnybrook Health Sciences Centre		Policy No:	HR-0089
Title	**Asbestos Management**	**Original:** *(mm/dd/yyyy)*	06/01/2005
Category	**Human Resources**	**Reviewed:** *(mm/dd/yyyy)*	03/02/2018
Sub-Category	**OccHealth & Safety**	**Revised:** *(mm/dd/yyyy)*	Dec. 2006, Jun. 2009, Oct. 2010, Nov. 2011, Sept. 2013, Mar. 2017
Issued By:	Human Resources		
Approved By:	Senior Leadership Team		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

POLICY STATEMENT:

Asbestos management is necessary to meet the requirements of the designated substance regulation respecting asbestos on construction projects and in buildings and repair operations. As per the Ontario Occupational Health and Safety Act and associated Asbestos Regulations, it is a Sunnybrook Health Sciences Centre policy to adhere to all necessary measures and procedures by means of engineering controls, work practices, hygiene practices and facilities to ensure that the time-weighted average exposure of a worker to any of the forms of airborne asbestos, individually or collectively, is reduced to the lowest practical level and shall not exceed 0.1 fibres per cubic centimetre of air.

This policy applies to every project at Bayview, Holland Orthopedic and Arthritic Centre (HOAC), St. John's Rehab, and Pine Villa, the project owner, and every constructor, employer and worker engaged in or on the project during the repair, alteration or maintenance of a building, which Asbestos-Containing Material (ACM) is likely to be handled, dealt with, disturbed or removed.

Employees or contractors doing asbestos-related maintenance, abatement, inspection or renovation must understand the hazards of asbestos exposure, and have the appropriate training in personal hygiene and work practices as well as the use, cleaning and disposal of respirators and protective clothing.

The contractor shall also ensure that every worker and supervisor involved in a Type 3 operation has successfully completed the Asbestos Abatement Worker/ Supervisor Training Program approved by the Ministry of Training, Colleges and Universities (Effective November 1, 2007). The Joint Health and Safety Committee (JOHSC) or Occupational Health and Safety shall be advised of the time and place where the instruction and training are to be carried out.

This policy will be reviewed annually as per the requirements in the Health & Safety Program

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Evaluation policy.

The procedures in Sections 1.0-13.0 outline the specific requirements for:

DEFINITION(S):

Abatement:
The removal of asbestos

Amended Water:
Water to which a chemical wetting agent (surfactant) has been added to improve penetration into asbestos-containing materials being removed.

Asbestos:
A fibrous silicate including actinolite, amosite, anthophyllite, chrysotile, crocidolite or tremolite (O. Reg. 278/05).

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Asbestos Containing Material (ACM):
A building material that contains 0.5% asbestos by dry weight.

Building:
Any structure, vault, chamber or tunnel including, without limitation, the electrical, plumbing, heating and air handling equipment (including rigid duct work) of the structure, vault, chamber or tunnel (O. Reg. 278/05).

Competent Person: means a worker who;

a) is qualified because of knowledge, training and experience to perform the work,
b) is familiar with the Act and with the provisions of the regulations that apply to the work, and
c) has knowledge of all potential or actual danger to health or safety in the work.

Friable material:
Material that when dry can be crumbled, pulverized or powdered by hand pressure, or is crumbled, pulverized or powdered. (O. Reg. 278/05).

HEPA filter:
A high efficiency particulate aerosol filter that is at least 99.97% efficient in collecting 0.3 micrometer aerosol (O. Reg. 278/05).

Homogeneous Material:
Material that is uniform in colour and texture (O. Reg. 278/05).

HVAC:
Heating, Ventilation, and Air Conditioning

Particulate:
A solid or liquid material dispersed in the air e.g. a dust, mist or fume

Project leader:
The person responsible for a particular construction or maintenance project; includes but is not limited to: staff from Corporate Planning & Development Project, Facilities Planning; Facilities Services, Plant Operations Power Plant, Maintenance; Building Managers etc.

Time Weighted Average (TWA) Exposure:
The time weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, for a working lifetime without adverse effects.

POLICY:

1.0 ASBESTOS SURVEYS AND CONSTRUCTION, RENOVATION AND

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MAINTENANCE PERMITS

If in doubt whether a material is asbestos-free, make sure to have it tested before disturbing it. Unknown materials are considered "Presumed Asbestos Containing Materials (PACM)" until proven otherwise. *(See Bulk Sampling)*

- Keep other people away and seal off the work area.

- Keep ACMs intact. Do not break them up.

Survey:

- A survey of the location of ACM (including non-friable asbestos materials) and the condition of friable asbestos materials will be completed and maintained to reflect any changes caused by construction, renovations or abatement. Occupational Health & Safety and Corporate Planning & Development at each campus will maintain copies of the survey. Asbestos surveys will be updated every 12 months (effective November 1, 2007).

- This survey is utilized to generate a list of asbestos locations for the employees performing maintenance work. These locations will be listed in the Construction, Renovation and Maintenance Permit (related to asbestos)'.

Construction, Renovation and Maintenance Permits (related to asbestos):

- Employees and contractors performing work requiring ceiling access, disturbance of walls or floor materials must obtain a 'Construction Renovation and Maintenance Permit' from Occupational Health / Infection Prevention and Control. This permit must be obtained before arranging for the work to determine if material containing asbestos will be disturbed.

- If it is determined that ACM exists and will be disturbed by the work an inspection is required. An inspection is not required if it is known that the material in question does not contain asbestos or if the material is to be handled as if it does contain asbestos and the most stringent procedures for the type of operation are to be followed.

IF	**THEN**
You are performing work require ceiling access, disturbance of walls or floor materials	obtain a Construction, Renovation and Maintenance Permit via Sunnynet>Maintenance Request>New Service Request>Maintenance Request
it is determined that ACM exists and will be disturbed by the work	an inspection is required (see Bulk Sampling).

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Tendering for a project:

- As part of tendering for a project, the project leader must provide a list of designated substances to all potential contractors who may work on the project. This list along with any inspections, reports or drawings must be included in any tendering information prior to the arrangement of the contract.
- No work that is likely to involve handling, dealing with, disturbing or removing the material shall be done unless, it has been determined whether the material is asbestos-containing material; or the work is performed in accordance with O. Reg. 278/05 as though the material were asbestos-containing material.

Bulk Sampling:

- All materials that may contain asbestos must be sampled before requesting tenders or arranging for work (including non-friable materials).
- Bulk sampling must be carried out on bulk material samples that are randomly collected by a competent worker and are representative of each area of homogeneous material.
- The minimum number of bulk material samples to be collected from an area of homogeneous material is set out in Table 1. of O. Reg. 278/05. Three samples for most cases except for those listed in Table 1 of O. Reg. 278/05 Bulk material samples, Subsection 3 (3).
- If analysis establishes that a bulk material sample contains 0.5 per cent or more asbestos by dry weight, the entire area of homogeneous material from which the bulk material sample was taken is deemed to be asbestos-containing material.
- O. Reg. 278/05, s. 3 (1) references the prescribed test method and procedures for establishing whether material is asbestos-containing material and for establishing its asbestos content and the type of asbestos.

2.0 CLASSIFYING ASBESTOS OPERATIONS

- One requirement of the regulation governing asbestos on construction sites is the classification of the work. This classification can be thought of in terms of work representing a high (Type 3) or medium (Type 2) or low hazard (Type 1). In evaluating the hazard, there are two necessary considerations:
    - the airborne concentrations of asbestos that will be generated by the work, and
    - the duration of the exposure.
- Thus operations that may expose a worker to asbestos are classified as Type 1, Type 2 and Type 3 operations (O. Reg. 278/05).
- Before commencing a Type 3 operation, and certain Type 2 operations [see 12 (3), O. Reg. 278/05], the project leader or the contractor/sub-contractor shall notify orally and in writing, the Ministry of Labour and provide contact information, description, location and dates of the work (as prescribed s. 11, O. Reg. 278/05). The corresponding precautions for each type must be observed. ***[see Appendices for Asbestos Operations Precautions for each of Type 1, 2, 3 and Type 2 Glovebag]***

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a. Description of Type 1 Operations (Low Hazard)

- The installation or removal of ceiling tiles that is ACM, if the tiles cover an area less than 7.5 square metres or 80 square feet (approx. 10 2X4 tiles) and are installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.

- The installation or removal of non-friable ACM, other than ceiling tiles, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.

- Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable ACM if, the material is wetted, and power tools are not used.

- The removal of less than one square metre of drywall in which ACM joint-filling compounds have been used.

- ***[See Appendix I for Type 1 Asbestos Operation Precautions.]***

b. Description of Type 2 Operations (Medium Hazard)

- The removal of all or part of a false ceiling to obtain access to a work area, if ACM is likely to be lying on the surface of the false ceiling.

- The removal or disturbance of one square metre or less of friable ACM during the repair, alteration, maintenance or demolition of all or part of a building, equipment or machinery.

- The enclosure of friable ACM.

- Application of tape, or a sealant or other covering to pipe or boiler insulation that is ACM.

- The installation or removal of more than 7.5 square metres or 80 square feet of ACM ceiling tiles (more than 10 tiles) without being broken, cut, drilled, abraded, ground, sanded or vibrated.

- Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable ACM material that cannot be wetted and power tools are not used.

- The removal of more than one square metre of drywall with ACM joint filling compounds.

- The breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable ACM with power tools equipped with HEPA filtered collection device.

- Removing ACM mechanical insulation (pipe, duct) using a glove bag. (See

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Appendix V)

- The cleaning or removal of filters from HVAC system in a building that has sprayed fireproofing that is ACM.

- Any other operation that may expose a worker to asbestos, and, is not classified as a Type 1 or Type 3 operation.

- *[See Appendix II, III, and V for Type 2 Asbestos* Operation Precautions.]

c. Description of Type 3 operations (High Hazard)

- The removal or disturbance of more than one square metre of friable ACM during the repair, alteration, maintenance or demolition of all or part of a building, machinery or equipment.

- The spray application of a sealant to friable ACM.

- The cleaning or removal of air-handling equipment, including rigid ducting but not including filters, in a building that has sprayed fireproofing that is ACM.

- The repair, altering or demolishing of all or part of a kiln, metallurgical furnace or similar structure that is made in part of refractory materials that are ACM.

- The breaking, cutting, drilling, abrading, grinding, sanding or vibrating of non-friable ACM, if the work is done by means of power tools that are not attached to dust-collecting devices equipped with HEPA filters.

- Work on ceiling tiles, drywall or friable ACM is classified according to the total area on which work is done consecutively in a room or enclosed area, even if the work is divided into smaller jobs.

- *[See Appendix II and IV for Type 3 Asbestos Operation Precautions.]*

3.0 ASSESSMENT & CONTROL PROGRAM

- Occupational Health & Safety and/or the appropriate project leader(s) must complete a written assessment of asbestos handling methods, potential exposure and the measures and procedures to control exposures for asbestos-related work at Sunnybrook. This assessment will be documented on the Construction, Renovation and Maintenance Permit form. The JOHSC may review the assessment at any time.

- If the assessment indicates likely exposure to asbestos that would affect the health of the employee or contractor then an asbestos control program must be implemented. The JOHSC shall be consulted when reviewing the control program. The control program

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must have provisions for:

i. Engineering controls, work practices, hygiene practices and facilities to control exposure

ii. Maintaining personal records of employee exposure

iii. Medical examinations and clinical tests for affected employees,

- The asbestos assessment must be re-evaluated when the process, procedures or methods of asbestos-related work change and the exposure to the employee or contractor would be significantly different.

- Occupational Health will maintain asbestos-related medical records.

Use of equivalent measure or procedure

A constructor, in the case of a project, or Sunnybrook, in any other case, may vary a measure or procedure required by this Regulation if the following conditions are satisfied:

- The measure or procedure, as varied, affords protection for the health and safety of workers that is at least equal to the protection that would be provided by complying with this Regulation.

- The constructor or Sunnybrook gives written notice of the varied measure or procedure, in advance, to the JOHSC or Occupational Health.

4.0 EMERGENCY RESPONSE PROCEDURES

An “emergency” is any disturbance of ACM which causes the release of asbestos fibres. Any disturbance of ACM must be addressed immediately.

Any employee who determines that there has been a release of asbestos fibres shall immediately notify the Project Manager, Maintenance and the OHS department and relay the location and the extent of the damage. The Project Manager, Maintenance and OHS will then institute the appropriate response action and document the incident on a Fibre Release Episode Report (Appendix VI).

Fibre releases can be termed “minor” or “major”. The determination of the type of release depends on the size or area of the affected material. The following guidelines will apply:

Minor Release:	Less than 9 sq.ft. of ACM (or 21 linear ft. of 1.6 in. pipe or equivalent)
Major Release:	Greater than 9 sq.ft. of ACM (or 21 linear ft. of 1.6 in. pipe or equivaler

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The following sections describe actions to be taken once the type of release has been determined. The Project Manager, Maintenance and OHS shall determine the type of release. All asbestos abatement work is to be done by an outside contractor specialized in this field.

4.1 Minor Release Episode

Any minor release episode will be abated following Type 2 procedures and the following shall apply:

- The area shall be immediately isolated as determined by the Project Manager, Maintenance and OHS. This may include physical barriers such as doors or plastic sheeting and the shutdown of the HVAC system.
- Personal protective equipment shall be worn when working in the area of the release.
- All debris shall be immediately saturated with amended water utilizing low pressure sprayers.
- All ACM shall be placed inside double 6 mil polyethylene bags and properly sealed. All bags shall be properly labeled with asbestos warning signs.
- All damaged ACM shall be carefully repaired and encapsulated or enclosed or removed.
- Upon completion of repairs and bulk cleanup, the entire area and exterior of the disposal bags shall be cleaned by the use of a HEPA vacuum. The exterior of the protective suits and footwear shall also be HEPA vacuumed.
- The entire area shall be wet wiped with amended water. The protective footwear shall be wet wiped. All wiping materials shall be disposed of as ACM in properly labeled double 6 mil polyethylene bags.
- All action taken shall be fully documented on a Fibre Release Episode Report form and submitted to The Project Manager, Maintenance and OHS.

4.2 Major Release Episode

Any major release episode shall require the immediate isolation of all affected areas and the involvement of a consultant and a removal contractor. A major release episode is considered more severe as it can result in the contamination of large areas of the building. The consultant will design the appropriate response action and will work closely with the Project Manager, Maintenance, Infection Prevention and Control, Risk Management and OHS. Guidelines identical to those listed in Section 4.1 shall be followed, however, depending on the circumstances, it may be elevated to Type 3 status at the discretion of the Project Manager,

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Maintenance and OHS.

5.0 RESPIRATORY PROTECTION (for employees performing asbestos work)

A respirator provided by Sunnybrook or contractor and used by a worker in a Type 1, Type 2 or Type 3 operation,:

· shall be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet shall be assigned to a worker for his or her exclusive use, if practicable;

· shall be used and maintained in accordance with written procedures that are established by the employer and are consistent with the manufacturer's specifications;

· shall be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker;

· shall have damaged or deteriorated parts replaced prior to being used by a worker; and when not in use, shall be stored in a convenient, clean and sanitary location.

· Sunnybrook employees whose work duties require the use of an air-purifying respirator shall be trained in the selection, use, care and maintenance of a half and full face piece tight fitting air-purifying respirator before being used in the workplace.

a. **Respiratory Training (For Employees performing the Asbestos Work)**

· The instruction and training related to respirators shall include the limitations of the equipment; inspection and maintenance of the equipment; proper fitting of a respirator; and respirator cleaning and disinfection. As prescribed by O. Reg. 278/05, s. 19 (3).

Type 1 operations:

· If a worker requests a respirator Sunnybrook will provide a NIOSH approved respirator to be used by the worker in accordance with Table 2 RESPIRATORS O. Reg. 278/05, and the worker shall wear and use the respirator.

Type 2 and 3 operations:

· Sunnybrook / contractor shall provide every worker who will enter the work area with a NIOSH approved respirator in accordance with Table 2 RESPIRATORS O. Reg. 278/05, and the worker shall wear and use the respirator.

6.0 CLEARANCE AIR SAMPLING

· Visual clearance and clearance air testing is required for all Type 3 work areas. The

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work area inside the enclosure passes the clearance air test only if every air sample collected has a concentration of fibres that does not exceed 0.01 fibres per cubic centimetres of air.

- The number of air samples to be collected shall be in accordance with Table 3 Air Samples, (O. Reg. 278/05, Table 3.)

- Air monitoring is specific refer to O. Reg. 278/05 on the requirement for forced air clearance testing to level of 0.01 f/cc using optical and / or electron microscope following Type 3 removal.

- Occupational Health & Safety shall keep a copy of the clearance air testing results for at least one year after receiving them. O. Reg. 278/05, s. 18 (9).

7.0 AIR MONITORING AND CONSULTANTS

Consultants hired to monitor asbestos abatement work shall:

i. Inspect the contaminant area to ensure it meets or exceeds the requirements under Ontario Regulations 278/05 and 837 prior to commencement. All air handling equipment should be shut down in the area.

ii. Periodically, monitor air inside and outside the containment area during work hours to verify the airborne fibre levels during removal procedures are under the recommended level.

iii. Ensure that negative pressure (if required) of 0.03”w.g. has been established prior to the commencement of abatement activities, and is continuously monitored using a digital manometer until the work area has been cleared via air sampling. Negative air units should be DOP (Dispersed Oil Particulate) tested on-site if being vented indoors.

iv. Periodically inspect the contractor during the project, to make sure safe work practices are in place and work is being performed according to the Regulation or Specifications.

v. Complete final inspection of the containment area. Conduct air monitoring to check all work is completed successfully and ensure that levels are lower than acceptable level prior to containment removal by the contractor.

vi. Airborne asbestos sampling must be conducted in accordance with standard methods for workplace air sampling and analysis.

vii. Results of airborne asbestos monitoring must be posted in an area available to the employees affected and must be made available to the

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JOHSC. Occupational Health & Safety must maintain sampling records for 1 year.

8.0 CONTAINMENT & WASTE REMOVAL

- The work area must be separated from the rest of the workplace by walls, barricades or fencing or by other suitable means.
- The mechanical ventilation system serving the work area must be disabled and all openings or voids, including ventilation ducts to or from the work area, must be sealed by tape or other appropriate means,
- For type 3 power tool work, asbestos dust must be contained by polyethylene sheeting or other suitable material in any area that the walls do not enclose the area and as curtains on each side of an entrance or exit from the work area.
- Asbestos waste must be placed in a container which is sealed, labeled and cleaned by HEPA vacuum or damp cloth.
- Once the work is completed, the work area must be vacuumed using a HEPA-filter vacuum before the barriers, enclosure and decontamination facility are removed.
- Any equipment or tools must be wiped with a damp cloth and vacuumed using a HEPA-filter vacuum
  or
- Removed from the area following waste removal requirements.
- Material used for barriers or enclosures must not be reused; once work is completed, the material must be wetted and placed in waste containers.

9.0 INFECTION PREVENTION & CONTROL (IP&C) PROTOCOL

IP&C protocol is specific. These controls and procedures (e.g. hoarding walls, HVAC isolation, negative pressure, etc.) are aimed at minimizing the risk of nosocomial infection by containment and prevention of particulate from the construction area migrating into the high risk patient area(s). To ensure that each construction and/or renovation project's design and process meet current infection control standards policy ***II-I-200 R Construction and Renovation,*** IP&C Policy Manual must be followed.

10.0 DECONTAMINATION FACILITIES & PROCEDURES

- Type 3 work requires a decontamination facility consisting of a series of interconnecting rooms including a room suitable for changing into protective clothing and for storing contaminated protective clothing and equipment, a shower room as prescribed in paragraph 7 of O. Reg. 278/05, s. 18 (4)., a room suitable for changing

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into street clothes and for storing clean clothing and equipment, and curtains of polyethylene sheeting or other suitable material that is impervious to asbestos, fitted to each side of the entrance or exit to each room.

- The rooms shall be arranged in sequence and constructed so that any person entering or leaving the work area must pass through each room.

- The barriers, enclosure and decontamination facility shall not be removed or dismantled until, cleaning has been done as described in paragraph 15 O. Reg. 278/05, s. 18 (4), and if clearance air testing is required, it has been completed and the work area inside the enclosure has passed the clearance air test. O. Reg. 278/05, s. 18 (4).

11.0 INSPECTIONS

The work area shall be inspected by a competent person for defects in the enclosure, barriers and decontamination facility,

I. at the beginning of each shift

II. at the end of a shift if there is no shift that begins immediately after the first-named shift, and

III. at least once each day on days when there are no shifts.

- Defects observed during an inspection shall be repaired immediately and no other work shall be carried out in the work area until the repair work is completed.

12.0 ELECTRICAL SAFETY

- If practicable, existing electrical power distribution systems that are not water-tight shall be de-energized and locked out where wet removal operations are to be carried out. All electrical work shall be done by a licensed electrician.

- Any temporary electrical power distribution systems tools and equipment involved in wet removal operations must be equipped with ground fault circuit interrupters, (GFCI).

13.0 MAINTENANCE & ABATEMENT

- Any new spray-applied material (e.g. fireproofing material), pipe insulation or boiler insulation must not contain more that 1% that can become friable (by dry weight).

- If existing friable asbestos containing material is visibly deteriorating, liquid sealant must not be used on the material.

- If machinery, equipment or part of a building that contains friable asbestos is to be

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demolished, the asbestos must be removed to the extent possible before the demolition.

· If a piece of friable insulation or fireproofing has broken off or been disturbed causing likely exposure, the material should be analyzed to determine if it contains asbestos e.g. bulk sampling using approved criteria.

· If the piece of broken material contains asbestos, the material is to be cleaned up and removed. If there are signs of further deterioration in the material, it must be repaired, sealed, removed or enclosed.

14.0 ONGOING ASBESTOS MANAGEMENT IN SUNNYBROOK BUILDINGS

Occupational Health and Safety has established a maintenance program for asbestos in the Sunnybrook buildings.

This program includes:

- The preparation and maintenance of a record of the location of ACM, friable and non-friable.

- Notification to the building's tenants of the location of such material.

- Notification to any workers in the building who may disturb or handle the material that the building contains asbestos.

- Establishment of a training program approved by the Ministry of Training Colleges or Universities, for those employees who are likely to handle the material (Effective November 1, 2007).

- Periodic inspection of the material to determine its condition.

- Plant Operations & Maintenance (POM) will be responsible for all non-flooring corrective actions.

- Environmental Services (ES) will be responsible for all flooring corrective actions.

- Corporate Planning and Development (CPD) will be responsible for any abatement or repair related to CPD project work.

- POM, ES and CPD will be responsible for providing all asbestos-related records to Occupational Health and Safety.

APPENDICES AND REFERENCES:

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Appendix I

ASBESTOS OPERATION PRECAUTIONS

Measures and Procedures for Type 1 operations

1. Before work begins, visible dust shall be removed using a damp cloth or a HEPA-filtered vacuum from any surface in the work area.

2. The spread of dust from the work area shall be controlled by measures appropriate to the work to be done including the use of drop sheets of polyethylene or other suitable material that is impervious to asbestos.

3. The material shall be wetted before and kept wet during the work to control the spread of dust or fibres, unless wetting would create a hazard or cause damage.

    a. A wetting agent shall be added to water that is to be used to control the spread of dust and fibres.

4. Frequently and at regular intervals during the doing of the work and immediately on completion of the work, dust and waste shall be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in a container (dust tight, suitable for the type of waste, impervious to asbestos, identified as asbestos waste) and drop sheets shall be wetted and placed in a container as soon as practicable.

    a. Drop sheets shall not be reused.

5. After the work is completed, polyethylene sheeting and similar materials used for barriers and enclosures shall not be reused, but shall be wetted and placed in a container as soon as practicable.

6. After the work is completed, barriers and portable enclosures that will be reused shall be cleaned, by using a vacuum equipped with a HEPA filter or by damp wiping, as soon as practicable

    a. Barriers and portable enclosures shall not be reused unless they are rigid and can be cleaned thoroughly.

7. Compressed air shall not be used to clean up and remove dust from any surface.

8. Eating, drinking, chewing or smoking shall not be permitted in the work area.

9. The worker may wear a NIOSH approved respirator in accordance with Table 2, of O. Reg. 278/05. Air purifying half-mask respirator with N-100, R-100 or P-100 particulate

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filter.

10. The worker shall wear the protective clothing provided by the employer.

    a. A worker who is provided with protective clothing shall, before leaving the work area, decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, if the protective clothing will not be reused, place it in a container.

11. Facilities for the washing of hands and face shall be made available to workers and shall be used by every worker when leaving the work area.

Appendix II

ASBESTOS OPERATION PRECAUTIONS

Measures and Procedures for Type 2 and Type 3 operations

1. The work area shall be identified by clearly visible signs warning of an asbestos dust hazard.

    a. Signs shall be posted in sufficient numbers to warn of the hazard and shall state in large clearly visible letters that, there is an asbestos dust hazard, and access to the work area is restricted to persons wearing protective clothing and equipment.

2. A wetting agent shall be added to water that is to be used to control the spread of dust and fibres.

3. Eating, drinking, chewing or smoking shall not be permitted in the work area.

4. Containers for dust and waste shall be dust tight, suitable for the type of waste, impervious to asbestos, identified as asbestos waste and cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before being removed from the work area, and removed from the workplace frequently and at regular intervals.

5. After the work is completed, polyethylene sheeting and similar materials used for barriers and enclosures shall not be reused, but shall be wetted and placed in a container as soon as practicable.

6. After the work is completed, barriers and portable enclosures that will be reused shall be cleaned, by using a vacuum equipped with a HEPA filter or by damp wiping, as soon as practicable.

    a. Barriers and portable enclosures shall not be reused unless they are rigid and can

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be cleaned thoroughly.

7. The worker shall wear a NIOSH approved respirator in accordance with Table 2, of O. Reg. 278/05.

8. Every worker who enters the work area shall wear the protective clothing provided by the employer. The protective clothing shall be made of a material that does not readily retain nor permit penetration of asbestos fibres, and shall consist of head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing, and shall include suitable footwear.

9. Compressed air must not be used to clean up or remove asbestos from any surface.

10. Only persons wearing protective clothing and equipment are permitted to enter a work area where there is an asbestos dust hazard.

11. For Type 2 or Type 3 work, employees or contractors must have training from a competent person in asbestos hazards, hygiene and work practices as well as the wearing and use of respirators and protective clothing.

Appendix III

ASBESTOS OPERATION PRECAUTIONS

Additional Measures and Procedures for Type 2 operations

1. For type 2 false ceiling work, the friable material that is likely to be disturbed shall be cleaned up and removed by using a vacuum equipped with a HEPA filter when access to the work area is obtained.

2. Before commencing work that is likely to disturb friable asbestos-containing material that is crumbled, pulverized or powdered and that is lying on any surface, the friable material shall be cleaned up and removed by damp wiping or by using a vacuum equipped with a HEPA filter.

3. Friable ACM that is not crumbled, pulverized or powdered and that may be disturbed or removed during the work shall be thoroughly wetted before the work and kept wet during the work, unless wetting would create a hazard or causes damage.

4. The spread of dust from a work area shall be controlled by measures appropriate to the work to be done, including the use of drop sheets of polyethylene or other suitable material that is impervious to asbestos.

5. If the operation is one mentioned in paragraph 1 or 2 of subsection 12 (3) of O. Reg.

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278/05 and is carried on indoors, the spread of dust from the work area shall be prevented, if practicable, by, using an enclosure of polyethylene or other suitable material that is impervious to asbestos (including, if the enclosure is opaque, one or more transparent window areas to allow observation of the entire work area from outside the enclosure), if the work area is not enclosed by walls, disabling the mechanical ventilation system serving the work area, and sealing the ventilation ducts to and from the work area.

6. Before leaving the work area, a worker shall, decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, and if the protective clothing will not be reused, place it in a container.

7. Facilities for the washing of hands and face shall be made available to workers and shall be used by every worker when leaving the work area.

Appendix IV

ASBESTOS OPERATION PRECAUTIONS

Additional Measures and Procedures for Type 3 operations

The following measures and procedures apply to Type 3 operations:

1. The work area is separate from the rest of the workplace by walls, the placing of barricades or fencing or other suitable means.

2. The spread of dust from the work area shall be prevented by,

   a. using enclosures of polyethylene or other suitable material that is impervious to asbestos (including, if the enclosure material is opaque, one or more transparent window areas to allow observation of the entire work area from outside the enclosure), if the work area is not enclosed by walls, and

   b. using curtains of polyethylene sheeting or other suitable material that is impervious to asbestos, fitted on each side of each entrance or exit from the work area.

3. Unless the operation is carried on outdoors, or inside a building that is to be demolished and will not be entered by any person except the workers involved in the operation and the workers involved in the demolition, the spread of dust from the work area shall also be prevented by,

   a. creating and maintaining within the enclosed area, by installing a ventilation system equipped with a HEPA filtered exhaust unit, a negative air pressure of

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0.02 inches of water, relative to the area outside the enclosed area,

b. ensuring that replacement air is taken from outside the enclosed area and is free from contamination with any hazardous dust, vapour, smoke, fume, mist or gas, and

c. using a device, at regular intervals, to measure the difference in air pressure between the enclosed area and the area outside it.

4. The ventilation system shall be inspected and maintained by a competent worker before each use to ensure that there is no air leakage, and if the filter is found to be damaged or defective, it shall be replaced before the ventilation system is used.

5. Before leaving the work area, a worker shall,

a. decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, and if the protective clothing will not be reused, place it in a container as described in paragraph 5 of section 15 of O. Reg. 278/05.

6. Facilities for the washing of hands and face shall be made available to workers and shall be used by every worker when leaving the work area.

Outdoors

In the case of an operation that is carried on outdoors, the following measures and procedures also apply:

1. If practicable, any asbestos-containing material to be removed shall be thoroughly wetted before and during removal, unless wetting would create a hazard or cause damage.

2. Dust and waste shall not be permitted to fall freely from one work level to another.

3. If practicable, the work area shall be washed down with water after completion of the clean-up and removal. Temporary electrical power distribution systems for tools and equipment involved in wet removal operations shall be equipped with ground fault circuit interrupters.

4. A decontamination facility shall be located as close as practicable to the work area and shall consist of,

a. a room suitable for changing into protective clothing and for storing contaminated protective clothing and equipment,

b. a shower room as described in paragraph 7 of subsection (4) of O. Reg. 278/05,

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and

c. a room suitable for changing into street clothes and for storing clean clothing and equipment.

5. The rooms shall be arranged in sequence and constructed so that any person entering or leaving the work area must pass through each room.

6. When leaving the work area, a worker shall enter the decontamination facility and shall, in the following order,

a. decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, if the protective clothing will not be reused, place it in a container as described in paragraph 5 of section 15 of O. Reg. 278/05,

b. shower, and

c. remove and clean the respirator.

Indoors

1. In the case of an operation mentioned in paragraph 1, 2, 3, 4 or 6 of subsection 12 (4) of O. Reg. 278/05 that is ***carried on indoors***, the following measures and procedures also apply:

2. Friable asbestos-containing material that is crumbled, pulverized or powdered and that is lying on any surface in the work area shall be cleaned up and removed using a vacuum equipped with a HEPA filter or by damp wiping and everything shall be removed from the work area or covered with polyethylene sheeting or other suitable material that is impervious to asbestos.

3. The spread of dust from the work area shall be prevented by an enclosure of polyethylene or other suitable material that is impervious to asbestos, if the work area is not enclosed by walls, and by a decontamination facility consisting of a series of interconnecting rooms including,

a. a room suitable for changing into protective clothing and for storing contaminated protective clothing and equipment,

b. a shower room as described in paragraph 7 of O. Reg. 278/05,

c. a room suitable for changing into street clothes and for storing clean clothing and equipment, and

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d. curtains of polyethylene sheeting or other suitable material that is impervious to asbestos, fitted to each side of the entrance or exit to each room.

4. The rooms described shall be arranged in sequence and constructed so that any person entering or leaving the work area must pass through each room.

5. The mechanical ventilation system serving the work area shall be disabled and all openings or voids, including ventilation ducts to or from the work area, shall be sealed by tape or other appropriate means.

6. Unless the operation is carried on inside a building that is to be demolished and will not be entered by any person except the workers involved in the operation and the workers involved in the demolition, the spread of dust from the work area shall also be prevented by,

a. creating and maintaining within the enclosed area, by installing a ventilation system equipped with a HEPA filtered exhaust unit, a negative air pressure of 0.02 inches of water, relative to the area outside the enclosed area,

b. ensuring that replacement air is taken from outside the enclosed area and is free from contamination with any hazardous dust, vapour, smoke, fume, mist or gas, and

c. using a device, at regular intervals, to measure the difference in air pressure between the enclosed area and the area outside it.

7. The ventilation system shall be inspected and maintained by a competent worker before each use to ensure that there is no air leakage, and if the filter is found to be damaged or defective, it shall be replaced before the ventilation system is used.

8. The shower room in the decontamination facility shall,

a. be provided with hot and cold water or water of a constant temperature that is not less than 40 Celsius or more than 50 Celsius,

b. have individual controls inside the room to regulate water flow and, if there is hot and cold water, individual controls inside the room to regulate temperature,

c. be capable of providing adequate supplies of hot water to maintain a water temperature of at least 40 Celsius, and

d. be provided with clean towels.

9. When leaving the work area, a worker shall enter the decontamination facility and shall,

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in the following order,

a. decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, if the protective clothing will not be reused, place it in a container as described in paragraph 5 of section 15, shower, and remove and clean the respirator.

10. If practicable, existing electrical power distribution systems that are not water-tight shall be de-energized and locked out where wet removal operations are to be carried out.

11. Temporary electrical power distribution systems for tools and equipment involved in wet removal operations shall be equipped with ground fault circuit interrupters.

12. Friable asbestos-containing material shall be thoroughly wetted before and during removal, unless wetting would create a hazard or cause damage.

13. The work area shall be inspected by a competent worker for defects in the enclosure, barriers and decontamination facility,

a. at the beginning of each shift,

b. at the end of a shift if there is no shift that begins immediately after the first-named shift, and

c. at least once each day on days when there are no shifts.

14. Defects observed during an inspection under paragraph 12 shall be repaired immediately and no other work shall be carried out in the work area until the repair work is completed.

15. If practicable, dust and waste shall be kept wet.

16. On completion of the work,

a. negative air pressure shall be maintained if required by subparagraph 5 I of O. Reg. 278/05,

b. the inner surface of the enclosure and the work area inside the enclosure shall be cleaned by a thorough washing or by vacuuming with a vacuum equipped with a HEPA filter,

c. equipment, tools and other items used in the work shall be cleaned with a damp cloth or by vacuuming with a vacuum equipped with a HEPA filter or they shall be placed in a container as described in paragraph 5 of section 15 before being

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removed from the enclosure, and

d. a visual inspection shall be conducted by a competent worker to ensure that the enclosure and the work area inside the enclosure are free from visible dust, debris or residue that may contain asbestos.

17. Once the work area inside the enclosure is dry after the steps set out in subparagraphs 15 ii, iii and iv have been completed, clearance air testing shall be conducted by a competent worker in accordance with subsection (5), unless the operation is carried on inside a building that is to be demolished and will not be entered by any person except the workers involved in the operation and the workers involved in the demolition. The barriers, enclosure and decontamination facility shall not be removed or dismantled until, cleaning has been done as described in paragraph 15, and if clearance air testing is required, it has been completed and the work area inside the enclosure has passed the clearance air test. O. Reg. 278/05, s. 18 (4).

Appendix V

ASBESTOS OPERATION PRECAUTIONS

Glove bag - Measures and Procedures for Type 2 Glove bag operations

1. Separate the work area from the rest of the workplace with walls, barricades, fencing or other suitable means.

2. Prevent the spread of ACM from the work area by disabling the mechanical ventilation system serving the work area and seal all openings or voids, including ventilation ducts to and from the working area.

3. Cover surfaces below the work area with drop sheets of polyethylene or other suitable material that is impervious to asbestos.

4. Ensure the glove bag is made of material that is impervious to asbestos and is sufficiently strong enough to support the weight of material that the bag will be holding.

   a. Equip the glove bag with: sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period, valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure, a tool pouch with a drain, a seamless bottom and a means of sealing off the lower portion of the bag, and a high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.

   b. Do not use a glove bag to remove insulation from a pipe, duct or similar

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structure if, it may not be possible to maintain a proper seal for any reason or the bag could become damaged for any reason.

5. Wear an air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter (O. Reg. 278/05, Table 2).

Appendix VI

Fibre Release Episode Report

1. Exact location where fibre release episode occurred (including room name, room number location within room etc.)

2. The release was reported by:

on: (date and time).

3. Describe the episode:

4. The asbestos containing material was was not cleaned up according to approved procedures. Describe the cleanup:

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Signed: Date:

(Project Manager, Maintenance or OHS)

REFERENCES

1. Ontario Ministry of Labour. Ontario Regulation 490/09 made under the Occupational Health and Safety Act 1990, as amended by O.Reg. 259/10; Designated Substances.
2. Ontario Ministry of Labour. Ontario Regulation 278/05 made under the Occupational Health and Safety Act 1990, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations, 2005.
3. Ontario Ministry of Labour. Ontario Regulation 67/93 made under the Occupational Health and Safety Act 1990, as amended to O.Reg. 631/05; Health Care and Residential Facilities
4. Ontario Ministry of Labour. Occupational Health and Safety Act and Regulations for Industrial Establishments,1990.
5. Canadian Standards Association (CSA). Z94.4-02 Selection, Use, and Care of Respirators, 2002.

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Mould Response Policy (IP&C and OHS)

Sunnybrook Health Sciences Centre		**Policy No:**	IP&C-0015
Title	**Mould Response Policy (IP&C and OHS)**	**Original:** *(mm/dd/yyyy)*	04/01/2005
Category	**Infection Prevention & Control**	**Reviewed:** *(mm/dd/yyyy)*	05/01/2007, 10/29/2010, 11/11/2013, 07/10/2017
Sub-Category	**Environmental Concerns & Reprocessing**	**Revised:** *(mm/dd/yyyy)*	07/10/2017
Issued By:	Infection Prevention & Control		
Approved By:	Medical Advisory Committee		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

POLICY STATEMENT:

It is a Sunnybrook Health Sciences Centre policy to establish procedures to ensure airborne mould is minimized through safe work practice. Procedures developed will assist to identify mould sites and the source, so that an appropriate plan of action can be put in place to assure the safety of our employees, patients and volunteers is maintained. Exposures will be kept to a minimal with respect to environmental pathogens such as moulds and other fungi. These environmental pathogens, such as *Aspergillus and Stachybotrys* can be harmful to patients with already compromised immune systems.

DEFINITION(S):

Fungus:
Any of a major group (Fungi) of saprophytic and parasitic spore-producing organisms usually classified as plants that lack chlorophyll and include moulds (filamentous fungi), rusts, mildews, smuts, mushrooms, and yeasts.

Immune Compromised:
A reduced or lacking ability for the body to defend against pathogens (bacteria, virus, and fungi). Examples of immune compromised individuals include oncology patients, HIV/AIDS patients, dialysis patients, and patients in Intensive care units (ICU) (e.g. critical care unit, burn unit, neurosurgical ICU, Neonatal ICU, etc.).

Mould:
A growth of filamentous fungi, with a portion growing into damp or decaying organic matter and a visible surface growth, which usually assumes a fluffy appearance. Examples of filamentous fungi include *Aspergillus* and *Stachybotrys*.

PROCEDURE: If mould is suspected:

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1. For an affected area greater than 10 ft^2, Plant Operations and Maintenance (POM) is to contact Infection Prevention & Control (IP&C) and Occupational Health & Safety (OHS) for direction and confirmation of the presence of mould.
2. If the presence of mould is confirmed, the affected area is to be hoarded off with two layers of 6 mil polyethylene sheeting. This is to prevent any further dissemination of fungal spores.
3. If the presence of mould is confirmed, and the **affected area is a ceiling tile or is less than 10 ft^2**, POM may remediate the mould following *CCA 82 - 2004 Mould Guidelines for the Canadian Construction Industry* in conjunction with *CSA Z317.13-17 Infection control during construction, renovation, and maintenance of health care facilities***.**
4. If the presence of mould is confirmed and the **affected area is greater than 10 ft^2**, POM (or Corporate Planning) must contact an external mould remediation contractor. An environmental consultant will be involved to oversee the work at the discretion of IP&C, OHS and POM (or Corporate Planning).
5. Project Manager or Project Lead must retain records of remedial work and forward copies to IP&C and OHS.
6. A Construction, Renovation and Maintenance Permit is to be requested for all work that disturbs building materials or includes ceiling entry.

APPENDICES AND REFERENCES:

RELATED POLICIES:
IP&C-0006 Infection Control during Construction, Renovation and Maintenance

STAKEHOLDERS:
Infection Prevention and Control
Plant Operations and Maintenance
Occupational Health and Safety
Corporate Planning

REFERENCES:

1. Mould guidelines for the Canadian construction industry. Canadian Construction Association, 2004.
2. Fungal contamination in public buildings: A guide to recognition and management. Federal-Provincial Committee on Environmental and Occupational Health, Health Canada, June 1995.
3. CSA Z317.13-17, Infection control during construction, renovation, and maintenance of health care facilities, Canadian Standards Association, 2016.

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Restricted & Confined Space Program

Sunnybrook Health Sciences Centre		Policy No:	HR-109
Title	**Restricted & Confined Space Program**	**Original:** *(mm/dd/yyyy)*	06/01/2005
Category	**Human Resources**	**Reviewed:** *(mm/dd/yyyy)*	02/08/2018
Sub-Category	**OccHealth & Safety**	**Revised:** *(mm/dd/yyyy)*	Feb. 2007, Nov. 2009, Dec. 2011, Dec. 2012, Nov. 2015
Issued By:	Human Resources		
Approved By:	Senior Leadership Team		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

POLICY STATEMENT:

It is a Sunnybrook Health Sciences Centre policy to establish procedures to safely manage work in areas or in equipment meeting the criteria for confined or restricted spaces in accordance with requirements of the Occupational Health and Safety Act and Health Care Regulation, O.Reg. 67/93.

The procedures in Sections 1.0 - 19.0 of this document outline the requirements for:

1. Identification of Restricted or Confined Spaces
2. Restricted Space Procedures
3. Written Confined/Restricted Space Program
4. Hazard Assessment
5. Control Plan
6. Coordinated Work
7. Entry Permits & Entering Confined Spaces
8. Training
9. Emergency Response & Equipment
10. Attendants
11. Isolation & Control of Material Movement
12. Atmospheric Testing
13. Ventilation & Purging
14. Explosive Atmosphere
15. Flammables or Combustibles
16. Warning Signs & Barricades
17. Equipment in Confined Spaces
18. Contractors
19. Records

DEFINITION(S):

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Atmospheric Hazard
Atmospheric hazards include an accumulation of flammable, combustible, or explosive agents; an oxygen content below 19.5% or above 23%; an accumulation of contaminants such as gases, vapors, fumes, dusts or mists that could result in health effects that pose an immediate threat to life or could interfere with a person's ability to escape unaided.

Competent Person
A person who: i) is qualified because of knowledge, training, and experience organizing the work and its performance ii) is familiar with the Occupational Health and Safety Act and its regulations and iii) has knowledge of any potential or actual danger to health or safety in the workplace.

Cold Work
Work without a source of ignition or that does not generate a spark or flame.

Hot Work
Work with a source of ignition or work that generates a spark or flame.

Confined Space
A fully or partially enclosed space that is not designed or constructed for human occupancy and in which atmospheric hazards may occur because of its construction, location or contents or because of work that is done in it.

Lead Employer
An employer who contracts external services to do confined space work.

Lower Explosive Limit (LEL)
The lowest concentration of a flammable gas or vapor in air that could flash or cause a fire in the presence of a spark or flame (also referred to as Lower Flammable Limit, LFL).

Upper Explosive Limit (UEL)
The highest concentration of a flammable gas or vapor in air that could flash or cause a fire in the presence of a spark or flame (also referred to as Upper Flammable Limit, UFL).

Project Leader
The person responsible for a particular construction or maintenance project; includes but is not limited to: staff from Corporate Planning & Development, Facilities Planning; Facilities Services, Plant Operations & Maintenance; Building Managers etc.

Purging
The process of displacing contaminants from a confined space.

Qualified Person
A worker who, because of knowledge, training and experience, is capable of performing a duty

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safely and properly.

Related Work
Work that is performed near a confined space in direct support of the work inside the confined space.

Restricted Space
A tank, vat, vessel, duct, vault, boiler or other space from which the egress of a worker is restricted, limited, or impeded because of the construction, design, location or other physical characteristics of the space.

POLICY:

1. **Identification of Restricted or Confined Spaces**
    - Restricted or confined spaces will be identified by Plant Operations and Occupational Health and Safety and reviewed by the Joint Occupational Health and Safety Committee (JOHSC).
    - Project leaders overseeing construction or maintenance work must be familiar with any confined space or restricted entries required for the project and must follow the appropriate procedures.

2. **Restricted Space Procedures**
    - Employees or contractors who will be entering an area meeting the definition for a restricted space must be informed of and become familiar with the procedures for entering and exiting the space as well as the characteristics of the space.
    - The project leader responsible for the entry must ensure procedures are established for rescue from the space in the event of an emergency.
    - There must be at least one person stationed outside and in proximity to the restricted space.
    - Any mechanical equipment in the restricted space must be disconnected from its power source and locked out.
3. **Written Confined/Restricted Space Program**
    - A written confined/restricted space program must be maintained in consultation with the Joint Occupational Health and Safety Committee (JOHSC).
    - The program must include methods for recognizing each space, assessing hazards, developing control plans, training workers and an entry permit system.
    - A copy of the written program must be provided to the JOHSC and available to all contractors and workers performing confined/restricted space work.
4. **Hazard Assessment**
    - A qualified person must complete and sign a written assessment of the hazards for a confined/restricted space with consideration of the hazards due to design, construction, location, use or contents of the space.
    - This information will be documented on the entry permit.
    - Copies of the assessment must be available upon request from the JOHSC / Safety Representatives of workers performing the confined/restricted space work and the workers themselves.

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- The assessment must be reviewed as often as necessary to ensure the plan remains adequate.

5. **Control Plan**
   - A competent person must complete a written control plan for each confined/restricted space before the entry.
   - The plan shall include:

- duties of workers,
- a coordination plan
- on-site rescue procedures
- rescue equipment
- methods of communication
- inspection of equipment
- personal protective devices equipment, or clothing
- adequate means of entering & exiting
- isolation of energy & control of materials movement
- atmospheric testing
- adequate procedures for working with explosive or flammable substances
- ventilation & purging
- attendants

   - The information will be documented on the entry permit.
   - The control plan must be reviewed as often as necessary to ensure it remains adequate.

6. **Coordinated Work**
   - If workers from more than one employer are working in the same confined/restricted space or doing related work, then the lead employer must prepare a co-ordination document to ensure that all confined/restricted space duties are performed to protect the health & safety of all workers.
   - A copy of the coordination document must be provided to each employer and the Safety Representative of each employer with workers performing confined/restricted space work.
7. **Entry Permits & Entering Confined Spaces**
   - The Project Leader or a qualified external consultant must complete a confined/restricted space entry permit prior to anyone entering the space. The

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permit must be made available to all employees or contractors who will enter the space or perform related work.

- The permit must have the following information
  - the location of the space
  - a description of the work being performed
  - the time period for the entry permit
  - name of each entrant and a record of their entries and exits
  - name of the attendant
  - a description of the hazards and corresponding control measures
  - if there is hot work, a description of appropriate measures and procedures
  - a list of emergency equipment and verification that the equipment is in working order
  - results from atmospheric testing
- The entry permit must be updated with any new information during the time of entry such as changes in air testing results or problems encountered during the entry.
- Each confined/restricted space must have an adequate means for entering and exiting the space.

8. **Training**
   - Every worker who enters a confined/restricted space or performs related work must have adequate training from a qualified person on safe work practices, following the control plan, and recognition of hazards.
   - Training will be assessed by Plant Operations and Maintenance and/or Occupational Health and Safety whenever there is a change in circumstances that may affect the safety of a worker in a confined/restricted space.
   - For Sunnybrook employees, training records will be maintained by the project leader and Occupational Health and Safety and must include the employee's name, the training provider and the type/date of the training.
9. **Emergency Response & Equipment**
   - The project leader responsible for the entry must complete a written emergency rescue procedure prior to a confined/restricted space entry based on the hazards identified in the hazard assessment and the control plan. The emergency rescue procedure shall be approved by the Supervisor in charge of the restricted/confined space work.
   - Communication methods appropriate for the hazards must be established and made available to the workers and the attendant.
   - If the control plan requires emergency equipment for serious health hazards such as potential engulfment, entrapment, the equipment must be readily available and appropriate for the parameters of the space.
   - Emergency equipment must be inspected by a competent person as often as necessary to ensure proper working order. The project leader overseeing confined/restricted space work must maintain equipment inspection records.
   - Each worker entering the confined/restricted space must be provided with Personal Protective Equipment (PPE) and safety equipment as indicated by the control plan and based on the air monitoring results.
   - Emergency response personnel must have and be trained to use the emergency

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PPE as described in the control plan. A self-contained breathing apparatus or air-supplied respirator with an escape bottle must be used during rescue operations in an unknown or Immediately Dangerous to Life or Health (IDLH) atmosphere.

10. **Attendants**
    - An assigned attendant must be stationed outside the confined space near the entrance and be in constant communication with the workers.
    - The attendant must monitor the safety of the workers and be able to summon a rescue response if required.
    - Attendants must be trained in first aid, and CPR as well as in the rescue procedures and the use of the equipment.
    - The attendant must not enter the confined space.
11. **Isolation and Control of Material Movement**

    Prior to each confined space entry, there must be adequate protection against:
    - Contact with moving equipment parts inside the confined space by disconnecting the equipment from its power source, de-energizing, locking out and tagging out. If the above measures are not possible, immobilize the equipment by blocking or other means.
    - Contact with electrical energy by disconnecting, de-energizing, locking & tagging the source of electrical energy or other means.
    - Release of hazardous substances or energy by blanking, disconnecting piping or other adequate means.
    - Drowning, engulfment, entrapment or other related hazards.
12. **Atmospheric Testing**
    - Workers are not permitted to enter the workspace if any atmospheric hazard is present including:
        - an oxygen content outside of the acceptable 19.5%-23% range
        - flammable, combustible, or explosive agents;
        - an accumulation of contaminants such as gases, vapors, fumes, dusts or mist that could result in health effects that pose an immediate threat to life or could interfere with a person's ability to escape unaided.
    - Prior to each entry, a qualified person must perform atmospheric testing to determine oxygen content, and the presence of combustible or toxic gases/vapors.
    - Testing must be repeated as often as necessary to ensure atmospheric conditions are within acceptable limits during the confined space work.
    - The instrumentation for the testing must be calibrated, in proper working order and appropriate to test the atmospheric hazards identified in the hazard assessment.
    - Results of all testing are to be documented on the confined space entry permit.
13. **Ventilation & Purging**
    - If the oxygen level is outside of the acceptable range (19.5-23%), the confined space must be purged and/or ventilated before workers enter the confined space.
    - If mechanical ventilation is to be used, there must be adequate warning of a failure.
    - If purging or ventilating is not practical or if an atmospheric hazard exists or is likely to exist, the workers entering the confined space must use appropriate respiratory protective equipment.

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- Any respiratory equipment used by workers in a confined space must be inspected by a qualified person and be in good working order.

14. **Explosive Atmosphere**
    - Workers must not enter or remain in a confined space that contains or is likely to contain an airborne, combustible dust or mist that may create an explosion hazard.
15. **Flammables or Combustibles**
    - No worker can enter or remain in a confined space that contains or is likely to contain an airborne combustible dust or mist which an atmospheric concentration may create an explosive hazard
    - If an explosive or flammable gas or vapor is present, the confined space can be entered only if the gas or vapor levels do not exceed:
        - 25% of LEL (For **Inspection Work**, no source of ignition)
        - 10% of LEL (For **Cold Work**, no source of ignition, flame or heat)
        - 5% of LEL (For **Hot Work**, generates heat, fire or spark) **and** the following must be implemented
            - an assessment confirms safety
            - a qualified person implements adequate protective procedures
            - a hot work permit is issued
            - an attendant is in place
            - atmospheric testing is continuous
            - The oxygen content does not exceed 23% and an adequate alarm is in place to alert if the gas or vapor exceeds 5% of LEL or oxygen content exceeds 23%

The above measures do not apply if the atmosphere in the confined space has been made inert by inert gas, there is continuous monitoring and the worker has appropriate respiratory protective equipment.

16. **Warning Signs & Barricades**
    - During confined space work, each entrance must be secured against unauthorized entry or have adequate warning signs and/or safety barricades.
    - Additional signage and locks should be in place to identify and secure confined and restricted spaces.
17. **Equipment In Confined Spaces**
    - **Compressed Gas Cylinders**
        - If compressed gas cylinders are required for the confined space work, the potential hazards and adequate controls must be considered in the hazard assessment and control plan.
    - **Torches and hoses**
        - Torches and hoses used for welding, brazing or cutting should be removed from a confined space when not in use and when the confined space is vacated e.g. on breaks or lunches.
        - If removal is not possible, the equipment should be disconnected at the source or closed and tagged while workers are on breaks.
    - **Electrical equipment**
        - Electrical tools and equipment used in a confined space must be grounded

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or double insulated.
    - If wet or damp conditions exist inside the space, tools must be protected by an approved Ground Fault Circuit Interrupter (GFCI).
    - Electrical tools and equipment used in a confined space where flammable vapours of explosive gases, or liquids are present must be Canadian Standards Association (CSA) approved for hazardous locations classified under CSA Standard C22.1, Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations, as Class 1, Division 2, Groups A, B and C.
    - Only non-sparking tools may be used in a confined space where flammable or explosive gases, vapours or liquids are present.
  - **Chemicals**
    - Chemicals that will be used in the confined space should be evaluated in the hazard assessment and control plan
    - The Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) of any product used in the confined space must be kept with the hazard assessment.

18. **Contractors**
    - Any contractors performing work in confined/restricted space shall be informed that the area is considered as such. The elements of the confined/restricted space program must be followed and the contractor entering the space must be informed of all aspects of the hazard assessment, control plan and testing results.
    - The project leader overseeing the contract work must verify that the contractors are adequately trained in confined/restricted space work and have appropriate personal protective equipment
19. **Records**
    - All records including permits, hazard assessments, control plans, and training records, must be kept for the longer of:
      - One year

        OR

      - The time period to have the 2 most recent records for each confined/restricted space

APPENDICES AND REFERENCES:

1. Ontario Ministry of Labour. Occupational Health and Safety Act, ONTARIO REGULATION 632/05, RESTRICTED AND CONFINED SPACES. Ottawa, 2011.
2. List of confined/restricted spaces
3. Restricted/Confined Space Permit

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Infection Control during Construction, Renovation and Maintenance

Sunnybrook Health Sciences Centre		Policy No:	IP&C-0006
Title	**Infection Control during Construction, Renovation and Maintenance**	Original: *(mm/dd/yyyy)*	01/01/2001
Category	**Infection Prevention & Control**	Reviewed: *(mm/dd/yyyy)*	09/01/2007, 03/09/2010, 03/08/2012, 11/11/2013, 11/20/2017
Sub-Category	**Construction & Renovation**	Revised: *(mm/dd/yyyy)*	09/01/2007, 11/20/2017
Issued By:	Infection Prevention and Control		
Approved By:	Medical Advisory Committee		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

POLICY STATEMENT:

It is a Sunnybrook Health Sciences Centre (Sunnybrook) policy to ensure that infection prevention and control guidelines and standards are adhered to with all health care facility planning, design, construction, renovation, maintenance and repair. The goal is to eliminate any infectious risks where possible and minimize those risks that cannot be eliminated from agents released or augmented because of actions undertaken within the health care facility.

DEFINITIONS:

Construction:
Minor or major building activities that disturb or modify building structures and systems; Includes new construction, renovation, maintenance, and repair work within or adjacent to the facility.

Construction Cleaning:
The complete removal of all debris and vacuuming the entire area with a HEPA equipped unit. Wet mopping of area is permitted, dry sweeping is not.

Constructor:
A person who undertakes a construction or renovation project for an owner; May be a contractor, subcontractor, construction manager, consultant, or tradesperson.

Fungus:
A diverse group of saprophytic and parasitic spore-producing organisms usually classified as plants that lack chlorophyll and include moulds (filamentous fungi), rusts, mildews, smuts, mushrooms, and yeasts.

HEPA (High-Efficiency Particulate Air) filter:

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An air filter with an efficiency of 99.97% in the removal of airborne particles 0.3*u* or larger.

Mould:
A growth of filamentous fungi, with a portion growing into damp or decaying organic matter and a visible surface growth, which usually assumes a fluffy appearance. Examples of environmentally significant filamentous fungi include *Aspergillus* and *Stachybotrys*.

Nosocomial Infection:
Infections that originate in a healthcare setting.

Project Manager (PM):
The lead representative from Corporate Planning and Development, Facilities Services and Others, responsible for the maintenance, construction or renovation project. The PM will advise I of any scheduled construction/renovation projects and ensure that IP&C requirements are addressed and adhered to from the start of the project.

Negative Pressure Differential:
Use of HEPA filtration units within the work zone to direct air flow from the corridors, or any adjacent area, into the work zone, ensuring that contaminated air cannot escape from the negative pressure room to other parts of the facility. Negative pressure differential with respect to all adjacent building areas is not less than 7.5 Pa (0.03 in wc).

PROCEDURE:

1. **Planning and Design Phase:**
   An interdisciplinary design team shall be assembled early on in the design process and must include an infection prevention and control representative. Designs shall incorporate the latest guidelines for design and construction of health care facilities (e.g. AIA, CSA). Subjects to be reviewed during the design phase include, but are not limited to, the following:
   - Number, location and type of airborne infection isolation rooms
   - Air-handling and ventilation needs in special areas such as operating theatres, critical care units, laboratories, etc.
   - Water systems to limit exposure to opportunistic water-borne organisms
   - Minimum spacing requirements
   - Sink selection and placement (see **Sink Standards**)
   - Finishes and surfaces
   - Assessment of risks related to the project utilizing the Risk Assessment and Preventative Measures Checklist. The determination of risk will guide the need for barriers during the construction/renovation project, and will allow for the associated costs to be incorporated into the appropriate budgets/tender documents
2. **Pre-Construction Phase:**
   At project start-up meeting, at meetings convened prior to the start of each Stage of the

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Work, at pre-installation meetings, and at regular progress meetings, infection prevention and control procedures are to be reviewed. The designated infection prevention and control representative shall attend such meetings. Subjects to be reviewed include, but are not limited to, the following:

- General outline of infection prevention and control requirements
- Identification of patient populations that may be at risk
- Prevention measures required during disruption of essential services (e.g. water, ventilation systems, electricity)
- PM is responsible for completing the online ***Construction, Renovation and Maintenance Permit*** to determine preventive measures required for each project
- The integrity of the facility's exterior structure, spatial separations, ventilation and water supplies for any infection control problems are reviewed and assessed
- Methods for dust containment and removal of construction debris are outlined
- Traffic patterns for construction workers and supply delivery routes will be established
- Needs assessment for increased filter changes during construction
- The need to close down dampers temporarily to reduce circulation of contaminated air or fumes is assessed
- Impact of air systems (correct air exchange rates and pressure relationships) in critical areas near construction activity
- Site inspection checklist
- Provisions for ceiling/wall access

3. **Construction Phase:**
    a. **Post *Construction, Renovation and Maintenance Permit* at the entrance to the area of construction**
    b. **Dust Control**
    Risk assessment of work zone shall be undertaken by IP&C, in conjunction with Project Manger at beginning of project. Preventative measures will be implemented to control the migration of dust particles from the work zone to adjacent areas. Methods will vary depending on the location, type of construction activity and population at risk.
    c. **Heating, Ventilation, Air Conditioning (HVAC)**
    All intake and exhaust vents/grills within work zone must be identified prior to construction. Where dust will be produced these vents/grills must be sealed off prior to construction to prevent contamination of HVAC system.

    Occupied spaces adjacent to the work zone must have functioning HVAC systems throughout the project. All shutdowns affecting occupied areas must be communicated to IP&C in advance to determine if alternative means of air are required.

    At the beginning and for the duration of construction/excavation outside/adjacent to the facility all intake grills will be identified and covered with a filter to prevent contamination. The internal pre-filter and primary filter for these air intakes will be monitored throughout the project and changed as required. IP&C and the Project Manager will monitor the HVAC system and determine if air monitoring

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is necessary.

d. **Plumbing**
IP&C is to be notified in advance of all water and steam shutdowns. Appropriate procedures must be followed throughout the project to ensure the potability of the water in the health care facility.

e. **Risk Reduction**
High risk populations must be moved to an area away from the construction zone if air quality cannot be ensured during construction. Do not transport any patients through the construction zone. Staff, patients and visitors are not permitted to enter the construction work area. Provisions will be made throughout the project to ensure that fire/emergency exits are not compromised.

Breaches in pre-specified infection control preventative measures, as outlined in **Appendix I**, that place staff and/or patients at risk will result in "stop" construction orders to the Project Manager and Site Foreman by Infection Prevention and Control. An Infection Prevention and Control Inspection Report shall be provided by IP&C outlining the deficiencies.

f. **Surveillance**
IP&C will conduct a pre-work inspection once all preventive measures are instituted and prior to the commencement of any work. An inspection report outlining deficiencies and permitting the project to proceed will be sent electronically to the PM involved (***Appendix II***). IP&C will perform regular site inspections to ensure continued compliance with assigned preventative measures and barrier integrity. The **Infection Control/Occupational Health and Safety Sign-off** (**Appendix III**) will be used for these inspections and is provided as part of the *Construction, Renovation and Maintenance Permit* and is to be posted at the worksite.

g. **Constructor Duties**
It is the responsibility of the constructor to ensure that all personnel on-site are trained and compliant with the IP&C preventive measures. Constructors are not permitted to use elevators in use by visitors/staff/patients. Where separate elevators are not available for use by the constructor specific times will be designated. Prior to construction IP&C, Project Manager and the Project Team will establish paths, times and procedures for the transportation of clean/sterile supplies, equipment and construction materials, including removal of construction debris. Constructors are required to follow the designated routes for entry/exit to and from the work zone to the outside.

h. **Mould**
If mould is discovered during construction IP&C and Occupational Health and Safety must be notified and they will report to the Joint Occupational Health and Safety Committee. Please refer to Mould Response Policy for further information.

Post-Construction Phase:

. Stages of Cleaning
Constructor is responsible for cleaning the work zone and adjacent zone on a regular basis throughout the project as per **Appendix I.** The work zone must be cleaned prior to and at completion of work prior to user hand off and before the

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following:

- Prior to reopening a supply air duct (to be completed by Constructor)
- Prior to removal of containment barriers (to be completed by Constructor)
- After the removal of containment barriers (to be completed by Sunnybrook Environmental Services)

a. At completion of project the HVAC system must be inspected for evidence of dust/water contamination and cleaned if necessary prior to user hand off.

   If the HVAC was turned off for the project then it must be re-commissioned prior to user hand off. Documentation shall be provided to Infection Prevention and Control regarding cleaning of HVAC system, viability of HEPA filters (if applicable), air balancing and direction of air flow.

b. Inspection/Sign-off
   At the completion of construction, prior to containment barrier removal IP&C is to be notified to inspect.

Appendix I (Click here to read / print Appendix I)
Risk Assessment and Preventative Measures Checklist

Appendix II (Click here to read / print Appendix II)

Appendix III (Click here to read / print Appendix III)

APPENDICES AND REFERENCES:

STAKEHOLDERS:
Plant Operations and Maintenance

REFERENCES:

1. Bartley JM and the 1997, 1998 and 1999 APIC Guidelines Committee. *APIC state-of-the-art report: the role of infection control during construction in health care facilities*. Am J Infect Control 2000;28(2):156-69
2. American Institute of Architects Academy of Architecture for Health. *Guidelines for design and construction of hospital and health care facilities.* Washington: American Institute of Architects Press, 2006.
3. Canadian Standards Association. *Canadian Health Care Facilities* (Z8000-11). Etobicoke: Canadian Standards Association, 2016.
4. Canadian Standards Association. *Infection Control during Construction or Renovation of Health Care Facilities (Z317.13-12)*. Etobicoke: Canadian Standards Association, 2012.
5. Canadian Standards Association. *Special Requirements for Plumbing Installations in Health Care Facilities (Z317.1-09)*. Etobicoke: Canadian Standards Association, 2009.
6. Canadian Standards Association. *Special requirements for Heating, Ventilation, and Air Conditioning (HVAC) Systems in Health Care Facilities (Z317.2-10)*. Etobicoke:

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Canadian Standards Association, 2015.
7. N.Y. City Dept. of Health. 2000. *Guidelines on assessment and remediation of fungi in indoor environments*. New York City Dept. of Health, New York, NY.

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Construction/Renovation Project Name/Identifier	

Project Manager and Contact Number	
Infection Prevention and Control Representative and Contact Number	
Constructor(s)	
Constructor's Contact Information	

Construction Activity Type		Population Risk Group	
Matrix Value		Proposed Project Start Date	

Part One: Types of Construction Activity

DEFINITIONS OF CONSTRUCTION ACTIVITY	
Type A	Inspections and General Upkeep Activities. Includes but is not limited to: removal of ceiling tiles for visual inspection (limited to 1 tile per 50 square feet); painting (but not sanding); installation of wall covering; electrical trim work; minor plumbing; and activities, which do not generate dust or require cutting into walls or access to ceilings other than for visual inspection
Type B	Small scale, short duration activities, which create minimal dust. Includes, but is not limited to, installation of telephone and computer cabling, access to chase spaces, cutting into walls or ceiling where dust migration can be controlled.
Type C	Any work that generates a moderate to high level of dust. Includes, but is not limited to, demolition or removal of built-in building components or assemblies, sanding of wall for painting or wall covering, removal of floor covering/wallpaper, ceiling tiles and casework, new wall construction, minor ductwork or electrical work above ceilings, major cabling activities.
Type D	Major demolition and construction projects. Includes, but is not limited to, heavy demolition, removal of a complete ceiling system, and new construction.

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Part Two: Classification of Population Risk Group

POPULATION RISK GROUP BREAKDOWN			
GROUP 1 LOW	GROUP 2 MEDIUM	GROUP 3 MEDIUM to HIGH	GROUP 4 HIGHEST
• Private/Office areas • Areas operating outside or void of patient care	• Patient Care areas not identified in Group 3 or 4 • Laundry • Cafeteria • Dietary • Materials Management • PT/OT/Speech • Admission/Discharge • Echocardiography Laboratories not specified as Group 3 • Public Corridors through which patients, supplies, linen pass)	• Emergency Rooms • Radiology/Medical Imaging • Post-anaesthesia Care units or Same Day Surgery (MG, M2) • Labour and Delivery • Newborn Nurseries • Medical laboratories (Microbiology (B1), Transfusion Science (B2), Chemistry (CG), Pathology (E4, M2, B1), Haematology lab (CG), etc.) • Post Surgical/Trauma Patient Care Units (D5, C5, D3, D6) • Oncology Units (C2, C6) • General Medicine Units (D2, D4, B4, C4)	• Ross Tilley Burn Centre (D7) • Critical Care Unit (M2) • Cardiovascular Intensive Care Unit (M2) • B5 Intensive Care Unit • Operating rooms (M2/D7/MG) • Central Processing Department • Newborn Intensive Care Unit • Pharmacy Admixture • Cardiovascular Care Unit (B3) • Cardiac Catheterization Suites (C3) • Intensive Care Unit D4ICU

Part Three: Construction Activity and Risk Group Matrix

A copy of the Risk Assessment and Preventive Measures Checklist must be sent to the Infection Prevention and Control Department to determine the matrix and determine the preventive measures required Adaptations to the prevention measures can only be made after approval has been provided by the infection control personnel.

	Construction/Renovation/Maintenance Activity			
Risk Group	**Type A**	**Type B**	**Type C**	**Type D**
Group 1	**I**	**II**	**II**	**III/IV**
Group 2	**I**	**II**	**III**	**IV**
Group 3	**I**	**III**	**III/IV**	**IV**
Group 4	**I-III**	**III/IV**	**III/IV**	**IV**

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Part Four: Recommendations for Infection Control Preventive Measures

Matrix Class I Requirements

Ia) C/R Activities - Dust Control

1	After visual inspection replace displaced tiles and close access panels
2	Work area HEPA vacuumed if dust created during activity
3	Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet

Ib) C/R Activities - Plumbing

4	Schedule water interruptions during periods of low user activity
5	Faucet aerators, gaskets and items made of materials that support the growth of Legionella are not installed or used
6	Water temperature meets standards set by Sunnybrook Health Sciences Centre
7	Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
8	Water lines flushed prior to re-use

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Matrix Class II Requirements

IIa) C/R Activities - Dust Control

1. All constructors and sub constructors must follow the assigned traffic route to and from the C/R zone
2. After visual inspection replace displaced tiles and close access panels
3. Active means provided to minimize dust generated and migrated into the atmosphere
4. Use drop sheets and water misting during cutting to control dust
5. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
6. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
7. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
8. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
9. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group

IIb) C/R Activities – HVAC

10. Ventilation system disabled in the C/R area until project completed (where possible)
11. Need to change and/or clean filters in C/R area monitored
12. Air intake and exhaust vents in C/R zone sealed off with polyethylene

IIc) C/R Activities - Plumbing

13. Schedule water interruptions during periods of low user activity
14. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
15. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*
16. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
17. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

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Matrix Class III Requirements

IIIa) C/R Activities – Dust Control

1. IP&C consultation completed and IP&C dust control measures approved
2. Impermeable solid dust barrier, from true ceiling to floor erected and inspected by IP&C before start of project (drywall/sheetrock/gypsum board)
3. Double layer of 6 mil fire retardant polyethylene is an alternative dust barrier, but IP&C must be consulted to determine optimal choice based on location, type and duration of project
4. Upper seals must be installed above the false ceiling to the true ceiling around all penetrations to complete the dust barrier
5. Sticky mat placed and maintained outside C/R zone to trap dust from workers shoes, equipment and debris that leaves the C/R zone
6. Constructors vacuum themselves with HEPA-filtered vacuum before leaving work site (alternatively constructors can wear cloth/paper coveralls that are removed each time they leave the work site)
7. Use drop sheets and water misting during cutting to minimize dust generated and migrated into the atmosphere
8. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
9. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
10. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
11. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
12. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group
13. Holes in walls repaired within 8 hours or temporarily sealed
14. Dust barrier shall remain in place until project complete, area has been thoroughly cleaned and inspected by IP&C
15. Dust barriers removed carefully to minimize the spreading of dust and other debris particles associated with the C/R project

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Matrix Class III Requirements (cont'd)

IIIb) C/R Activities – HVAC

16. High-Efficiency Particulate Filters (HEPA) shall be used to obtain a negative pressure differential. Constructor responsible for providing appropriate number of units based on square footage of C/R zone
17. Filters shall be monitored and replaced if clogged or functioning below the manufacturer's specifications
18. Negative pressure differential with respect to adjacent areas is no less than 7.5 Pa (0.03 in wc)
19. Intake and exhaust vents/grills within C/R zone to be sealed off with poly for the duration of the project
20. Where possible air is to be exhausted directly outside and way from intake vents, alternatively air is to be filtered through HEPA filter before being re-circulated
21. Ventilation systems working properly in adjacent areas
22. Ventilation system is cleaned if contaminated by soil, water or dust after C/R project completion

IIIc) C/R Activities – Plumbing

23. An alternate source of potable water must be provided for users during prolonged plumbing shutdowns and/or after major plumbing installation/repairs until potable water has been cleared for signs of *Legionella*
24. Schedule water interruptions during periods of low user activity
25. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
26. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*
27. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
28. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

IIId) C/R Activities – Risk Reduction

29. High risk patients in/adjacent to C/R areas moved
30. Cleaning frequency of areas adjacent to C/R zone by cleaning by Hospital Environmental Services to be increased while project is underway
31. Traffic pattern designated for clean or sterile supplies and equipment that avoids C/R zone
32. Hospital medical allied health staff are not permitted to enter to then C/R zone for the duration of the project

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Matrix Class IV Requirements

IVa) C/R Activities – Dust Control

1. IP&C consultation completed and IP&C dust control measures approved
2. Impermeable solid dust barrier with anteroom erected and inspected by IP&C before start of project
3. Upper seals must be installed above the false ceiling to the true ceiling around all penetrations to complete the dust barrier
4. Sticky mat placed and maintained fresh outside and inside anteroom to trap dust from workers shoes, equipment and debris that leaves the C/R zone
5. Construction workers leave C/R zone through anteroom to be vacuumed with HEPA-filtered vacuum before leaving work site (alternatively constructors can wear cloth/paper coveralls that are removed each time they leave the work site)
6. Impermeable solid dust barrier, from true ceiling to floor erected and inspected by IP&C before start of project (drywall/sheetrock/gypsum board)
7. Use drop sheets and water misting during cutting to minimize dust generated and migrated into the atmosphere
8. Seal windows, unused doors, plumbing penetrations, electrical outlets and any other potential air leaks within C/R zone
9. Ensure that patient care equipment and supplies are protected from dust exposure by removal from space by hospital staff or by covering with a drop sheet
10. Debris removed from C/R zone in covered containers *or* covered with moistened sheet before transport
11. Work area wet mopped or HEPA vacuumed if dust created during activity and at completion of project
12. Horizontal and vertical surfaces to be cleaned with a hospital approved disinfect at completion of project prior to turnover to user group
13. Holes in walls repaired within 8 hours or temporarily sealed
14. Dust barrier to remain in place until project complete, area has been thoroughly cleaned and inspected by IP&C
15. Dust barriers removed carefully to minimize the spreading of dust and other debris particles associated with the C/R project

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Matrix Class IV Requirements (cont'd)

IVb) C/R Activities – HVAC

16. High-Efficiency Particulate Filters (HEPA) shall be used to obtain a negative pressure differential. Constructor responsible for providing appropriate number of units based on square footage of C/R zone
17. Filters shall be monitored and replaced if clogged or functioning below the manufacturer's specifications
18. Negative pressure differential with respect to adjacent areas is to be maintained no less than 7.5 Pa (0.03 in wc)
19. Intake and exhaust vents/grills within C/R zone to be sealed off with poly for the duration of the project
20. Where possible air is to be exhausted directly outside and way from intake vents, alternatively air is to be filtered through HEPA filter before being re-circulated
21. Ventilation systems working properly in adjacent areas
22. Ventilation system is cleaned if contaminated by soil, water or dust after C/R project completion

IVc) C/R Activities – Plumbing

23. An alternate source of potable water must be provided for users during prolonged plumbing shutdowns and/or after major plumbing installation/repairs until potable water has been cleared for signs of *Legionella*
24. Schedule water interruptions during periods of low user activity
25. Faucet aerators, gaskets and items made of materials that support the growth of *Legionella* are not installed or used
26. Water temperature meets standards set by *Sunnybrook Health Sciences Centre*
27. Any discoloured water or water leaks to walls and substructures reported to maintenance and IP&C representative
28. Hyper-chlorinate or superheat stagnant domestic water and flush water lines in C/R zone and adjacent patient areas before re-use

IVd) C/R Activities – Risk Reduction

29. High risk patients in/adjacent to C/R areas moved
30. Cleaning frequency of areas adjacent to C/R zone by cleaning by Hospital Environmental Services to be increased while project is underway
31. Traffic pattern designated for clean or sterile supplies and equipment that avoids C/R zone
32. Hospital medical and/or allied health staff are not permitted to enter to then C/R zone for the duration of the project

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Sunnybrook
HEALTH SCIENCES CENTRE

INFECTION PREVENTION AND CONTROL
APPENDIX II:
CONSTRUCTION/RENOVATION/REPAIR MONITORING CHECKLIST

Date: _____ **Time:** _____

Location: _____ ___ **Inspector:** _____

Construction/Renovation/Repair site has been checked for:

ITEM	COMPLIANCE?		
1. Construction Barriers	**Y**	**N**	**N/A**
Infection Control Permit/Sign off posted outside work area			
Airtight plastic or drywall barriers extend from floor to ceiling			
All airtight penetrations sealed with heavy tape			
All remaining hospital equipment, doors, holes, conduits, unused windows, outlets in work area covered with poly and sealed			
Doors to anteroom and work site remain securely closed			
Upper seals intact			
Portable containment cube intact, labeled and completely sealed			
Portable HEPA vacuum or HEPA filtration unit attached outside cube and turned on during ceiling/wall access			
2. Negative Air	**Y**	**N**	**N/A**
HVAC system has been isolated to prevent contamination of the duct system. Supply vents are blocked and return vents are filtered			
Equipment to prevent airborne particulates from escaping work area are used appropriately (e.g. portable HEPA filter units/filtered vacuums, exhaust fans)			
Doors to anteroom and work site remain securely closed			
Portable HEPA filtration unit is well secured (clamped hose) and ducted properly			
Work site is at negative pressure to surrounding areas (0.03kpa)			
Contractors properly attired (coveralls/booties put on over clothing) prior to entering work zone			

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3. CLEANLINESS OF AREA	Y	N	N/A
Protective clothing properly removed and disposed of, or existing clothing properly vacuumed in ante-room prior to leaving work area			
Sticky mats or adhesive strips are clean and available at doorways for shoe dust collection			
No visible dust or footprints outside of work zone			
Anteroom is intact and free of debris/dust			
Sticky mats are fresh and available at doorways for dust collection			
Construction area cleaned daily.			
Demonstrated compliance with traffic patterns, both construction worker and supply/debris removal.			

COMMENTS/NOTES

_____

_____

_____

_____

_____

- Any major deficiencies should be addressed immediately. Non-compliance should be brought to the attention of the Project Manager (refer to Infection Control Risk Assessment Tool)
- This monitor checklist will be completed periodically for the duration of the construction/renovation/repair project
- A corrective action log for documented non-compliance will be maintained by Infection Prevention and Control

Created by Infection Prevention and Control: July 2006,
Updated: November 2017

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Appendix III

Infection Control/Occupational Health and Safety Sign-off

Project Name/Location: ________________________________

Project Manager: ________________________________

Contractor: ________________________________

Initial sign-off (Infection Prevention and Control):

Date: ____________________ Signature: ____

Initial sign-off (Occupational Health and Safety):

Date: ____________________ Signature: ____

To be completed by IPC/OHS

Date	Walk-off (sticky) mats in place and in good condition	Negative pressure of 7.5 Pa (0.03 in wc) continuously monitored	Containment is well sealed	Comments/Correction actions	Initials
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		
	◯Yes ◯No	◯Yes ◯No	◯Yes ◯No		

(November 2017)

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Smoke-Free Environment

Sunnybrook Health Sciences Centre		Policy No:	ADM-0034
Title	**Smoke-Free Environment**	**Original:** *(mm/dd/yyyy)*	04/01/2000
Category	**Administration**	**Reviewed:** *(mm/dd/yyyy)*	
Sub-Category	**Corporate Policies**	**Revised:** *(mm/dd/yyyy)*	01/01/2007, 2/23/2010, 09/16/2015; 03/29/17
Issued By:	Smoking Cessation Team		
Approved By:	Board of Directors		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

POLICY STATEMENT:

It is a Sunnybrook Health Sciences Centre (Sunnybrook) strategic goal to lead in health and safety best practices. The health and safety of our **staff**, **volunteer**, **student**, **visitor** and **patient** (see definitions for terms in bold face) population is important to us. As a healthcare facility, we strive to assist in the prevention of diseases caused by smoking and the effects of second hand smoke.

POLICY APPLICABILITY

Smoking is prohibited in all areas of the hospital (i.e. **hospital premises** and **property**) except for within designated smoking areas. Hospital premises and property include the inside of the building in its entirety, exterior grounds, parking garages, vehicles, and bus shelters. This policy applies to all staff, volunteers, students, visitors and patient population that are within the physical boundaries of Sunnybrook (see hospital premises and property definitions), unless considered to be legally exempt from the legislation.

This policy applies to all tobacco, smoke or vapour producing products (e.g. cigarettes, cigars, pipes, chewing tobacco, herbal tobacco products, electronic cigarettes, electronic nicotine delivery systems, etc.). The sale of tobacco, smoke or vapour producing products is prohibited on hospital premises and property.

POLICY

Recognizing that a smoke-free environment may be a difficult adjustment for our smoking population of staff, volunteers, students, visitors and patients, we offer support to assist smokers.

According to the regulation to the *Smoke-Free Ontario Act*, special considerations will be given to our Veteran residents and we will accommodate those who are residing at Sunnybrook in either George Hees or Kilgour Wing (General, O Reg 48/06, s. 21).

Sunnybrook recognizes and must comply with applicable municipal, provincial and federal

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legislation:

- *Smoke-Free Ontario Act*
- Federal *Tobacco Act*
- *Occupational Health & Safety Act*
- *Electronic Cigarettes Act*
- Other applicable policy or legislation.

DEFINITION(S):

Staff
any individual that is employed by Sunnybrook, anyone working under contractual agreements, volunteers, medical, dental and midwifery staff and all others carrying out business on behalf of Sunnybrook.

Students
an individual who is assigned to Sunnybrook as part of their training for a future position in a healthcare setting or other type of similar setting.

Volunteer
an individual working for Sunnybrook in an unpaid capacity and performs various tasks that are important to our organization.

Patient
broadly refers to any inpatient or outpatient of Sunnybrook at any of its campuses (i.e. Bayview, Holland Centre, and St. John's Rehabilitation).

Visitor
any person on hospital premises and property that is visiting Sunnybrook or any of its campuses.

Property
this includes the Bayview campus, the Holland Centre and St. John's Rehabilitation. Sunnybrook programs and staff that are tenants at other locations must comply with the Provincial and Federal legislation and any specific policies of the landlord.

Clinical Leaders
those leaders responsible for supervising students, residents, fellows and other temporary persons that are assigned to work at Sunnybrook from universities, colleges and other educational facilities.

Hospital Premises:
Bayview Campus: all hospital property, buildings and grounds generally bordered by Bayview Avenue on the west, Burnt Brook ravine on the south, Sunnybrook Park on the east, and by private property and Sunnybrook Park on the north. ***(Click to see pdf version of Sunnybrook Campus Smoke Free Property Boundary map)***

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St. John's Rehabilitation: the building and grounds generally bordered by Cummer Avenue on the north, the ravine on the south, The Sisterhood of St. John the Divine convent on the west, Cummer Valley Middle School and private property to the east***(Click to see pdf version of St. John's Rehabilitation Smoke-Free Property Boundary map)***

Holland Centre: the building and grounds bordered by Wellesley Street on the north, the private laneway on the south, and including the west and east laneways owned by the hospital. ***(Click to see pdf version of Holland Centre Campus Smoke-Free Property Boundary map***

Exemptions include designated smoking areas in the following locations:

Aging and Veterans Care:

- two designated indoor smoking rooms in L Wing (veteran residents only)
- one outside smoking area on the north side of K Wing (veteran residents only)
- one outside smoking area on the west side of L Wing (veteran residents only).

Estates of Sunnybrook:

- one outside smoking area near the McLean Estate (for clients and guests only)
- one outside smoking area near the Vaughn Estate (for clients and guests only).

PROCEDURE:

Roles & Associated Responsibilities:

Overall responsibility for policy implementation:

Managers – are responsible to assure that all staff are aware of the Smoke-Free Policy and risks of policy non-compliance.

Physicians – are responsible to advise *all* Sunnybrook patients that come to Sunnybrook's hospital premises and property that they must abide by Sunnybrook's Smoke-Free Policy. Smoke-Free posters will be provided to Physicians upon request for use in their offices.

Clinical Leaders – are responsible to assure that all students, residents, fellows and other temporary persons assigned to Sunnybrook are aware of the Smoke-free Policy and risks of non-compliance to the policy.

New staff - upon recruitment to Sunnybrook, will be given information regarding the Smoke-Free Policy.

Communications and Stakeholder Relations– is responsible for developing messaging and collaborating with Corporate Planning to produce materials to support the implementation of this policy (permanent signage remains the responsibility of Corporate Planning).

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Senior Leadership Team – is responsible for the support and implementation of the Smoke-Free Policy and to assure that all Leaders under their portfolios are aware of the policy and risk of non-compliance.

Security – is responsible for the enforcement of the Smoke-Free Policy to assure that all patients, families, visitors and staff abide by the policy. They will support the non-compliance measures.

No smoking signs – will be clearly displayed at all entrances into Sunnybrook and all parking garages.

Smoking cessation support:

Staff/Volunteers/Physicians/Students wishing to quit smoking will be provided with onsite smoking cessation support. Assistance is available through the Occupational Health & Safety department and Sunnybrook's Smoking Cessation Team at smokingcessation@sunnybrook.ca to assist staff/volunteers/physicians/students that require support.

Patients with a history of smoking prior to admission and who require assistance in order to refrain from smoking during their hospital stay can request assistance and will be provided with support for the withdrawal of nicotine as determined by the individual physicians and their units. They will also be provided with information on cessation if requested.

Visitors will be informed about Sunnybrook's Smoke-Free Policy through internal and external signage

Policy Non-compliance:

Staff/Volunteers/Physicians/Students All staff, volunteers, physicians and students who do not comply with this policy may be subject to disciplinary action.

Visitors, the general public, contractors and other individuals conducting business on Hospital property who do not comply with this policy will be asked to stop using the prohibited product. If they fail to comply they will be given a verbal reminder. Repeat violations *may* lead to being escorted from the property by security.

Patients who do not comply with this policy will be asked to stop using the prohibited product. If they fail to comply with the request to extinguish the tobacco, smoke, or vapour producing product, they will be escorted to their care centre and notation made on their records by a member of the patient's circle of care for discussion with the interprofessional healthcare team.

Provincial Public Health Smoke Enforcement Officers will be monitoring compliance to the legislation at Sunnybrook, as well as all other healthcare facilities across Ontario. All persons found to be in non-compliance with the Provincial legislation **will be fined** by the Public Health Enforcement Officer as per the penalties determined by the legislation.

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Staff are encouraged to play an important role in gently reminding anyone smoking on Sunnybrook property (with the noted exceptions) of the requirements under the Smoke-Free Policy. Staff should not jeopardize their safety when reminding a smoker.

APPENDICES AND REFERENCES:

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Mandatory Permit Request for Construction, Renovation and Maintenance

Did you know there's a special permit you need for any construction, renovation or maintenance work?

This permit allows Occupational Health and Safety and Infection Prevention and Control to determine if there will be potential exposure to hazardous materials, both chemical and biological.

What are some examples of work requiring a permit?
- Painting
- Plumbing work - minor and more significant
- Work above ceilings
- Flooring

Why is this important?
These projects can generate a high level of dust. An asbestos assessment is also important.

How do I get a permit?
Visit Sunnynet, go to "Facility" ----> "Plant Operations and Maintenance" ----> "Maintenance Request Form". Log in (using your email username and password). Under "New Service Request" ----> "Permit Request".

Keep staff and patients safe - get a permit!

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HOT WORK PERMIT

BEFORE INITIATING HOT WORK, CAN THIS JOB BE AVOIDED? IS THERE A SAFE WAY?

This Hot Work Permit is required for any temporary operation involving open flames or producing heat and/or sparks. This includes, but is not limited to: Brazing, Cutting, Grinding, Soldering, Torch Applied Roofing and Welding dust.

Hot Work being done by: ( ) Employee.

( ) Contractor. (Name & Company Name)_____

Address:_____ Telephone # _____

Date: _____Start Time: _____Completion Time: _____

Building/Wing: _____Floor: _____

Work To Be Done:_____

(Check appropriate Box Below for By-pass)

( ) Smoke ( ) Heat ( ) Flame ( ) Water Flow

PRECAUTIONS- taken by worker(s)

( ) Sprinkler in service ( ) Worker equipped with personnel protective equipment.

( ) Hot Work equipment in good repair. ( ) Fire extinguisher available at work site.

WITHIN 11 METERS (36 FT) OF WORK

( ) Floors swept clean of combustibles. Flammable liquids, dust, lint and oily deposits removed.

( )Combustible materials moved away from work site or protected b non-combustible covers.

( ) All wall and floor openings covered.

FIRE WATCH – Maintained by worker(s)

( ) To be provided during an d30 minutes after operation.

( ) Supplied with a fully charged an operable fire extinguisher.
( ) Trained in use of equipment and in sounding the fire alarm.

FINAL CHECK-Made by Security

Work area an all adjacent areas to which sparks and heat might have spread (including floors above and below and on opposite side of wall(s) were inspected 30 min. after the work was completed and were found fire safe.
( ) Final check to be made 30 minutes after completion of any operation.

Permit Authorizing individual Signed:_____

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Confined/Restricted Space Entry Permit

Campus:	Date:	Entry Supervisor:

	Confined space		Restricted space

Location/Description of confined/restricted space:	Purpose of entry/Duties of workers:
Scheduled start time:	**Scheduled finish time:**

Hazard assessment (select all that apply)

	Oxygen deficient atmosphere		Engulfment/Entrapment		Other – list
	Oxygen enriched atmosphere		Toxic atmosphere		
	Hot work (welding, cutting, grinding)		Noise		
	Flammables/Combustibles		Energized electrical equipment		
	Hazardous chemicals				

Comments:

Control plan and pre-entry checklist (select all that apply)

	Safety department notified		Barriers in place		Exhaust ventilation
	Entry supervisor trained/qualified		All tools non-sparking/explosion proof		Forced air ventilation
	Entrants trained/qualified		No powder-actuated tools		Low voltage (<25V) lighting used
	Attendant person trained/qualified		Electrical equipment explosion proof		Lighting levels adequate
	Space drained/cleaned/purged		Electrical equipment grounded		No compressed gas cylinders
	Lockout/Tagout complete		Ground fault circuit interrupters provided		Other – list
	Warning signs in place		Hot work permit (attached)		
	Bump test performed		Written entry procedure available		
	Pre-entry briefing completed		SDS sheets available		
	Clearances secured		Adequate means for exit/entry		

Comments:

On-site rescue procedures/rescue equipment/method of communication (describe and verify that equipment is in good working order):

Personal protective equipment (select all that apply)

	Protective clothing		Protective gloves		Harness and lifeline
	Fire retardant clothing		Supplied air respirator		Other – list
	Hard hat		Air purifying respirator		
	Eye/Face protection		SCBA		
	Hearing protection		Communications equipment		
	Protective footwear		Fire extinguishers		

Comments:

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Atmospheric testing (for confined space only: perform as often as necessary before and while worker is in space)						
Oxygen (O_2): 19.5-23% Combustible gas: <25% LEL for inspection, <10% for cold work, <5% for hot work Other: based on TWA, STEL, C						
Time	**Oxygen (O_2)**	**Combustibles**	**Other:**	**Other:**	**Other:**	**Other:**

Authorized entrant	**Time in**	**Time out**	**Attendant**

Authorization
I certify that all necessary precautions, including emergency procedures, have been taken to make this confined/restricted space safe for entering and for conducting the prescribed work during the prescribed time(s). Permit prepared by: (print name) (sign name)

Please submit copy of permit to Occupational Health and Safety (H292 or #SB, Safety Team) upon completion of work

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Sunnynet

Data Centre and Hub Room Access Policy

Sunnybrook Health Sciences Centre		Policy No:	ICS-025
Title	Data Centre and Hub Room Access Policy	Original: *(mm/dd/yyyy)*	06/11/2012
Category	Information and Communication Services	Reviewed: *(mm/dd/yyyy)*	06/11/2012
Sub-Category	Network & Security	Revised: *(mm/dd/yyyy)*	10/05/2012
Issued By:	IT Operations Committee		
Approved By:	Sam Marafioti		

The Sunnybrook Intranet document is considered the most current.
Please ensure that you have reviewed all linked documents and other referenced materials within this page.

Data Centre and Hub Room Access Policy

Policy

It is Sunnybrook's policy to permit only authorized access to data centre and hub rooms in accordance with Sunnybrook Information Services security policies and procedures in order to ensure the integrity and availability of services dependent on these mission critical resources.

Definitions

Agent means any authorized Sunnybrook person accessing a data centre or hub room.

Visitor means any authorized non-Sunnybrook person seeking access to a data centre or hub room.

Purpose

This policy outlines Information Services standards for access to and maintenance of all Sunnybrook data centres and hub rooms ("facilities"). The policy is intended to enable secure access to facilities and to ensure that these facilities are maintained and operated in a safe, clean and effective manner in order to provide continuous service for dependent systems and infrastructure. All persons accessing data centres or hub rooms must abide by this policy. Failure to comply may result in loss of facility access privileges and/or removal

of equipment.

Applicability

This policy applies to:

- All authorized Information Services administrators and their authorized agents who maintain equipment owned and operated by Information Services in a data centre or hub room; and
- Any other Sunnybrook person who owns or maintains equipment housed in or accessed via any Sunnybrook data centre or hub room.
- Any Visitor for any purpose whatsoever.

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Procedures

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1 - Authorized Data Centre and Hub Room Activities

Hub rooms are intended to be single purpose rooms for accommodating Information Services network systems (network cabling and equipment), servers and storage systems and may include associated cables, monitors, power, air conditioning units, temperature monitoring units, humidity monitoring, tape drives, backup media, etc.

In addition, other Sunnybrook authorized corporate systems or infrastructure services may be housed within or accessible through a data centre or hub room, including patient monitor network systems, Medical Imaging PACS network equipment, Research network equipment, etc. Other rooms may have been built as multipurpose rooms which have other corporate systems installed such as fire alarm panels, Coax video systems, etc.

Note: installation of any non-IS owned or operated system or service in a data centre or hub room must receive prior written approval from Sunnybrook's CIO.

-

2 – Administrator Responsibilities:

It is the responsibility of each Information Services system administrator to ensure that all data centres and hub rooms and all associated equipment therein are maintained and operated in a safe and effective manner, including the performance of on-going maintenance and monitoring for any unusual conditions, e.g. overheating, flooding, etc.. All non-normal operating conditions must be reported to the Manager of Information Technology at the

earliest opportunity.

- All data centres and hub rooms must be kept in a safe, clean and professional manner at all times. All waste must be immediately disposed of by the respective Administrators and the waste deposited into proper containers.
- All entrances to data centres and hub rooms must kept clear as per fire/security regulations.
- All non-normal operating conditions must be reported to the Manager of Information Technology at the earliest opportunity.
- Staff failing to adhere to this policy will be reported to Director of Information Technology who will take applicable disciplinary action where required.

3 – Access

Access to a Sunnybrook data centre or hub room by any person requires
1) authorization from Information Services; and
2) either an IS escort or a personally issued KeyScan–enabled Sunnybrook ID badge.

- KeyScan-enabled access does not require an Information Services escort. Those persons accessing a data centre or hub room who have not been issued a KeyScan-enabled card must be escorted.
- Escort, where required, must be provided by either an authorized Sunnybrook Information Services or Security Services representative.
- KeyScan-enabled card access will generally be provided to authorized Sunnybrook staff (agents) and 3rd parties (visitors) requiring routine, non-escorted access on an individual, case-by-case basis.
- Individuals must only use a personally issued KeyScan-enabled card and all individuals must either scan in or be escorted to enter a room (all tailgating is strictly prohibited).
- Access (whether by escort or KeyScan) will be logged and routinely audited by information Services.

Sunnybrook Information Services Purposes

Sunnybrook agents (IS and non-IS departmental server admins) requiring temporary or permanent access to data centres and hub rooms must send a request to the IS Network team and receive written authorization prior to access.

Temporary access to these rooms will be granted on a short-term basis for 3rd

party vendors or other visitors performing work on behalf of Information Services (e.g. for software or hardware installation or maintenance).

Sunnybrook Non-Information Services Purposes

Access to data centres and hub rooms rooms for non-IS purposes must be authorized by the Director of Information Technology or designate. Temporary access to these rooms will be granted on a short-term basis for 3rd party vendors (visitors) requiring access to service or install non-IS systems in the room (e.g. renovations to the room, service or installation of air conditioning, etc.), including but not limited to:

- Installation or service of any non-IS systems such as Patient Monitor, PACS or Research, fire alarm panels, security system panels, electrical service panels, coax TV systems, etc.
- For construction work near or in these rooms requiring access, including installation of conduit or cables that will pass through the rooms; etc.
- Access by other non-IS Sunnybrook project managers, maintenance and service personnel or their agents (e.g. for Facilities Planning or Maintenance personnel, vendors or contractors) who may require access to these rooms to implement projects, install systems or maintain and service essential systems such as on an ongoing basis or in emergencies.

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4 - Security:

Authorized Access Only

Access to data centres and hub rooms is absolutely restricted to authorized individuals as documented in this policy and as identified by the Manager, Information Technology in the IS Network Team Data Centre and Hub Room Access access control list.

- All data centres and hub rooms must be kept locked at all times.
- Access to data centres and hub rooms will be logged and audited by the Manager, Information technology
- All persons requesting access will be required to supply identifying information (name, company name or department, room number and phone number/local) and the purpose for entry before being granted access.
- Access is permitted for those activities required for the indicated purpose and under no circumstances shall other activities occur for any other purpose without written approval of the Manager, Information Technology.

- Security badges must be worn at all times.

Visitors

- All Visitors must be escorted at all times by an authorized SB Information Services staff or member of Sunnybrook's Security staff unless they have been issued a KeyScan-enabled Sunnybrook ID badge (see Appendix 1).
- Authorized Visitors who may require continuous access for greater than 5 days may be provided with a temporary Visitors' badge enabling KeyScan access at their cost or at the cost of their sponsor at the discretion of the Manager, Information Technology.
- Visitors are not permitted to have possession of any data centre or hub room access lock key other than an authorized KeyScan-enabled Sunnybrook ID badge which has been assigned to them personally.

Enforcement:

- Any person found to have violated this policy may be subject to disciplinary action, up to and including termination of employment and/or legal action at the sole discretion of Sunnybrook Health Sciences Centre.

Contact Information:

George Lee	x4219	page 7308
David Chong	x7232	page 8101
Myles Leicester	x4377	page 8137
Wilfred Yan	x85322	page 5416

IS Help Desk	x4159
Fire and Security	x4589

Appendix 1

Requesting Access to ICN Data Centres and Hub Rooms

The following procedures must be used for requesting access to any Sunnybrook data centres or hub room.

Requesting access during business hours:

1) Users requiring access to data centres or hub rooms must email the IS Network team for access. The IS Helpdesk can also be called and will, in turn, email and page the ICN Network team. Users are to identify themselves and indicate the reason they require access to this room as well as date and time required.
2) The IS Network team will review the request and access may require further management approval without prior notice.

3) The IS Network team may personally provide access to the room or submit a request to Sunnybrook Security Services to authorize access.

4) The IS Network team will log all access, including identity of user, data centre or hub room number, date, start and stop times and reason for access.

Requesting access after business hours:

1) Users requiring access to hub room must call the Security office (ext. 4589) to request access. Users must identify themselves and indicate the reason they require access.

2) Security will only provide access to persons appearing on a list of pre-approved personnel provided by the IS Network team or based on prior written permission of a member of the IS network Team or the manager, Information Technology.

   a) If a person is authorized for entry, Security will open the door to permit user access to the room.

   b) If user is not authorized for entry then Security will deny access and advise the user to contact IS the following day.

      i) If the user cannot wait then Security may contact the IS Helpdesk for assistance in contacting an authorized IS representative.

      ii) If Security contacts the IS Helpdesk, the Helpdesk personnel will assess the request and, if necessary, email and page the ICN Network Team for directions.

5) Security will log all access, including the identity of user, data centre or hub room number, date, start and stop times and purpose for access.

Requesting KeyScan Access

Note: Some rooms are equipped with KeyScan access. Visitors may be a assigned KeyScan-enabled Sunnybrook ID badge as noted above, however only escorted Visitor access can be granted to rooms without KeyScan pads.

The following procedure is used for requesting KeyScan access to data centres:

1. User submits request by email to IS Helpdesk or IS Network team. Name, department, phone number and pager number of person(s) requiring access, data centre(s) to be accessed and reason for access must be provided. Pre-approved requests may be provided by IS management on behalf of the user.

2. All requests will be forwarded to IS Network team. If the request is questionable then it will be forwarded to IS management for approval. (e.g. to install non-IS systems or allow departmental servers to be installed in the ICN data centres).

3. If a request is approved and accepted then the IS Network team will forward an e-mail to Security to authorize access via KeyScan.

> **Note:** Security will not accept requests directly from users and will only accept requests from the IS Network team.

If short term temporary access is requested then the IS Network team will specify the number of days for which access has been granted.

4. Security will create a KeyScan-enabled Sunnybrook ID badge for the approved access and confirm back to ICN Network team and/or directly to the user(s) requiring access. Vendors requiring a temporary ID badge can pick it by visiting the Security office (CG03) only after providing proper identification. Prior email notification of access approval must be received by Security from the IS Network team.

> **No person may use a KeyScan-enabled Sunnybrook ID badge which has not been assigned to them personally to access a data centre or hub room.**

5. If temporary access was issued, at the completion of the access period, IS Network team will issue a follow-up email to Security to remove access.
6. If IS Network team is informed of a user leaving the hospital who no longer requires access to a room, IS will issue an email to Security to remove any KeyScan access which may have been previously assigned to that individual.
7. The IS Network team will maintain a spreadsheet of users that have been granted Keyscan access. Date of request and room accesses granted as well as the date of request or access code removal will be recorded.

Fire Watch Procedure

Fire Alarm Outages Sunnybrook Health Sciences Centre

A fire watch is required should the sprinkler system or fire alarm system or components of either system be on bypass, disconnected, or fail to work as designed and not provide continuous facility-wide protection. Components of fire alarm system could include but is not limited to: the fire alarm panel, smoke or heat detection system, and the fire alarm notification system. A designated person, trained in containment and extinguishment shall implement a fire watch of the total impacted area of the facility.

DOCUMENTATION: Every fire watch tour needs to be documented with the findings which will include the date, time and staff initials of person(s) performing the watch. A fire watch tour is a continuous activity performed by having one or more assigned/trained staff walking the entire affected area of the system outage. The tour monitors the facility through direct observation for possible signs of fire.

OCCURENCES: Sprinkler and fire alarm system outages can occur during construction, renovations or other planned or unplanned events which eliminate part or the entire sprinkler of fire alarm system's functioning ability.

WHAT TO DO:

1. Contact security when any bypasses are required or a problem is encountered with the sprinkler or fire alarm system.

2. Security will contact Toronto Fire and the fire alarm company to be made aware of the impairment to the impacted system

3. The fire watch procedure shall designate the wing, floor or building identifier during the facility tour.

4. Location of the facility's fire extinguishers shall be known in the impacted building and additional extinguisher(s) shall be supplied and kept in a known location by the contractor during construction and renovation.

5. Fire watch tours shall occur continuously. Typically at 1 hour intervals 24 hours a day for as long as the system is impacted.

6. A fire watch should check and document the following in all rooms including:

- Patient/Resident rooms
- Offices
- Mechanical and Electrical rooms
- Construction or renovation work areas shall be monitored continuously

7. Observation of fire or smoke during this fire watch should immediately initiate the facility's fire safety plan. Remove anyone requiring assistance, Alert other's by shouting, calling 5555 from a house phone or 416 480 5555 from a cell phone and pulling a fire alarm pull station(pull station may be disabled depending the nature of the impairment). Contain the fire by closing doors and prepare to evacuate.

8. Maintenance staff shall be available on site or on call for equipment emergency shut down situations.

Sunnybrook Fire Watch Log

Date	Area impacted
System impacted	Expected duration of fire watch

Contact/Person conducting fire watch	Business name
Phone number	Address
City	Postal code

Fire watch patrol is to be performed at 1 hour intervals until the impaired fire system is restored. Document each fire watch patrol on the log sheet below. In addition document any significant related events in more detail in the “Additional Comments” section. Make additional copies of this form as needed.

Date mm/dd	Time	AM	PM	Findings
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Additional Comments:

I have read and understand the Fire Watch instructions. I have accepted the Fire Watch responsibility and carried out the duties of the fire watch as required. I have accurately documented the date, time and events of the fire watch on this fire watch log.

Signature

Date

This form is to be retained and surrendered to Sunnybrook Fire Prevention at UB07, Bayview Campus upon completion of the fire watch.

MAPLE ENVIRONMENTAL INC.
ENVIRONMENT, HEALTH & SAFETY CONSULTANTS

LIMITED DESIGNATED SUBSTANCE SURVEY REPORT (RENOVATION AREAS)

M-Wing - MG IR/US Project
Sunnybrook Bayview Campus
2075 Bayview Avenue
Toronto, Ontario

Presented to:
Sunnybrook Health Sciences Centre
2075 Bayview Avenue
Toronto, Ontario
M5N 3M5

Attention: Ray Annetta
ray.annetta@sunnybrook.ca

March 2020

Maple Project No. 18290

482 South Service Rd. E. • Suite 116 • Oakville • Ontario • L6J 2X6 • Tel: 905-257-4408 • Fax: 905-257-8865
www.MapleEnvironmental.com

EXECUTIVE SUMMARY

Maple Environmental Inc. ('Maple') was retained by Sunnybrook Health Sciences Centre to perform a survey for Designated Substances as well as polychlorinated biphenyls (PCBs) and mould within the selected areas around the OR14 Hybrid Project on M-Wing Second Floor located at 2075 Bayview Avenue, Toronto, Ontario (the 'Site'). It is Maple's understanding that the building requires a survey to identify possible hazardous building materials that may be disturbed during the renovation within the areas surveyed.

The OR14 Hybrid Project is limited to the following areas surveyed on the Second Floor in M-Wing which included Rooms M2220 (OR Sterile Core), M2 280 (OR Sterile Corridor), M2282 (Prep Area), M2283 (Wash/Scrub Area), M2284 (Office), and M2285 (Operating Room 14) as indicated on NORR Drawing. The findings of the current survey are summarized below. Please refer to the main body of this report for details on all materials.

Based on the infectious control constraints imposed for the area, no destructive testing or disturbance of any structural finishes such as lifting of ceiling tiles or sampling of wall finishes was conducted during this assessment. Visual assessment was conducted of the areas deemed to be affected by the proposed renovations.

FINDINGS

Asbestos

No asbestos-containing materials (ACM) were identified within the surveyed areas at the time of the assessment.

It should be noted that due to the presence of solid walls and ceilings (i.e. masonry block walls and above solid ceilings) throughout the survey area, access for viewing within the wall and ceiling cavities was not always possible. Suspect asbestos-containing materials may be present within wall and ceiling cavities that were not identified but are suspected to be present in this report. Caution should be taken when demolishing solid walls and ceilings within the areas being surveyed.

Lead

Based on the sampling restrictions imposed for this assessment, no bulk samples were collected during this assessment. As M-Wing was constructed in 1998, the potential of "Lead-Containing" paint finishes being present is minimal and so the painted finishes are to be considered as "Low-Level Lead" (which are considered to be "virtually-safe").

It should be noted that lead may also be present in wiring connectors, electric cable sheathing, solder joints on copper piping, ceramic glazes, lead sheeting, masonry mortar, and as sub-surface layers to the most recent paint layers currently applied, where present at the Site.

Mercury

Mercury vapour is present in all fluorescent light tubes. Liquid mercury is also present in thermostatic switches located within the surveyed area.

Silica

Free crystalline silica, present as common construction sand, is present in all concrete and masonry products where present within the surveyed areas.

Mould

No visible mould growth was observed to be present within the surveyed area at the time of the assessment.

It is possible that mould growth is present in concealed areas such as wall or ceiling cavities, pipe chases, etc. or in areas not currently assessed by Maple. The client should notify Maple should any water damage or suspect mould growth be discovered.

PCBs

The fluorescent lamp fixtures observed contained T8 fluorescent light tubes. Light fixtures with T8 light bulbs have electronic ballast and are therefore considered not to contain PCB.

RECOMMENDATIONS

Based on the Laboratory Analytical Results and observations made on Site, Maple provides the following recommendations:

- No asbestos related recommendations are warranted at this time. However, Maple requests the opportunity to be present to review the contents of the ceiling spaces once the ceilings have been removed to confirm findings.
- It should be noted that due to the presence of solid walls and ceilings (i.e. masonry block walls and above solid ceilings) throughout the survey area, access for viewing within the wall and ceiling cavities was not possible. Suspect asbestos-containing materials may be present within wall and ceiling cavities that were not identified but are suspected to be present in this report. Caution should be taken when demolishing solid walls and ceilings within the areas being surveyed.
- "Low-Level Lead" paints (0.1% or less) are considered "virtually safe" provided that:
    - Airborne lead concentrations are kept below 0.05 mg/m^3;
    - General dust suppression and worker hygiene procedures are utilized; and
    - Torching or other activities that create fumes are not completed.
- Remove all mercury containing components (including fluorescent light tubes) prior to renovations if the materials are being removed. These components should be removed intact and disposed of appropriately.
- Proper dust suppression techniques and other safety precautions to control possible generation of silica dust from the demolition of concrete and masonry products present in the surveyed area should follow those outlined in the Ministry of Labour Guideline- Silica on Construction Projects, 2004.

Appropriate procedures for lead, mercury, and silica must be observed if these materials are likely to be disturbed by scheduled renovations. Please refer to Section 5.0 of the report to review the required procedures.

Consideration should be given to assessing other areas of the building that could be associated with the current project, including travel path, mechanical or electrical ties in the areas outside of the immediate project area, and penetrations through the slab impacting floors below or above.

TABLE OF CONTENTS

1.0 INTRODUCTION

Maple Environmental Inc. ('Maple') was retained by Sunnybrook Health Sciences Centre (SHSC) to perform a survey for Designated Substances as well as polychlorinated biphenyls (PCBs) and mould within the selected areas around the OR14 Hybrid Project on Second Floor of M-Wing located at 2075 Bayview Avenue, Toronto, Ontario (the 'Site'). It is Maple's understanding that the building requires a survey to identify possible hazardous building materials that may be disturbed during the renovation within the areas surveyed.

The OR14 Hybrid Project is limited to the following areas surveyed on the Second Floor in M-Wing which included Rooms M2 220 (OR Sterile Core), M2 280 (OR Sterile Corridor), M2 282 (Prep Area), M2 283 (Wash/Scrub Area), M2 284 (Office), and M2 285 (Operating Room 14) as indicated on the NORR Drawing. The findings of the current survey are summarized below. Please refer to the main body of this report for details on all materials.

Section 30 of the Ontario Occupational Health and Safety Act requires that the following Designated Substances be included in a Designated Substance Survey:

Asbestos
Lead
Mercury
Silica
Isocyanates
Vinyl Chloride Monomer
Benzene
Acrylonitrile
Coke Oven Emissions
Arsenic
Ethylene Oxide

Additional detailed information with respect to asbestos was collected at the time of the survey to ensure compliance with Ontario Regulation 278/05.

Based on the infectious control constraints imposed for the area at the time of the assessment, no destructive testing or disturbance of any structural finishes such as lifting of ceiling tiles or sampling of wall finishes was conducted during this assessment. Visual assessment was conducted of the areas deemed to be affected by the proposed renovations.

The assessment was performed by Richards Reboks of Maple on March 23rd, 2020.

2.0 APPLICABLE ONTARIO REGULATIONS

Applicable Ontario Regulations for each of the materials included in the investigation are briefly described below.

2.1 Designated Substances and Other Hazardous Materials

Section 30 of the Occupational Health and Safety Act requires building owners or their agents (architects, general contractors, etc.) to prepare or have prepared a Designated Substance report for specified potentially hazardous materials possibly present in a facility. The owner must ensure that a prospective constructor has received a Designated Substance report before entering into a binding contract with the contractor. The owner is liable to the contractor for damages and costs arising from unreported materials (of which the owner should reasonably have been aware) and could also be subject to orders and fines from the Ministry of Labour.

In addition to the requirements under the Occupational Health and Safety Act, Section 6 of the Ministry of Labour Regulations for Construction Projects requires the contractor, when submitting the Notice of Project form, report any Designated Substances likely to be used, handled or disturbed during the project.

The disturbance of asbestos materials on construction projects is controlled by Ministry of Labour Regulation R.R.O. 2005/278. The disposal of asbestos waste is controlled by Ministry of Environment Regulation, R.R.O. 1990/347.

There are no specific Ministry of Labour regulations for control of the other Designated Substances on construction projects. However, the Ministry of Labour actively enforces the general duty clause of the Health and Safety Act which protects workers and provides guidance on exposure monitoring, permissible exposure levels, medical monitoring, etc. for all Designated Substances.

Although Regulations exist for many of the Designated Substances, they apply to industry settings using Designated Substances in manufacturing processes, and do not apply to general property management, renovation or maintenance of buildings.

Polychlorinated Biphenyls ("PCBs") and mould were also included in the investigation, which are not specifically named as Designated Substances. No specific regulations are attached to these materials but are generally governed by the due diligence section of the Health and Safety Act for employers to protect their workers.

2.2 Ontario Regulation 278/05 (Asbestos)

Ontario Regulation 278/05 applies to buildings with regards to maintenance, renovations or demolition work where asbestos-containing materials (ACM) is present and may be disturbed. The Regulation requires that a detailed asbestos inventory be performed in all buildings where friable and non-friable asbestos materials are present. The inventory must be available at the work place and must identify the type of asbestos, and location of asbestos on a room-by-room basis. The following report does not necessarily meet the requirements for an asbestos survey under Ontario Regulation 278/05.

In addition, the regulation requires all buildings where asbestos has been used as part of the building to implement an Asbestos Management Program (AMP).

2.3 Ontario Regulation 347

Ontario Regulation 347 applies to the transport of waste from the location of generation to a landfill site authorized to receive specific wastes. The regulation also prescribes procedures on how the specific wastes are to be handled at the landfill site.

The major requirements of the building owner and the person(s) removing the waste are to ensure that:

- The waste is appropriately packaged and labelled;
- The transport vehicle is appropriately placard; and
- The waste is to be transported as directly as possible to the landfill site once it leaves the site.

Some wastes require the owner to register a Generator (of waste) number and many wastes require classification that can restrict or even prohibit their disposal in landfill.

It is important to note that the building owner can be held responsible for the waste until the waste disposal site accepts it.

2.4 Ontario Regulation 362

Ontario Regulation 362, made under the Ontario Environmental Protection Act applies to the waste management and transport of PCB waste from the location of generation to a landfill site authorized to receive specific wastes. The regulation also prescribes procedures on how the specific wastes are to be handled at the landfill site.

3.0 SURVEY SCOPE AND METHODOLOGY

The Project is limited to the sections of the Second Floor in M Wing as indicated in the NORR Drawings. The findings of the current survey are summarized below. Please refer to the main body of this report for details on all materials.

In order to determine the location of materials included in the assessment, the project technologist entered the room where practical (i.e. where access was possible without the demolition of walls, roof or ceilings or destruction of flooring). Representative views were made above accessible suspended ceiling systems. Cavities within solid ceiling and wall systems were accessed via existing access panels only. The inventory did not include demolition of building systems or finishes to check on possible hidden conditions.

3.1 Asbestos-Containing Building Materials (ACM)

The scope of the survey included all friable asbestos products and all major non-friable asbestos materials. The term friable is applied to a material that can be readily reduced to dust or powder by hand or moderate pressure. Asbestos materials that are friable have a much greater potential to release airborne asbestos fibres when disturbed.

Typical friable asbestos materials include: sprayed fireproofing or thermal insulation, textured (stippled) plaster, and thermal mechanical insulation. Typical non-friable materials include: asbestos cement (transite) products, vinyl floor tiles, asbestos textiles and gaskets. Additional materials such as ceiling tiles, drywall joint compounds and vinyl sheet flooring are classified as non-friable, but because of their ability to release dust when disturbed are considered as “potentially friable” for the purpose of this report.

Bulk samples of materials suspected to contain asbestos were collected for analysis during the survey. Specifically, a small volume of material was removed either from a damaged section of suspect material or taken from intact material. In these latter cases, the material from which the sample was collected was sealed with tape to temporarily prevent fibre release. Samples were placed in plastic bags and sealed until receipt by an independent laboratory. To ensure quality results, the independent laboratory chosen successfully participates in an "Asbestos Proficiency Analytical Testing Program". As such, these independent laboratories are responsible for their findings.

Bulk samples were collected in accordance with regulatory sampling requirements and with sufficient frequency to obtain a general pattern of asbestos use within the building. Due to building renovations or modifications that may have occurred in the past, the consistency of the application of asbestos materials may not be uniform throughout the entire Site.

It is important to note that without sampling each individual wall, pipe section, ceiling tile etc. it is not possible to identify the asbestos content of every material present in the selected areas. For this reason, visually similar materials are considered to be homogenous with those already sampled elsewhere in the building without additional analysis.

O. Reg. 278/05 prescribes that a minimum number of samples be collected of materials suspected to contain asbestos. These minimum sampling requirements are summarized in Table 1, below.

Table 1 - Suspect ACM Bulk Sampling Requirements

Type of Material	Quantity of Material Present	Minimum # of Bulk Samples Required
Surfacing Materials (i.e. sprayed fireproofing, drywall joint compound, texture coat, and plaster)	Up to 90 sq. m. (1000 sq. ft.)	3
	From 90 sq. m. (1000 sq. ft.) to 450 sq. m. (5000 sq. ft.)	5
	Greater than 450 sq. m. (5000 sq. ft.)	7
All other potential ACM	Any	3

Excluding surfacing materials, the laboratory was instructed to cease analysis within Sample Groups of homogenous materials when one of the samples in the group is found to contain asbestos. For example, if three samples of a type of vinyl floor tile are collected (as required by O. Reg. 278/05) and submitted for analysis and the first sample is positively identified as containing asbestos, the balance of the sample group is not analysed.

EMC Scientific Inc. ('EMC'), an independent laboratory, was selected to analyse the collected bulk suspect asbestos samples. EMC successfully participates in an "Asbestos Proficiency Analytical Testing Program" and as such, is responsible for its findings. EMC followed the Code of Practice for the identification of asbestos in bulk material, as detailed in O. Reg. 278/05. Bulk samples were analysed using the Polarized Light Microscopy ("PLM") Technique with Dispersion Staining. The identification of asbestos fibre in bulk material is based on a collective set of parameters dependent on the unique shape and crystallographic properties of each fibre as viewed through the microscope. This method is useful for the qualitative identification of asbestos and the semi-quantitative determination of asbestos content in bulk materials expressed as a percent of projected area. The method identifies types of asbestos and also measures percent of asbestos as perceived by the analyst in comparison to standard area projections or trained experience.

The recommendations made as part of this report with respect to asbestos have taken into consideration: the condition and accessibility of the material, vibration, air movement, and general activities likely to occur within the vicinity of the ACM.

In each area or room inventoried, the technician recorded the quantity, condition (GOOD, FAIR, or POOR) of each suspect asbestos-containing material.

The definitions for condition and accessibility of the asbestos-containing items are as follows:

GOOD Material is intact with no visible signs of damage.

FAIR Material is visibly damaged but can be repaired.

POOR Material is damaged beyond repair and likely needs to be removed.

Where ACM is found to be in GOOD condition and not likely to deteriorate or fall, the general recommendation would be to re-evaluate the condition of the material on an annual basis (required by O. Reg. 278/05). This recommendation can be subject to change if the material is located in a manner that persons untrained in asbestos awareness could physically damage it.

Where ACM is found to be damaged (i.e. FAIR or POOR condition), a recommendation to have the material cleaned-up, repaired, removed, enclosed, or encapsulated is offered. The recommendation will also indicate which asbestos procedure should be used to perform the remedial work (i.e. Type 1, Type 2, Type 3, or Glove Bag Asbestos Abatement Procedures).

3.2 Lead

As there were restrictions to the disturbance of surfaces during the assessment, the assessment did not include for the collection and analysis of paint colour applications for the presence of lead in the paint. Other materials that possibly contain lead were identified by known historic use, where relevant.

3.3 Mercury

The assessment included a visual identification of fluorescent light tubes, switches, electrical controls, heating system thermostats, thermometers, and other components historically known to contain mercury.

3.4 Other Designated Substances

Other materials listed in Section 1.0 of this Report were identified on a visual basis where present, as part of the current assessment. It should be noted that no manufacturing or heavy industrial activities are known by Maple to occur at the Site. Therefore, Designated Substances associated with these activities (i.e. those other than Asbestos, Lead, Mercury, and Silica) would not be expected to be present in the areas surveyed.

3.5 Mould

The assessment for mould was conducted in accordance with standard industry practice as set out in the Canadian Construction Association (CCA) "Mould Guidelines for the Canadian Construction Industry" for a visual assessment. Although there are no regulatory requirements in Ontario for such an assessment, the CCA Guidelines, and similar guidelines from other agencies have been accepted as the industry standard by most experts, consultants, the Ontario Ministry of Labour, and the Canadian Construction Association.

All guidelines and protocols for mould investigations indicate that investigations should be performed largely on a visual basis with limited collection of bulk and/or air samples. The Ontario Ministry of Labour has consistently enforced the removal of all mould from buildings regardless of mould genus or species, and therefore bulk samples or air samples for confirmation of mould are not typically collected for investigative purposes where mould is visible.

3.6 Polychlorinated Biphenyls

Common types of fluorescent lamp fixtures observed in institutional settings contain either T8 or T12 fluorescent light tubes. T12 fixtures are older fixtures and have the potential of using PCB-containing ballast. T8 fixtures have electronic ballast and are considered as not containing PCB. Maple did not open any light fixtures to review the ballast present based on company policy.

Once the ballasts are removed from the fixtures, the Manufacturers labels/codes collected from fluorescent lamp ballasts suspected of containing Polychlorinated Biphenyls ("PCBs") are compared with Environment Canada's document titled "Identification of Lamp Ballasts Containing PCBs", which identifies PCB-containing ballasts.

3.7 Limitations and Omissions from Scope

Due to the nature of building construction some limitations exist as to the possible thoroughness of any building materials inventory. The field observations, measurements, and analysis are considered sufficient in detail and scope to form a reasonable basis for the findings presented in this report. Maple warrants that the findings and conclusions contained herein have been made in accordance with generally accepted evaluation methods in the industry and applicable regulations at the time of the performance of the inventory.

It is possible that conditions may exist which could not be reasonably identified within the scope of the inventory or which were not apparent during the Site investigation. Maple believes that the information collected during the investigation concerning the property is reliable. No other warranties are implied or expressed.

During a standard ACM inventory performed for the purposes of regulatory compliance, it is industry practice to exclude certain suspect asbestos-containing materials from sampling. These materials are often excluded from sampling due to the risk of compromising the health and safety of the technician, other building occupants, or the integrity of the systems with which these materials are associated. Examples of such materials include; elevator brakes, roofing felts and mastics, high voltage wiring, mechanical packing and gaskets, underground services or piping, fire-doors, window caulking and levelling compound. Where observed, these materials were presumed to be ACM.

3.8 Previous Reports

Where possible, Maple utilized the observations and representative bulk sampling results from previous Survey Reports that were made available at the time of the survey. Maple utilized sampling data from the following source:

- January, 2020 – Maple Environmental Inc. Project 18501 – Limited Designated Substance Survey of M-Wing MG IR/US Renovation Project.

4.0 INVENTORY FINDINGS

The findings of the survey are presented separately below for each of the eleven Designated Substances as well as microbial growth (mould), and polychlorinated biphenyls. Asbestos is further detailed by typical applications of asbestos.

Based on the infectious control constraints imposed for the area, no destructive testing or disturbance of any structural finishes such as lifting of ceiling tiles or sampling of wall finishes was conducted during this assessment. Visual assessment was conducted of the areas deemed to be affected by the proposed renovations

4.1 Asbestos

The following is a brief discussion of the extent to which ACM was identified in the surveyed area. The discussion is organized under the headings of materials that are generally suspected of containing asbestos.

Three (3) bulk samples were collected from a previously damaged section of drywall wall for the determination of asbestos content and submitted to the lab to be analysed. The sample numbers refer to the laboratory analysis report presented as Appendix I and summarised in Table 2 below.

Table 2 - Summary of Analysis of Asbestos Bulk Samples

Sample No.	Room Name	Sample Description	Result
S01A	M2 220 (OR Sterile Core)	White, Drywall Joint Compound	None Detected
S01B	M2 220 (OR Sterile Core)	White, Drywall Joint Compound	None Detected
S01C	M2 220 (OR Sterile Core)	White, Drywall Joint Compound	None Detected

No asbestos-containing materials (ACM) were identified in the areas surveyed.

Details for all sampled and suspected asbestos-containing materials are presented below under the headings of the most typical asbestos applications in buildings.

It should be noted that due to the presence of solid walls and ceilings (i.e. cinder block walls and above solid ceilings) throughout the survey area, access for viewing within the wall and ceiling cavities was not always possible. Suspect asbestos-containing materials may be present within wall and ceiling cavities that were not identified but are suspected to be present in this report. Caution should be taken when demolishing solid walls and ceilings within the areas being surveyed.

4.1.1 Sprayed Fireproofing

No sprayed fireproofing was identified within the surveyed area at the time of the assessment.

4.1.2 Thermal Mechanical Insulation (Friable)

Non-asbestos mechanical insulations are present in the surveyed areas. The various types of mechanical insulations and the system to which they are applied are summarised below.

Pipe Fittings:

All pipe fittings observed within the surveyed area were either insulated with non-asbestos fibreglass and PVC or were un-insulated.

Pipe Straights:

All pipe straights within the surveyed areas were either not insulated or insulated with a layer of non-asbestos fibreglass insulation or non-asbestos fibreglass insulation with a PVC jacketing.

It is important to note that due to the presence of solid wall and ceiling systems, the assessment was not able to confirm or deny the presence of ACM pipe insulation within wall and ceiling cavities. The presence of concealed ACM pipe insulation should be assumed as well as within rooms that were not accessible during the assessment. It is possible that ACM is present that was not identified in this report.

Duct Systems

Duct systems observed throughout the surveyed area were observed to be either un-insulated or were insulated with foil-face fibreglass insulation which is not suspected to contain asbestos.

4.1.3 Texture Finish (Friable)

No texture coat finishes were identified within the surveyed area at the time of the assessment.

4.1.4 Acoustic Ceiling Tiles (Potentially Friable)

No asbestos-containing acoustic ceiling tile systems were identified within the surveyed area at the time of the assessment.

Two (2) visually distinct types of ceiling tile systems were observed in the surveyed areas. A brief description of the ceiling tile is outlined below:

- AT-01 (2’ x 4’ Textured Pinholes):

  No bulk samples of AT-01 were collected as the tile was visually similar to the tiles observed in the MG IR/US Project (Maple Project 18501) which had a manufacture’s date stamp code was present on the backside of the tile indicating that the tiles were recently manufactured and therefore not suspected to contain asbestos.

- AT-02 (2’x4’ Plain Tile):

  No bulk samples of AT-02 were collected as it is Maple’s understanding that the tiles were recently installed and therefore not suspected to contain asbestos.

4.1.5 Vinyl Sheet Flooring (Potentially Friable)

No vinyl sheet flooring finishes were identified within the surveyed area at the time of the assessment.

4.1.6 Vinyl Floor Tile (Non-Friable)

No vinyl floor tile systems were identified within the surveyed area at the time of the assessment.

4.1.7 Asbestos Cement Products "Transite" (Non-Friable)

No asbestos-containing cement panels, commonly referred to as Transite, was found within the surveyed areas at the time of the assessment.

4.1.8 Drywall Joint Compound (DJC) (Potentially Friable)

No asbestos-containing drywall joint compound was identified within the surveyed area at the time of the assessment. Interior drywall finishes were present in the form of partition walls or ceiling finishes throughout the OR14 Hybrid Project.

Three (3) representative samples (Sample Set S-01A-C) of drywall joint compound were collected during the current assessment from a previously damaged section of wall in Room M2 220 (OR Sterile Core) and analyzed for determination of asbestos content. Analysis of Sample Set S-01 found that the joint compound samples collected did not contain asbestos. These results concur with the previous sampling results for the bulk drywall joint compound samples collected from M-Wing Ground Floor Project (Maple Project 18501).

Should drywall joint compound be identified in rooms not accessed by Maple, collection and analysis of the drywall joint compound is required.

4.1.9 Plaster (Potentially Friable)

No plaster finishes were identified within the surveyed areas at the time of the assessment.

4.1.10 Vermiculite (Friable)

No vermiculite insulation was observed to be present within the surveyed areas at the time of the assessment. It should be noted that loose fill vermiculite insulation can often be present within voids of masonry and possibly some pre-manufactured surveyed area components that would not be identified during the course of this assessment.

4.2 Lead

As part of the current assessment, Maple did not collect any bulk paint samples for determination of lead content due to the constraints put on the survey methodology.

Maple utilized the lead sampling results from the MG IR/US Project (Maple Project 18501) which considered all paint samples to be "Low-Level Lead" (considered to be "virtually safe").

4.3 Mercury

Mercury vapour is present in all fluorescent light tubes. Liquid mercury is also present in thermostatic switches located within the surveyed area.

4.4 Silica

Free crystalline silica, present as common construction sand, is present in all concrete and masonry products where present in the Select areas surveyed.

4.5 Isocyanates

Free isocyanate compounds would not be expected to be found in a non-manufacturing facility.

4.6 Vinyl Chloride Monomer

Vinyl chloride monomer would not be expected to be found in a non-manufacturing facility.

4.7 Benzene

Benzene would not be expected to be found in a non-manufacturing facility.

4.8 Acrylonitrile

Acrylonitrile would not be expected to be found in a non-manufacturing facility.

4.9 Coke Oven Emissions

Coke oven emissions would not be expected to be found in a non-manufacturing facility.

4.10 Arsenic

Arsenic would not be expected to be found in a non-manufacturing facility.

4.11 Ethylene Oxide

Ethylene oxide would not be expected to be found in a non-manufacturing facility.

4.12 Mould

No visible mould was observed in the surveyed areas.

It is possible that mould growth is present in concealed areas such as wall or ceiling cavities, pipe chases, etc. or in areas not currently assessed by Maple. The client should notify Maple should any water damage or suspect mould growth be discovered.

4.13 Polychlorinated Biphenyls (PCBs)

The fluorescent lamp fixtures observed contained T8 fluorescent light tubes. T8 fixtures have electronic ballast and are considered as not containing PCB.

5.0 RECOMMENDATIONS

5.1 Asbestos

As no asbestos-containing materials (ACM)were identified within the surveyed area at the time of the assessment, no asbestos recommendations warranted. However, Maple requests the opportunity to be present to review the contents of the ceiling spaces once the ceilings have been removed to confirm our findings.

5.2 Lead

"Low-Level Lead" paints (0.1% or less) are considered virtually safe provided that:

- Airborne lead concentrations are kept below 0.05 mg/m^3;
- General dust suppression and worker hygiene procedures are utilized; and
- Torching or other activities that create fumes are not completed.

Further, prior to disposal it is recommended that materials containing lead should be sampled and analyzed for Metals/Inorganics using the Toxicity Characteristic Leaching Procedure (TCLP) as described under O. Reg. 347. The testing is required to determine waste classification in accordance with Ontario Regulation 347 of R.R.O. 1990 made under the Environmental Protection Act.

5.3 Mercury

Mercury vapour is present in all fluorescent light tubes. All fluorescent light tubes should be handled and disposed of appropriately.

5.4 Silica

Proper dust suppression techniques and other safety precautions to control possible generation of silica dust from the demolition of concrete and masonry products present in the building should follow those outlined in the Ministry of Labour Guideline- Silica on Construction Projects, 2004.

6.0 LIMITATIONS

Due to the nature of building construction some limitations exist as to the possible thoroughness of the subject investigation. The field observations are considered sufficient in detail and scope to form a reasonable basis for the findings presented in this report. Maple warrants that the findings and conclusions contained herein have been made in accordance with generally accepted evaluation methods in the industry and applicable regulations at the time of the performance of the assessment.

It is possible that conditions may exist which could not be reasonably identified within the scope of the investigation or which were not apparent during the site investigation. Maple believes that the information collected during the investigation period concerning the property is reliable. No other warranties are implied or expressed.

Information provided by Maple is intended for Client use ONLY. Any use by a third party, of reports or documents authored by Maple, or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Maple accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted.

The liability of Maple or its staff will be limited to the lesser of the fees paid or actual damages incurred by the Client. Maple will not be responsible for any consequential or indirect damages. Maple will only be liable for damages resulting from negligence of Maple; all claims by the Client shall be deemed relinquished if not made within two years after last date of services provided.

Please contact Maple Environmental Inc. at (905) 257-4408 for inquiries regarding this project.

MAPLE ENVIRONMENTAL INC.

Environment, Health and Safety Consultants

Prepared By:

Richards Reboks,
Senior Project Technologist

Reviewed By:

Kyle Prosser
Senior Project Manager

APPENDIX I

LABORATORY ANALYSIS REPORT - ASBESTOS

emcscientific
INCORPORATED

Laboratory Analysis Report

To:

Richards Reboks
Maple Environmental Inc.
482 South Service Road East, Suite 116
Oakville, Ontario
L6J 2X6

EMC LAB REPORT NUMBER: A57707
Job/Project Name: SHSC, OR14 Hybrid
Analysis Method: Polarized Light Microscopy – EPA 600
Date Received: Mar 23/20 **Date Analyzed:** Mar 23/20
Analyst: Jack Eastwood, *Analyst*
Reviewed By: Malgorzata Sybydlo, *Laboratory Manager*

Job No: 18290
Number of Samples: 3
Date Reported: Mar 23/20

Client's Sample ID	Lab Sample No.	Description/Location	Sample Appearance	SAMPLE COMPONENTS (%)			
				Asbestos Fibres		Non-asbestos Fibres	Non-fibrous Material
S01A	A57707-1	DJC – by door to equipment storage room	White and off white, joint compound	**ND**			100
S01B	A57707-2	DJC – by door to equipment storage room	White and off white, joint compound	**ND**			100
S01C	A57707-3	DJC – by door to equipment storage room	White and off white, joint compound	**ND**			100

Note:
1. Bulk samples are analyzed using Polarized Light Microscopy (PLM) and dispersion staining techniques. The analytical procedures are in accordance with EPA 600/R-93/116 method.
2. The results are only related to the samples analyzed. **ND** = None Detected (no asbestos fibres were observed), **NA** = Not Analyzed (analysis stopped due to a previous positive result).
3. This report may not be reproduced, except in full without the written approval of EMC Scientific Inc. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.
4. The Ontario Regulatory Threshold for asbestos is 0.5%. The limit of quantification (LOQ) is 0.5%.

Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Technical File (CSU)

CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01

ModuEvo ENERGY LIGHT 9-10

Sales Order

Customer	Project	Lot	CSU	Technical File
Hospital Philips-Sunnybrook **Toronto** **Canada**	CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01 Room name Hybrid Creation Date 2019-11-01 Sales representative HOUDE	Lot # 1.1 Description **Common Data** Validation Date 2020-02-11	**Range** **ModuEvo** **Series** **ENERGY Light** **Application Type** Anesthesia **Weight** 185.50 kg **Available net load** 94.50 kg	Number of CSUs **1** Installation date 2020-02-11 Customer signature

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

ITEMS INFORMATION

Reference	Article #	Qty. per CSU	Qty. In tech. File	Designation
ENERGY LIGHT 9-10	SU000200034	1	1	MODUEVO ENERGY LIGHT PENDANT 2 BEAMS : 900 MM / 35,4 INCHES LIGHT BEAM + 1000 MM / 39,4 INCHES MOTORIZED BEAM WITH AC230V/120V - LOADING CAPACITY: 150 KG / 331 LBS - HEIGHT ADJUSTMENT 710 MM / 28 INCHES
SUSPENSION TUBE 500 MM	SU000300007	1	1	SUSPENSION TUBE FOR MODUEVO CEILING PENDANTS 500 MM / 19,7 INCHES
TWIN 806	SU000300023	1	1	MODUEVO TWIN DISTRIBUTOR 800 MM / 31,5 INCHES EQUIPPED WITH 4 EPoS- OPEN WITH 6 PANELS FOR SOCKETS AND OUTLETS
ELE 201 MO	SU000400027	10	10	RED ELECTRICAL DUPLEX - 20A - 125V
ELE 252 MO	SU000400067	6	6	US SINGLE GANG RESERVATION, FACEPLATE ONLY
INGAZ01 MO	SU000500001	3	3	PRICE FOR THE INSTALLATION OF A LISTED GAS OUTLETS, (KNOWN AND STUDIED BUT NOT PROVIDED BY MAQUET)
GAZ 500 MO	SU000500076	3	3	DISS OXYGEN (O2) OUTLET - CANADA MODEL
GAZ 501 MO	SU000500077	2	2	DISS NITROUS OXIDE (N2O) OUTLET - CANADA MODEL
GAZ 502 MO	SU000500078	1	1	DISS MEDICAL AIR OUTLET - CANADA MODEL
D/ME SHELF R 685	SU000600095	1	1	SHELF (WxD = 685x450 MM / 27x17,7 INCHES) WITH DUO CLAMPS (ONE ELECTRICAL AND ONE MECHANICAL) AND 2 RAILS - LOADING CAPACITY: 50 KG / 110,2 LBS
DONUT Q CLAMP	SU000600035	4	4	CABLE WINDING WHEEL (DONUT) WITH QUICK CLAMP
ADAPTOR ON SUSPENSION TUBE(Front)	SU000600030(F)	1	1	ADAPTOR ON SUSPENSION TUBE (FOR MONITOR ARM AND GCX ADAPTOR)
ADAPTOR GCX	SU000600031	1	1	GCX MONITOR ARM ADAPTOR
E/M BRAKE 02	SU000600074	1	1	ELECTRO-MAGNETIC BRAKE SYSTEM FOR 2 AXES OF MECHANICAL PENDANT AND ENERGY (EXCEPT FOR SINGLE PLG II, FIXED AND ROTARY COLUMNS). DO NOT FORGET TO QUOTE THE CONTROL HANDLE
SHELF SPACER 1	SU000600105	1	1	75 MM / 2,95 INCHES SPACER IN ORDER TO SHIFT A SHELF OR A DRAWER FROM THE DISTRIBUTION MODULE WITH LARGER DISTANCE
SHELF685 HANDLE U/D 1/2	SU000300044	1	1	SHELF 485 CONTROL HANDLE FOR HEIGHT ADJUSTMENT OF ENERGY AND CARGOLIFT WITH 1AXIS OR 2 AXES BRAKE CONTROL – HAS TO BE INTEGRATED ON SHELF 685 MM / 27 INCHES EQUIPPED WITH ELECTRICAL CLAMP
GAZ 504 PB	SU000500079	2	2	DISS VACUUM OUTLET - CANADA MODEL
SPACER 97	SU000700021	1	1	97 MM / 3,82 INCHES ADJUSTMENT SPACER FOR ALL SERIES EXCLUDING SINGLE ENERGY TO FIT MOUNTING ON MODULAR CEILING ATTACHMENT II

Number of CSUs **1**

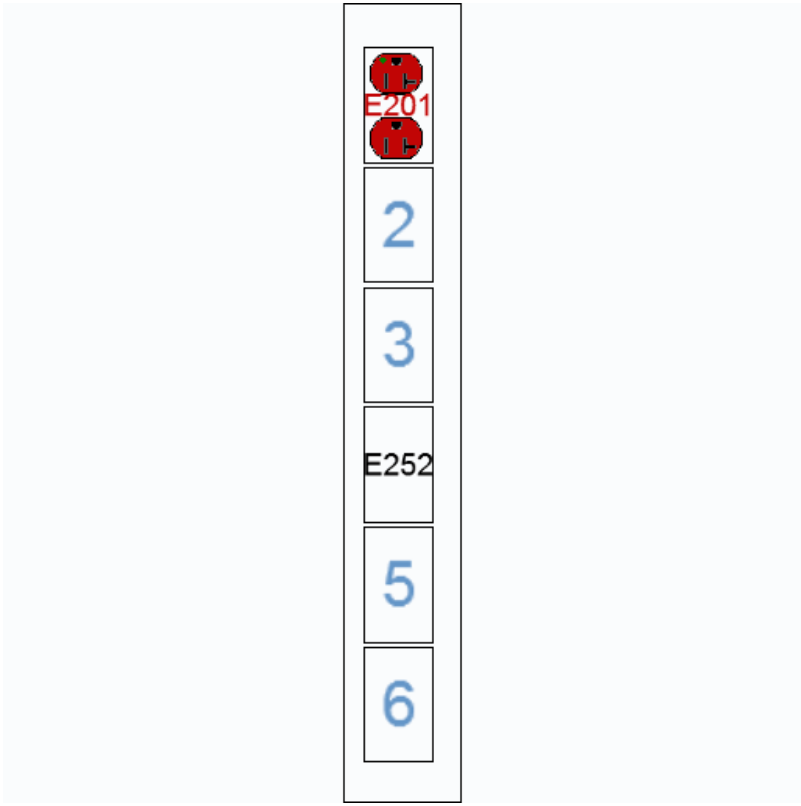
Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			12
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

Electric norm Canadian

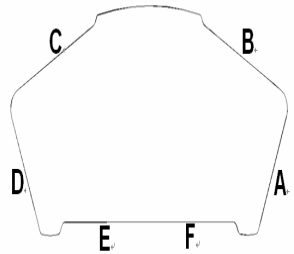
Panel of 1 channel 800mm **Identification** **A**

Circuit type Red and Blue - 2,5 mm²



Top module

CABLES LENGTH 4,400.00 mm



NUMBER OF LOW CURRENT SHEATH : 0
NUMBER OF HIGH CURRENT SHEATH : 4

Pos. #	Article #	Type	Brand	Designation	Cir. #
1	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
4	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	

Project
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01

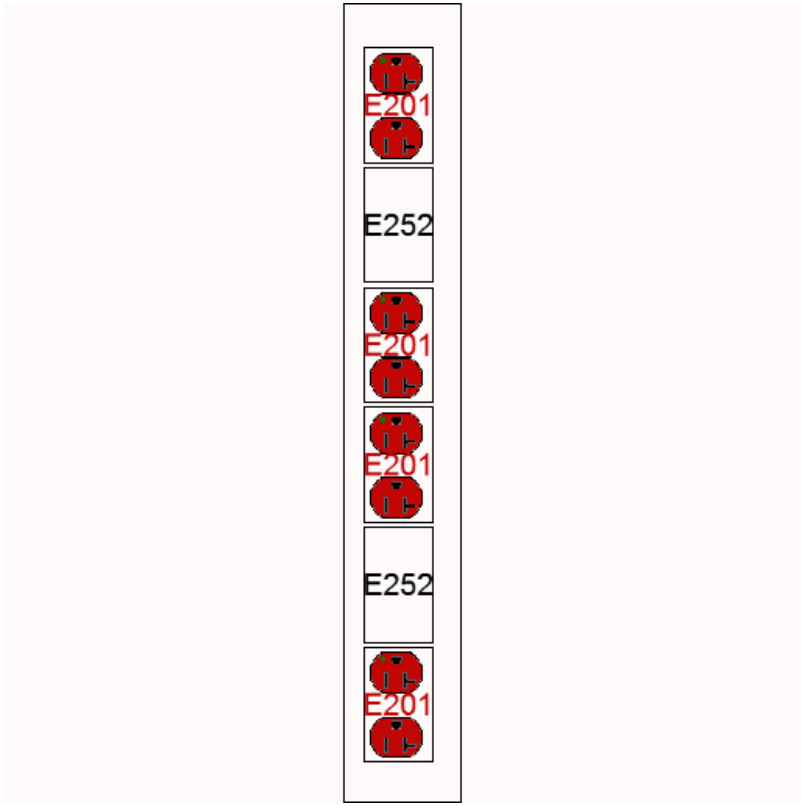
Name of the Health Centre	Health center location	Installation date for this project	
Philips-Sunnybrook	Toronto		
Qty of Entities 4 Pen, 5 OR L, 2 OR T **Number of lots** 1	**State of project** Valid **Status** Prospection	**Description** Room M2285	**Sales representative** HOUDE

Panels info

Electric norm Canadian

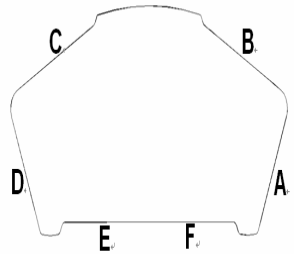
Panel of 1 channel 800mm **Identification** **B**

Circuit type Red and Blue - 2,5 mm²



Top module

CABLES LENGTH 4,400.00 mm



NUMBER OF LOW CURRENT SHEATH : 0
NUMBER OF HIGH CURRENT SHEATH : 4

Pos. #	Article #	Type	Brand	Designation	Cir. #
1	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
2	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	
3	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
4	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
5	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	
6	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	

Project
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01

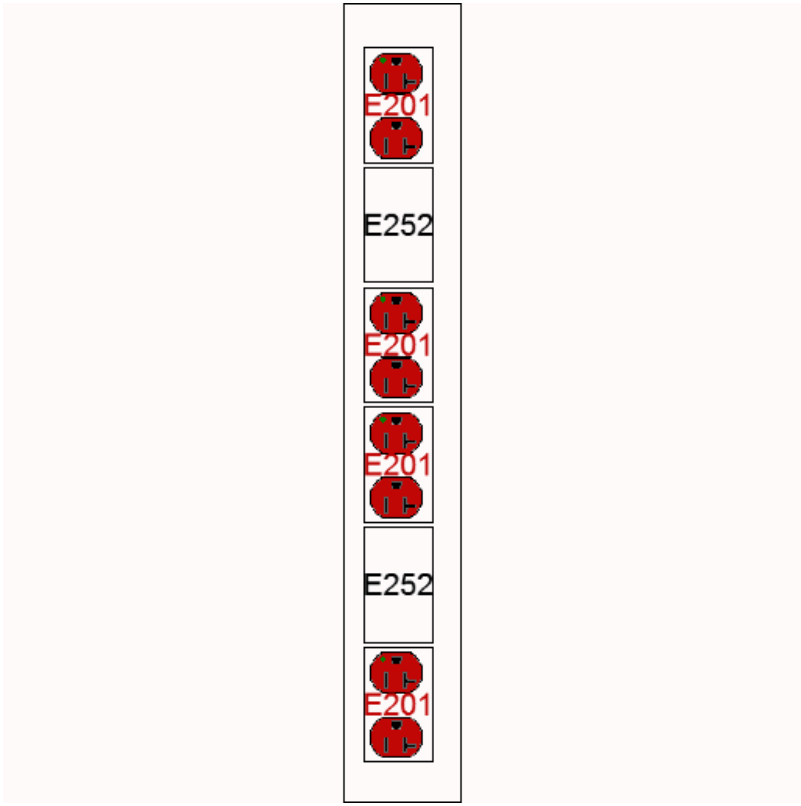
Name of the Health Centre	Health center location	Installation date for this project	
Philips-Sunnybrook	Toronto		
Qty of Entities 4 Pen, 5 OR L, 2 OR T **Number of lots** 1	**State of project** Valid **Status** Prospection	**Description** Room M2285	**Sales representative** HOUDE

Panels info

Electric norm Canadian

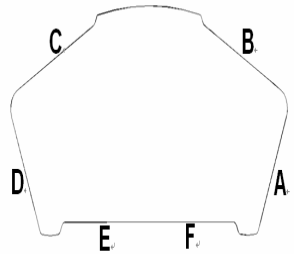
Panel of 1 channel 800mm **Identification** **C**

Circuit type Red and Blue - 2,5 mm²



Top module

CABLES LENGTH 4,400.00 mm



NUMBER OF LOW CURRENT SHEATH : 0
NUMBER OF HIGH CURRENT SHEATH : 4

Pos. #	Article #	Type	Brand	Designation	Cir. #
1	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
2	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	
3	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
4	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
5	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	
6	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	

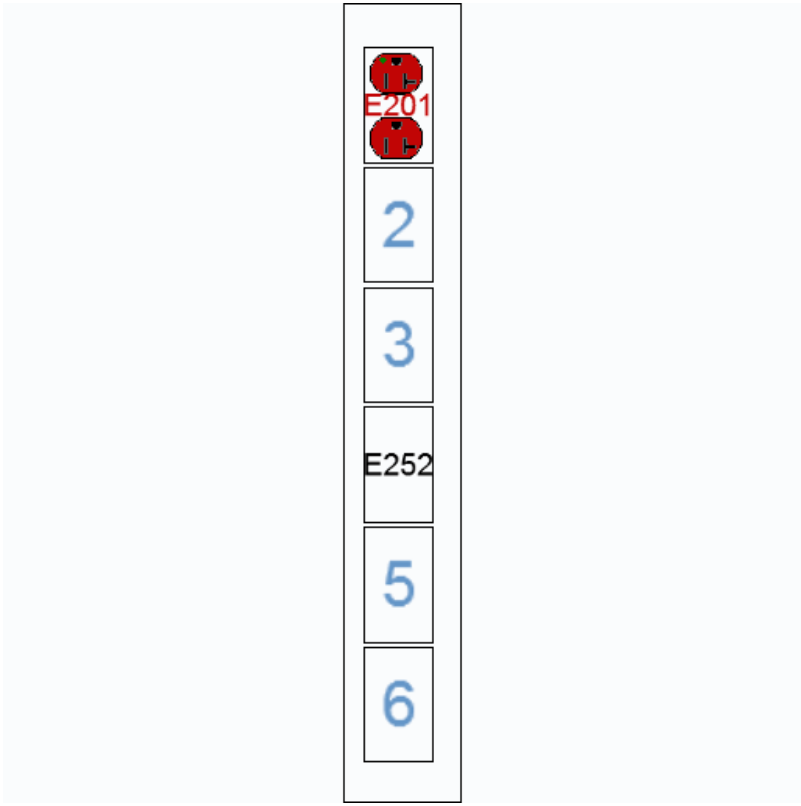
Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			12
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

Electric norm Canadian

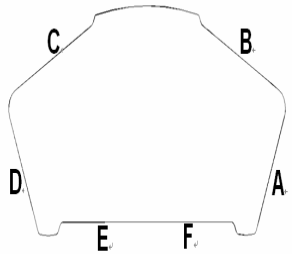
Panel of 1 channel 800mm **Identification** **D**

Circuit type Red and Blue - 2,5 mm²



Top module

CABLES LENGTH 4,400.00 mm



NUMBER OF LOW CURRENT SHEATH : 0
NUMBER OF HIGH CURRENT SHEATH : 4

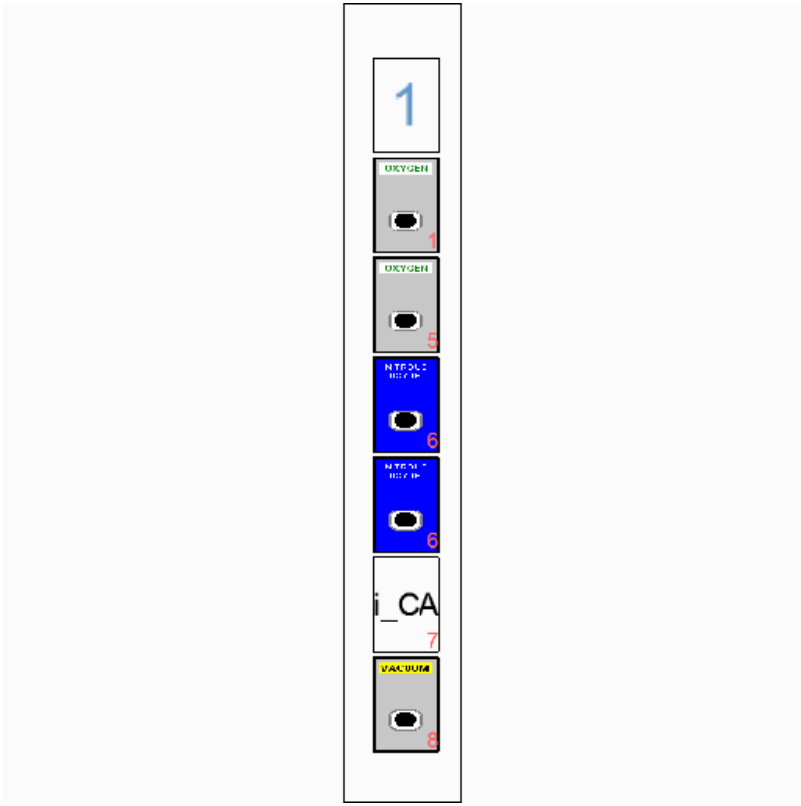
Pos. #	Article #	Type	Brand	Designation	Cir. #
1	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
4	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

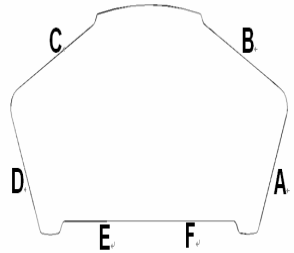
Gas norm Canadian

Panel of 1 channel 800mm **Identification** **E**



Top module

PIPES LENGTH 4,400.00 mm



NUMBER OF GAS HOSES : 8

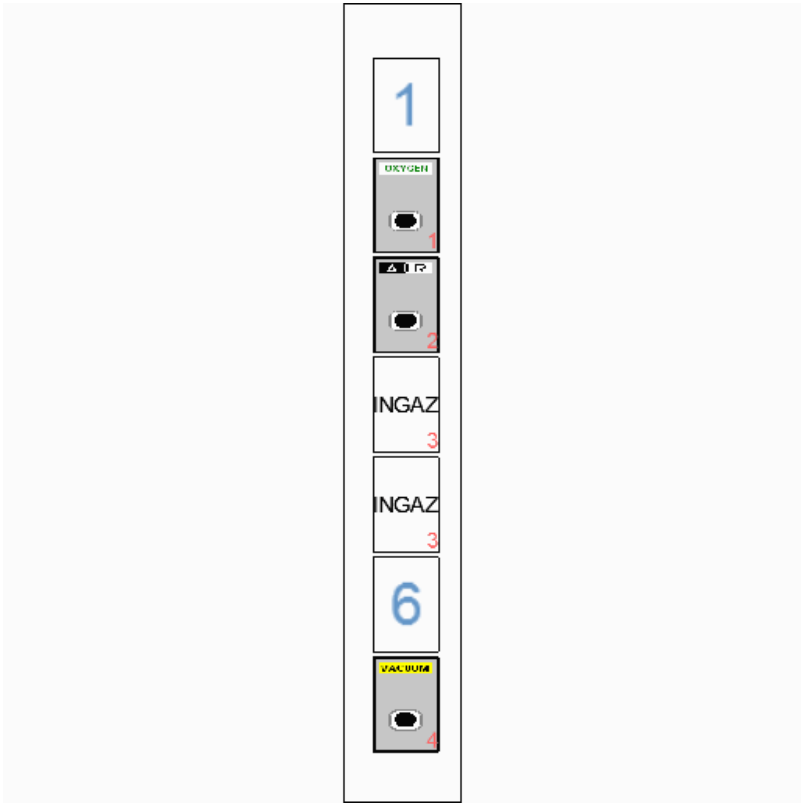
Pos. #	Article #	Type	Brand	Designation	Cir. #
2	SU000500076	Oxygen (O2)	DISS	Oxygen outlet - GAZ 500	1
3	SU000500076	Oxygen (O2)	DISS	Oxygen outlet - GAZ 500	5
4	SU000500077	Nitrous Oxide (N2O)	DISS	Nitrous oxyde outlet - GAZ 501	6
5	SU000500077	Nitrous Oxide (N2O)	DISS	Nitrous oxyde outlet - GAZ 501	6
6	SU000500001	Other	Other brand name	Compressed air (tools) outlet instal. (i_CA)	7
7	SU000500079	Vacuum	DISS	Vacuum outlet - GAZ 504	8

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

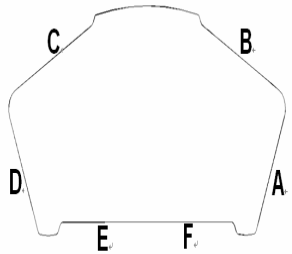
Gas norm Canadian

Panel of 1 channel 800mm **Identification** **F**



Top module

PIPES LENGTH 4,400.00 mm



NUMBER OF GAS HOSES : 8

Pos. #	Article #	Type	Brand	Designation	Cir. #
2	SU000500076	Oxygen (O2)	DISS	Oxygen outlet - GAZ 500	1
3	SU000500078	Medical Air (AC 3 bar)	DISS	Medical air outlet - GAZ 502	2
4	SU000500001	Other	Other brand name	Known Outlet Installation	3
5	SU000500001	Other	Other brand name	Known Outlet Installation	3
7	SU000500079	Vacuum	DISS	Vacuum outlet - GAZ 504	4

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Technical File (CSU)

ENERGY LIGHT 9-10-Anesthesia-(Hybrid)

Anchor and room heights

Finished ceiling	2,900.00 mm
Under Ceiling	3,500.00 mm
Plenum	600.00 mm
calculated height of REH	404.00 mm
mini. room height	2,015.50 mm

Pneumatic / Magnetic brakes	Yes
[ ] 1 axis	[X] Axis 1
[X] 2 axis	[X] Axis 2
[ ] 3 axis	[ ] Axis 3

CSU Data

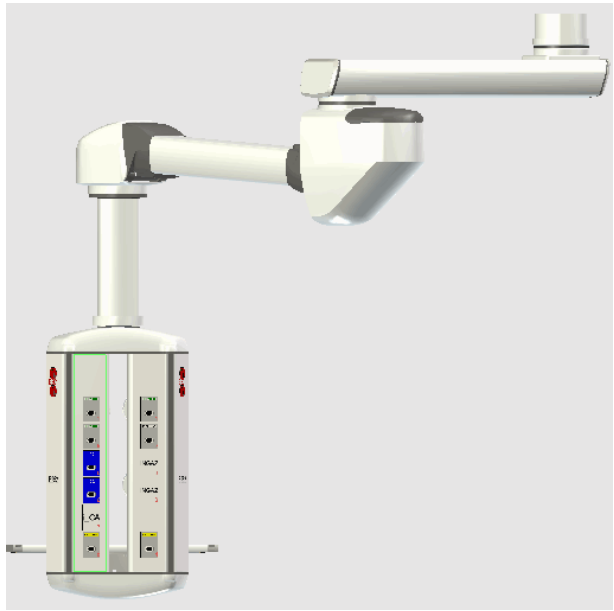
Computed col. Height	
Height from floor to Module hole	
Height from floor to Second Mo	
Lenght of elec. Cables	4,400.00 mm
Lenght of gas. Hose	4,400.00 mm
LE'	
LG'	

Suspension tube length	500.00 mm
Position Module/floor	838.65 mm
Position 2nd Module/floor	
Height between floor to column	

Common Data	CSU	Technical File
Validation Date 2020-02-11	**ENERGY LIGHT 9-10-Anesthesia-(Hybrid)** **Range** **ModuEvo** **Series** **ENERGY Light** Room number Hybrid Description Number of Specific Demands 0	Installation date 2020-02-11 Customer signature

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

CSU SIDE VIEWS ENERGY LIGHT 9-10-Anesthesia-(Hybrid)



Common Data	CSU	Technical File
Validation Date 2020-02-11	**ENERGY LIGHT 9-10-Anesthesia-(Hybrid)** **Range** **ModuEvo** **Series** **ENERGY Light** Room number Hybrid Description Number of Specific Demands 0	Installation date 2020-02-11 Customer signature

Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Technical File (CSU)

CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01

ModuEvo HEAVY 15-15

Sales Order

Customer	Project	Lot	CSU	Technical File
Hospital Philips-Sunnybrook **Toronto** **Canada**	CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01 Room name Hybrid Creation Date 2019-11-01 Sales representative HOUDE	Lot # 1.1 Description **Common Data** Validation Date 2020-02-11	**Range** **ModuEvo** **Series** **Heavy** **Application Type** Surgery **Weight** 177.73 kg **Available net load** 149.27 kg	Number of CSUs **1** Installation date 2020-02-11 Customer signature

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

ITEMS INFORMATION

Reference	Article #	Qty. per CSU	Qty. In tech. File	Designation
HEAVY 15-15	SU000200031	1	1	MODUEVO HEAVY CEILING PENDANT - 2 BEAMS OF 1500 MM + 1500 MM / 59 + 59 INCHES - LOADING CAPACITY: 199 KG / 439 LBS
FLAT COVER	SU000900001	1	1	FLAT COVER FOR ALL SERIES OF MODUEVO PENDANTS - SINGLE OR DOUBLE MOUNTING WITH MODULAR CEILING ATTACHMENT II
SUSPENSION TUBE 500 MM	SU000300007	1	1	SUSPENSION TUBE FOR MODUEVO CEILING PENDANTS 500 MM / 19,7 INCHES
SLIM 1203	SU000300016	1	1	MODUEVO SLIM DISTRIBUTOR OF 1200 MM / 47,2 INCHES WITH 3 PANELS FOR SOCKETS AND OUTLETS
ELE 201 MO	SU000400027	6	6	RED ELECTRICAL DUPLEX - 20A - 125V
ELE 252 MO	SU000400067	3	3	US SINGLE GANG RESERVATION, FACEPLATE ONLY
GAZ 505 MO	SU000500080	2	2	DISS NITROGEN (N2) OUTLET - CANADA MODEL
GAZ 500 MO	SU000500076	1	1	DISS OXYGEN (O2) OUTLET - CANADA MODEL
D/M SHELF R 685	SU000600086	3	3	SHELF (WxD = 685x450 MM / 27x17,7 INCHES) WITH DUO MECHANICAL CLAMPS AND 2 RAILS - LOADING CAPACITY: 50 KG / 110,2 LBS
D/ME SHELF R 685	SU000600095	1	1	SHELF (WxD = 685x450 MM / 27x17,7 INCHES) WITH DUO CLAMPS (ONE ELECTRICAL AND ONE MECHANICAL) AND 2 RAILS - LOADING CAPACITY: 50 KG / 110,2 LBS
DONUT Q CLAMP	SU000600035	4	4	CABLE WINDING WHEEL (DONUT) WITH QUICK CLAMP
SHELF SPACER 1	SU000600105	4	4	75 MM / 2,95 INCHES SPACER IN ORDER TO SHIFT A SHELF OR A DRAWER FROM THE DISTRIBUTION MODULE WITH LARGER DISTANCE
AC30002	ARD513650999	1	1	IV STAND WITH 2 HOOKS - Ø 16 MM/0.63 INCHES (USE AN AC30004 TO FIX IT ON STANDARD RAIL)
S/M RAIL 400	SU000600009	1	1	RAIL OF 25x10x400 MM / 0.98x0.39x15.8 INCHES WITH SINGLE MECHANICAL CLAMP -LOADING CAPACITY: 30 KG / 66 LBS)
E/M BRAKE 02	SU000600074	1	1	ELECTRO-MAGNETIC BRAKE SYSTEM FOR 2 AXES OF MECHANICAL PENDANT AND ENERGY (EXCEPT FOR SINGLE PLG II, FIXED AND ROTARY COLUMNS). DO NOT FORGET TO QUOTE THE CONTROL HANDLE
AC30004	ARD513648999	1	1	RAIL ATTACHMENT FOR ACCESSORY WITH A 16MM POLE
SHELF685 HANDLE 1/2	SU000300041	1	1	SHELF 685 CONTROL TO MANAGE THE BRAKES ON 1 AXIS OR 2 AXES FOR 685 MM / 27 INCHES SHELF EQUIPPED WITH AN ELECTRICAL CLAMP
R RING 01	SU000900003	1	1	SET OF 2 REDUCING RINGS WHICH HAS TO BE QUOTED WHEN CEILING COVER IS MOUNTED WITH SINGLE PENDANT
GAZ 504 PB	SU000500079	2	2	DISS VACUUM OUTLET - CANADA MODEL
Spacer 265	SU000700009	1	1	265 MM / 10,4 INCHES ADJUSTMENT SPACER FOR MODUEVO DUO MOUNTING ON MODULAR ANCHOR SYSTEM II
S FLANGE	SU000700002	1	1	STANDARD SINGLE FLANGE PLATE FOR SINGLE CEILING PENDANT MODUEVO CONNECTING THE BEAM TO THE MODULAR CEILING ATTACHMENT II

Project **CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01**			12
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

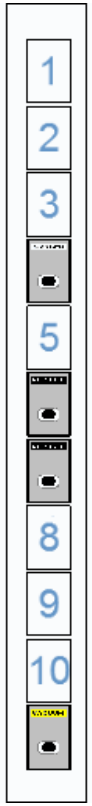
Number of CSUs **1**

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

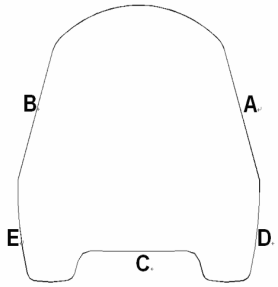
Gas norm Canadian

Panel of 1 channel 1200mm **Identification** **A**



Top module

PIPES LENGTH 5,570.00 mm



NUMBER OF GAS HOSES : 5

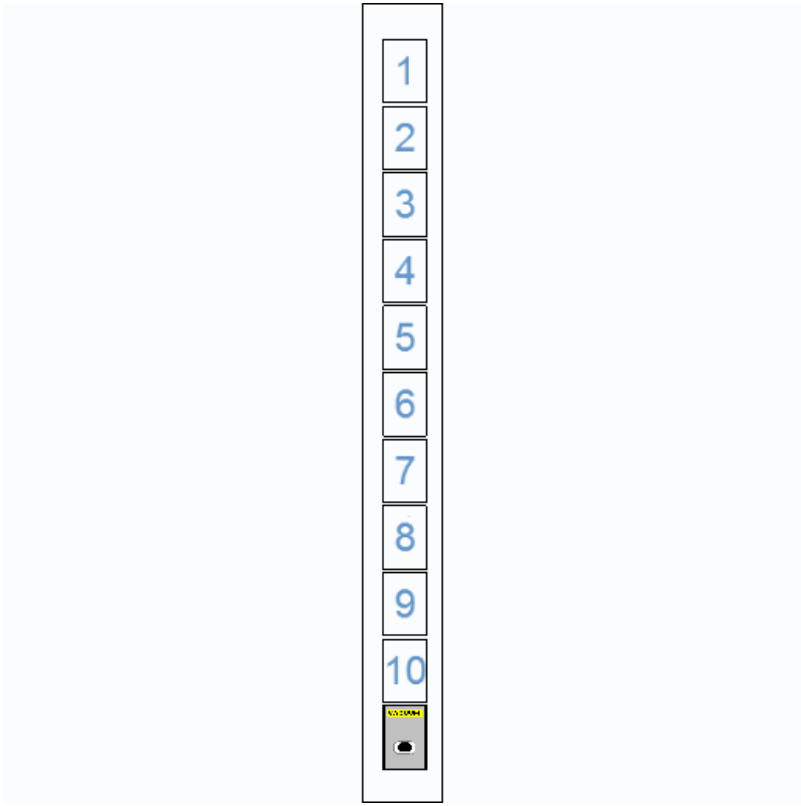
Pos. #	Article #	Type	Brand	Designation	Cir. #
4	SU000500076	Oxygen (O2)	DISS	Oxygen outlet - GAZ 500	
6	SU000500080	Nitrogen (N2)	DISS	Nitrogen outlet - GAZ 505	
7	SU000500080	Nitrogen (N2)	DISS	Nitrogen outlet - GAZ 505	
11	SU000500079	Vacuum	DISS	Vacuum outlet - GAZ 504	

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

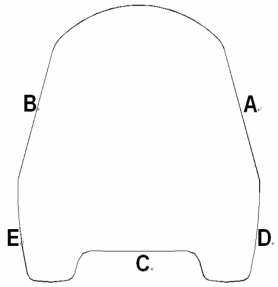
Gas norm Canadian

Panel of 1 channel 1200mm **Identification** **B**



Top module

PIPES LENGTH 5,570.00 mm



NUMBER OF GAS HOSES : 5

Pos. #	Article #	Type	Brand	Designation	Cir. #
11	SU000500079	Vacuum	DISS	Vacuum outlet - GAZ 504	

Project
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01

Name of the Health Centre	Health center location	Installation date for this project	
Philips-Sunnybrook	Toronto		
Qty of Entities 4 Pen, 5 OR L, 2 OR T **Number of lots** 1	**State of project** Valid **Status** Prospection	**Description** Room M2285	**Sales representative** HOUDE

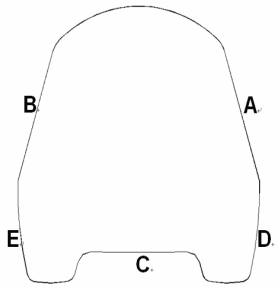
Panels info

Electric norm Canadian

Panel of 1 channel 1200mm **Identification** **C**

Circuit type Red and Blue - 2,5 mm²

Top module



CABLES LENGTH 5,550.00 mm

NUMBER OF LOW CURRENT SHEATH : 0
NUMBER OF HIGH CURRENT SHEATH : 2

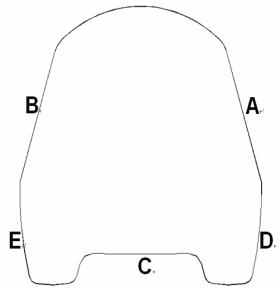
Pos. #	Article #	Type	Brand	Designation	Cir. #
1	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	
2	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
3	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
4	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	
5	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
6	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
7	SU000400067	Other	Other brand name	Low current reserv. outlet - without flex. Conduit	
8	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	
9	SU000400027	Red duplex	Other brand name	Duplex outlet (20A) with standby	

Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

Top module

Panel of 1 channel 1200mm **Identification** **D**



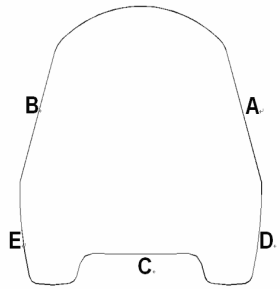
This panel has no outlet

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

Top module

Panel of 1 channel 1200mm **Identification** **E**

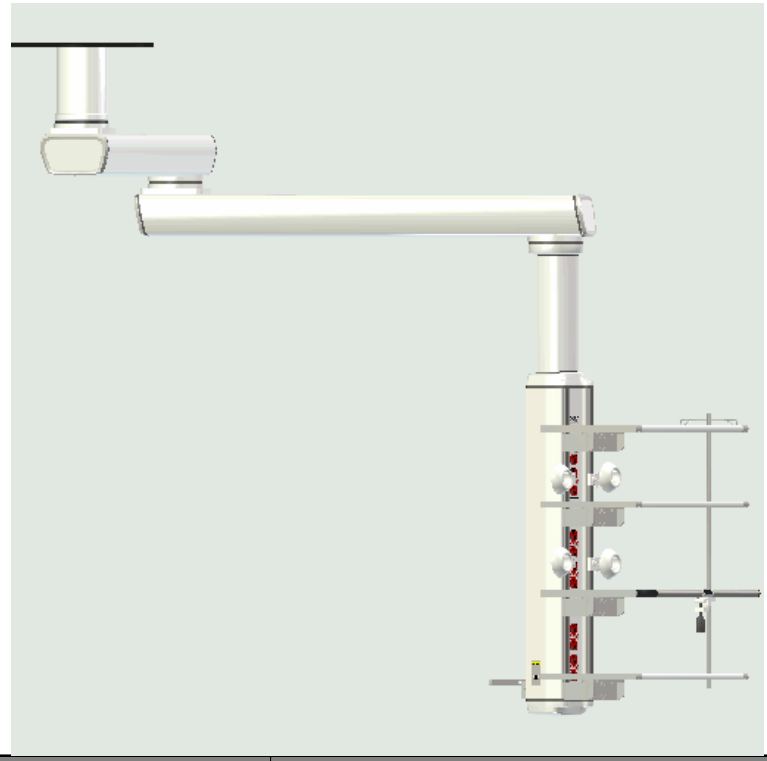


This panel has no outlet

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Technical File (CSU)

HEAVY 15-15-Surgery-(Hybrid)



Anchor and room heights

Finished ceiling	2,900.00 mm
Under Ceiling	3,500.00 mm
Plenum	600.00 mm
calculated height of REH	404.00 mm
mini. room height	2,385.50 mm

Pneumatic / Magnetic brakes	Yes
[ ] 1 axis	[X] Axis 1
[X] 2 axis	[X] Axis 2
[ ] 3 axis	[ ] Axis 3

CSU Data

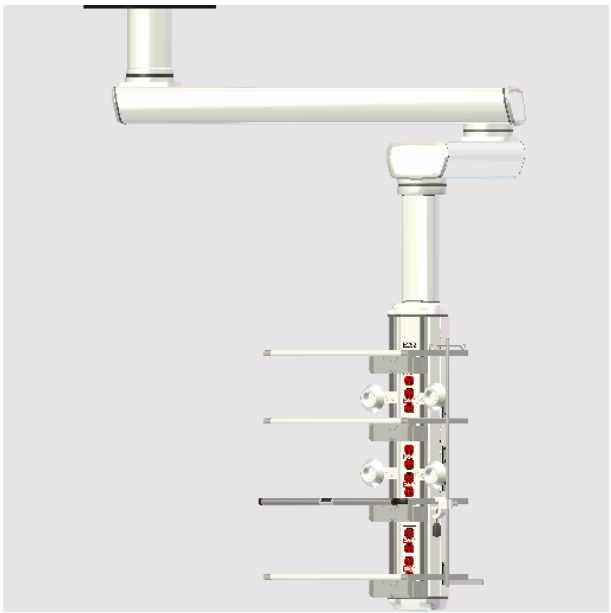
Computed col. Height	
Height from floor to Module hole	
Height from floor to Second Mo	
Lenght of elec. Cables	5,550.00 mm
Lenght of gas. Hose	5,570.00 mm
LE'	
LG'	

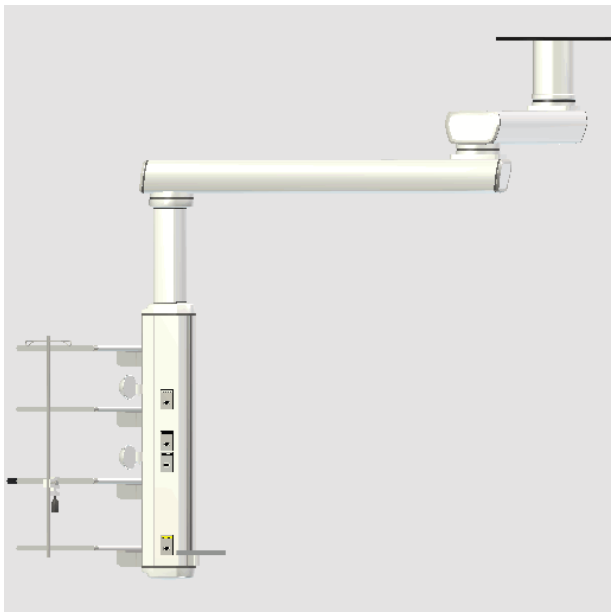
Suspension tube length	500.00 mm
Position Module/floor	392.07 mm
Position 2nd Module/floor	
Height between floor to column	

Common Data	CSU	Technical File
Validation Date 2020-02-11	**HEAVY 15-15-Surgery-(Hybrid)** **Range** **ModuEvo** **Series** **Heavy** Room number Hybrid Description Number of Specific Demands 0	Installation date 2020-02-11 Customer signature

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

CSU SIDE VIEWS HEAVY 15-15-Surgery-(Hybrid)





Common Data	CSU		Technical File
Validation Date 2020-02-11	**HEAVY 15-15-Surgery-(Hybrid)**		Installation date 2020-02-11
	Range	**ModuEvo**	
	Series	**Heavy**	
	Room number	Hybrid	Customer signature
	Description		
	Number of Specific Demands	0	

Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			12
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Technical File (CSU)

CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01

ModuEvo PLG-II LIGHT 6-0

Sales Order

Customer	Project	Lot	CSU	Technical File
Hospital Philips-Sunnybrook **Toronto** **Canada**	CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01 Room name Hybrid Creation Date 2019-11-01 Sales representative HOUDE	Lot # 1.1 Description **Common Data** Validation Date 2020-02-11	**Range** **ModuEvo** **Series** **PLG II** **Application Type** Anesthesia **Weight** 70.50 kg **Available net load** 28.50 kg	Number of CSUs **1** Installation date 2020-02-11 Customer signature

Project
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01

Name of the Health Centre	Health center location	Installation date for this project	
Philips-Sunnybrook	Toronto		
Qty of Entities	**State of project**	**Description**	**Sales representative**
4 Pen, 5 OR L, 2 OR T	Valid	Room M2285	HOUDE
Number of lots	**Status**		
1	Prospection		

ITEMS INFORMATION

Reference	Article #	Qty. per CSU	Qty. In tech. File	Designation
PLG-II LIGHT 6-0	SU000200004	1	1	MODUEVO LIGHT CEILING PENDANT - 1 BEAM OF 600 MM / 23,6 INCHES - LOADING CAPACITY: 350 KG / 772 LBS
FLAT COVER	SU000900001	1	1	FLAT COVER FOR ALL SERIES OF MODUEVO PENDANTS - SINGLE OR DOUBLE MOUNTING WITH MODULAR CEILING ATTACHMENT II
PLG II TUB 200	SU000300027	1	1	SUSPENSION TUBE FOR MODUEVO PLGII WITH RIGID COVER STRIP R1, BEARING - 200 MM / 7,9 INCHES
PLG II 14-0	SU000300001	1	1	PLG II DISTRIBUTOR MODUEVO: SIMPLE DISTRIBUTOR BEAM WITH VERTICAL MOVEMENT OF 400 MM / 15,7 INCHES WITH A SET OF 2 FACADES / PANELS (LxW = 720x170 MM / 28.4x6.7 INCHES) - STOP SYSTEM
ELE 201 PB	ARD517001725	9	9	RED ELECTRICAL DUPLEX - 20A - 125V
GAZ 500 PB	ARD517001753	3	3	DISS OXYGEN (O2) OUTLET - CANANA MODEL
GAZ 233 PB	ARD517001730	2	2	DISS EVACUATION OUTLET
GAZ 502 PB	ARD517001751	2	2	DISS MEDICAL AIR OUTLET - Canada MODEL
GAZ 501 PB	ARD517001752	2	2	DISS NITROUS OXIDE (N2O) OUTLET - Canada MODEL
FO cable	SU0001990029	2	2	FIBER OPTIC CABLE – 50/125µm MULTIMODE OM3 – 2 STRANDS – SC CONNECTORS DUPLEX - DUPLEX FEMALE OUTLET SOCKET ON PANNEL – CABLE LENGTH 5M
R RING 02	SU000900004	1	1	SET OF 2 REDUCING RINGS WHICH HAS TO BE QUOTED WHEN CEILING COVER IS MOUNTED WITH DUO PENDANTS
GAZ 504 PB	ARD517001750	2	2	DISS VACUUM OUTLET - Canada MODEL
Spacer 265	SU000700009	1	1	265 MM / 10,4 INCHES ADJUSTMENT SPACER FOR MODUEVO DUO MOUNTING ON MODULAR ANCHOR SYSTEM II
D FLANGE	SU000700003	1	1	STANDARD DOUBLE FLANGE PLATE FOR DUO MOUNTING CEILING PENDANTS CONNECTING THE BEAM TO MODULAR CEILING ATTACHMENT II OR ANCHORAGE PLATE. LIMITATION FOR DUO MOUNTING ACCORDING TO MODULAR CEILING ATTACHMENT II AND ANCHORAGE PLATE

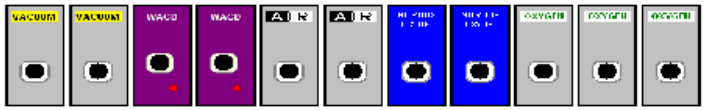
Number of CSUs **1**

Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			12
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

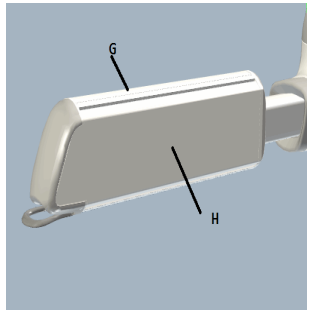
Panels info

Gas norm Canadian

PLG-II Panel 1 **Identification** **G**



Top module



PIPES LENGTH 1,800.00 mm

NUMBER OF GAS HOSES : 11

Pos. #	Article #	Type	Brand	Designation	Cir. #
1	ARD517001750	Vacuum	DISS	Vacuum outlet - GAZ 504	
2	ARD517001750	Vacuum	DISS	Vacuum outlet - GAZ 504	
3	ARD517001730	EVAC	DISS	Evacuation outlet - GAZ 233	
4	ARD517001730	EVAC	DISS	Evacuation outlet - GAZ 233	
5	ARD517001751	Medical Air (AC 3 bar)	DISS	Medical air outlet - GAZ 502	
6	ARD517001751	Medical Air (AC 3 bar)	DISS	Medical air outlet - GAZ 502	
7	ARD517001752	Nitrous Oxide (N2O)	DISS	Nitrous oxyde outlet - GAZ 501	
8	ARD517001752	Nitrous Oxide (N2O)	DISS	Nitrous oxyde outlet - GAZ 501	
9	ARD517001753	Oxygen (O2)	DISS	Oxygen outlet - GAZ 500	
10	ARD517001753	Oxygen (O2)	DISS	Oxygen outlet - GAZ 500	
11	ARD517001753	Oxygen (O2)	DISS	Oxygen outlet - GAZ 500	

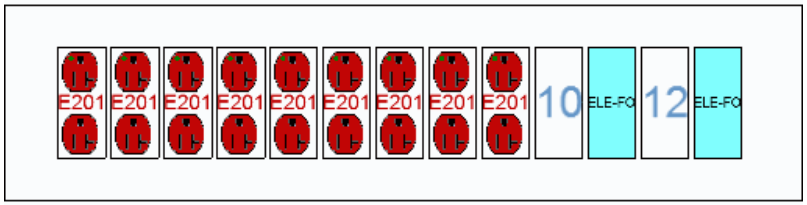
Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			12
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Panels info

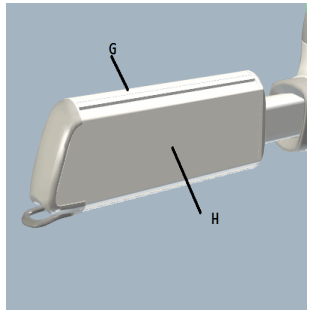
Electric norm Canadian

PLG-II Panel 2 **Identification** **H**

Circuit type Red and Blue - 2,5 mm²



Top module



CABLES LENGTH 1,810.00 mm

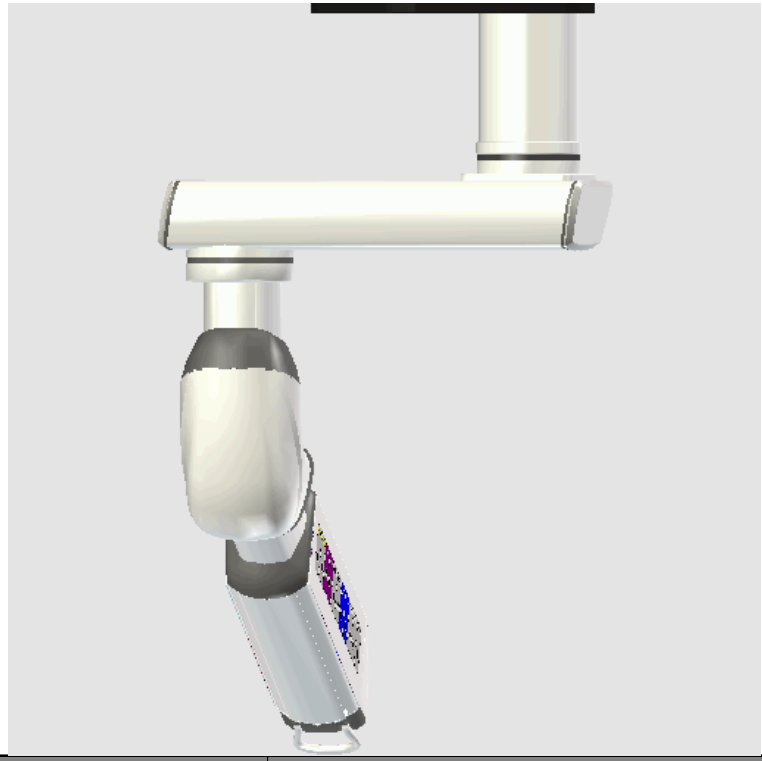
NUMBER OF LOW CURRENT SHEATH : 2
NUMBER OF HIGH CURRENT SHEATH : 3

Pos. #	Article #	Type	Brand	Designation	Cir. #
1	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
2	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
3	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
4	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
5	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
6	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
7	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
8	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
9	ARD517001725	Red duplex	Other brand name	Duplex outlet (20A) with standby	
11	SU0001990029	Communication	Other brand name	ELE FO CABLE	
13	SU0001990029	Communication	Other brand name	ELE FO CABLE	

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Technical File (CSU)

PLG-II LIGHT 6-0-Anesthesia-(Hybrid)



Anchor and room heights

Finished ceiling	2,900.00 mm
Under Ceiling	3,500.00 mm
Plenum	600.00 mm
calculated height of REH	404.00 mm
mini. room height	660.50 mm

Pneumatic / Magnetic brakes	No	
☐ 1 axis		☐ Axis 1
☐ 2 axis		☐ Axis 2
☐ 3 axis		☐ Axis 3

CSU Data

Computed col. Height	
Height from floor to Module hole	
Height from floor to Second Mo	
Lenght of elec. Cables	1,810.00 mm
Lenght of gas. Hose	1,800.00 mm
LE'	
LG'	

Suspension tube length	200.00 mm
Position Module/floor	1,505.71 mm
Position 2nd Module/floor	
Height between floor to column	

Common Data	CSU	Technical File
Validation Date 2020-02-11	**PLG-II LIGHT 6-0-Anesthesia-(Hybrid)** **Range** **ModuEvo** **Series** **PLG II** Room number Hybrid Description Number of Specific Demands 0	Installation date 2020-02-11 Customer signature

Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			12
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

CSU SIDE VIEWS PLG-II LIGHT 6-0-Anesthesia-(Hybrid)

Common Data	CSU		Technical File
Validation Date 2020-02-11	**PLG-II LIGHT 6-0-Anesthesia-(Hybrid)**		Installation date 2020-02-11
	Range	**ModuEvo**	
	Series	**PLG II**	
	Room number	Hybrid	Customer signature
	Description		
	Number of Specific Demands	0	

Project			
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			12
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Technical File (CSU)

CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01

Modutec M PWR 9-10 230 BP

Sales Order

Customer	Project	Lot	CSU	Technical File
Hospital Philips-Sunnybrook **Toronto** **Canada**	CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01 Room name Hybrid Creation Date 2019-11-01 Sales representative HOUDE	Lot # 1.1 Description **Common Data** Validation Date 2020-02-11	**Range** **Modutec** **Series** **MODUTEC Power** **Application Type** Surgery **Weight** 289.00 kg **Available net load** 5.50 kg	Number of CSUs **1** Installation date 2020-02-11 Customer signature

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

ITEMS INFORMATION

Reference	Article #	Qty. per CSU	Qty. In tech. File	Designation
M PWR 9-10 230 BP	SU0002990063	1	1	230V MOTORISED PENDANT 2 BEAMS: 900 MM / 35.4 INCHES HEAVY MODUTEC BEAM AND 1000 MM / 39.4 INCHES MOTORISED BEAM - VERTICAL MOVEMENT: 620 MM / 24.4 INCHES - GROSS LOAD CAPACITY : 150 KG / 331 LBS (CEILING BRACKETS INCLUDED) , WITH BEAM PLUS RESERVED
COV PB FLAT D 001	ARD517005960	1	1	DOUBLE FLAT CEILING COVER (TWO PARTS, LENGTH * WIDTH = 1030 * 580 MM / 40,5 * 22.8 INCHES) FOR DUO OF MODUTEC CEILING PENDANTS (FOR PL G 12-0 PLEASE ADD A R RING ECL), FOR SURGICAL LIGHTS (PRISMALIX, AXCEL, X'TEN, POWERLED, HLX 3000 AND G8 EVOLUTION) AND FOR SATELITE RANGE WHEN MOUNTED WITH CEILING ATTACHMENT
TUB PB Philips	SU0006990028	1	1	SUSPENSION TUBE 150 MM WITH RIGID COVER STRIP R1 FROM 100 TO 1000MM IN INCREMENTS OF 100MM AND 150MM SUSPENSION TUBE
BRAKE-II M 02 PB	SU0002990085	1	1	ELECTROPNEUMATIC BRAKE SYSTEM FOR 2 AXES OF MODUTEC MEDIUM, MEDIUM-HEAVY, HEAVY AND MOTORISED SERIES. DO NOT FORGET TO QUOTE THE POWER SUPPLY AND THE CONTROL UNIT WHICH HAS TO BE INTEGRATED ON THE HANDLES
POWER SUPPLY	ARD517003973	1	1	POWER SUPPLY FOR AMBIENT LIGHT BANDS AND ELECTRO-PNEUMATIC BRAKES -100, 110 V AND 220 V COMPATIBLE
R RING ECL 02	ARD515067999	1	1	SET OF 2 REDUCING RINGS WHICH HAS TO BE QUOTED WHEN A DOUBLE SEMI-CURVED CEILING COVER COV PB D SCURVED AND COV DSCURVED A (INSIDE DIAMETER OF 433 MM) IS MOUNTED WITH A SUSPENSION TUBE OF PRISMALIX, AXCEL, X'TEN, POWERLED, HLX 3000 AND G8 EVOLUTION SURGICAL LIGHTS (TUB XXX - EXTERNAL DIAMETER OF 130 MM); CEILING BRAKETS INCLUDED
PHILIPS SCREEN ADAPTOR 2	SU0006000003	1	1	ISOLATION INTERFACE FOR PHILIPS MCS WITH FLEXVISION XL, INCLUDE ADAPTOR BETWEEN SUSPENSION TUBE AND PHILIPS FLEXVISION XL, ISOLATION KITS, CONTROL UNIT FOR THE VERTICAL MOVEMENT AND THE ELECTROPNEUMATIC BRAKE SYSTEM ON 2 AXES OF M POWER
SPACER 280 PB 02	ARD517004920	1	1	280 MM ADJUSTMENT SPACER FOR MM SERIES IN DUO WITH HM, HH OR MODUTEC POWER 2 BEAMS VERSION
PLATE M PB	ARD517005948	1	1	STANDARD PLATE CONNECTING THE BEAM TO THE CEILING ATTACHMENT OR THE ANCHORAGE PLATE FOR MODUTEC LL, MM, HM AND MOTORISED M PWR 0-10, 6-10, 9-10 AND 0-8 SERIES

Number of CSUs **1**

Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

Technical File (CSU)

M PWR 9-10 230 BP-Surgery-(Hybrid)

Anchor and room heights

Finished ceiling	2,900.00 mm
Under Ceiling	3,500.00 mm
Plenum	600.00 mm
calculated height of REH	436.00 mm
mini. room height	1,275.00 mm

Pneumatic / Magnetic brakes	No	
☐ 1 axis		☐ Axis 1
☐ 2 axis		☐ Axis 2
☐ 3 axis		☐ Axis 3

CSU Data

Computed col. Height	
Height from floor to Module hole	
Height from floor to Second Mo	
Lenght of elec. Cables	
Lenght of gas. Hose	
LE'	
LG'	

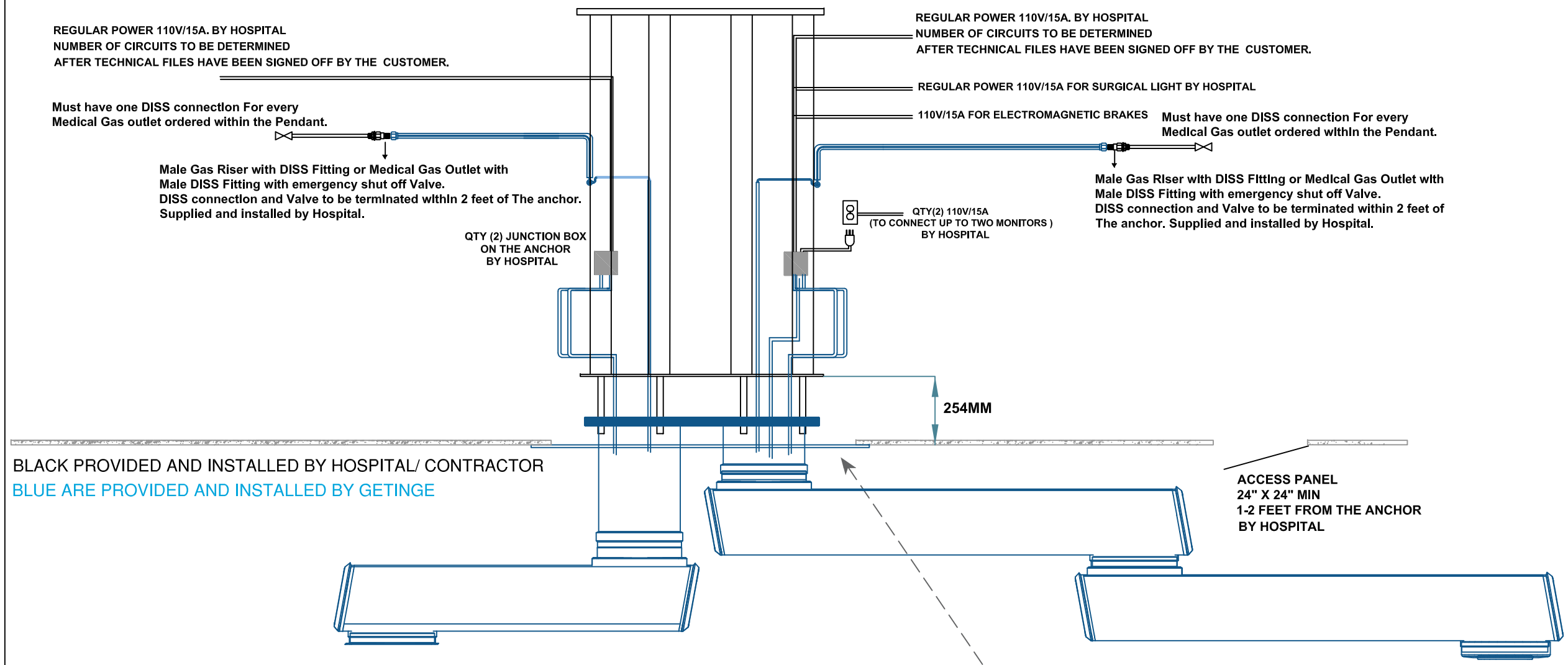
Suspension tube length	
Position Module/floor	2,063.06 mm
Position 2nd Module/floor	
Height between floor to column	

Common Data	CSU	Technical File
Validation Date 2020-02-11	**M PWR 9-10 230 BP-Surgery-(Hybrid)** **Range** **Modutec** **Series** **MODUTEC Power** Room number Hybrid Description Number of Specific Demands 0	Installation date 2020-02-11 Customer signature

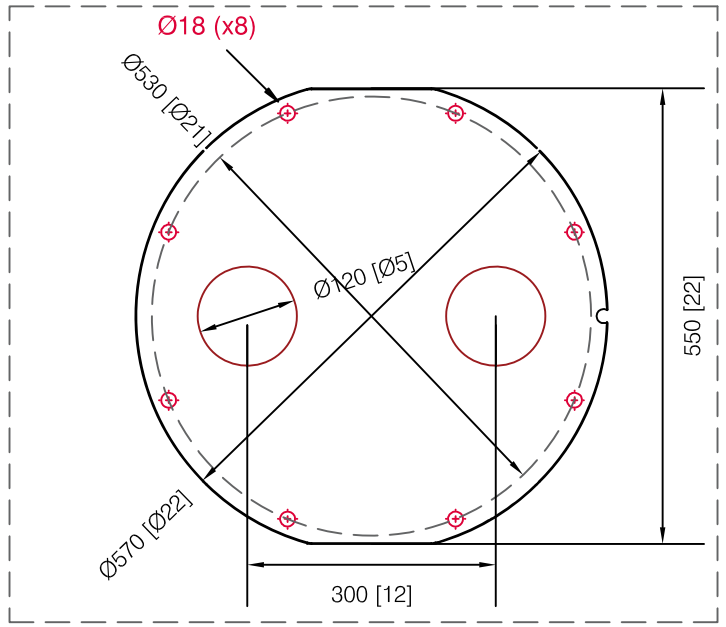
Project			12
CA-MH-ON-Philips-Sunnybrook-Toronto-12-2019-11-01			
Name of the Health Centre Philips-Sunnybrook	Health center location Toronto	Installation date for this project	
Qty of Entities 4 Pen, 5 OR L, 2 OR T Number of lots 1	State of project Valid Status Prospection	Description Room M2285	Sales representative HOUDE

CSU SIDE VIEWS M PWR 9-10 230 BP-Surgery-(Hybrid)

Common Data	CSU		Technical File
Validation Date 2020-02-11	**M PWR 9-10 230 BP-Surgery-(Hybrid)**		Installation date 2020-02-11
	Range	**Modutec**	
	Series	**MODUTEC Power**	
	Room number	Hybrid	Customer signature
	Description		
	Number of Specific Demands	0	



REQUIRED BOLT PATTERN ON THE ANCHOR



	LOADED WEIGHT (lbs)	LOADED MOMENT (ft.lb)
ENERGY LIGHT 9-10	616	3228
PLG-II LIGHT 6-0	855	2351

GETINGE

ITEM	ITEM NO.	DESCRIPTION	QTY

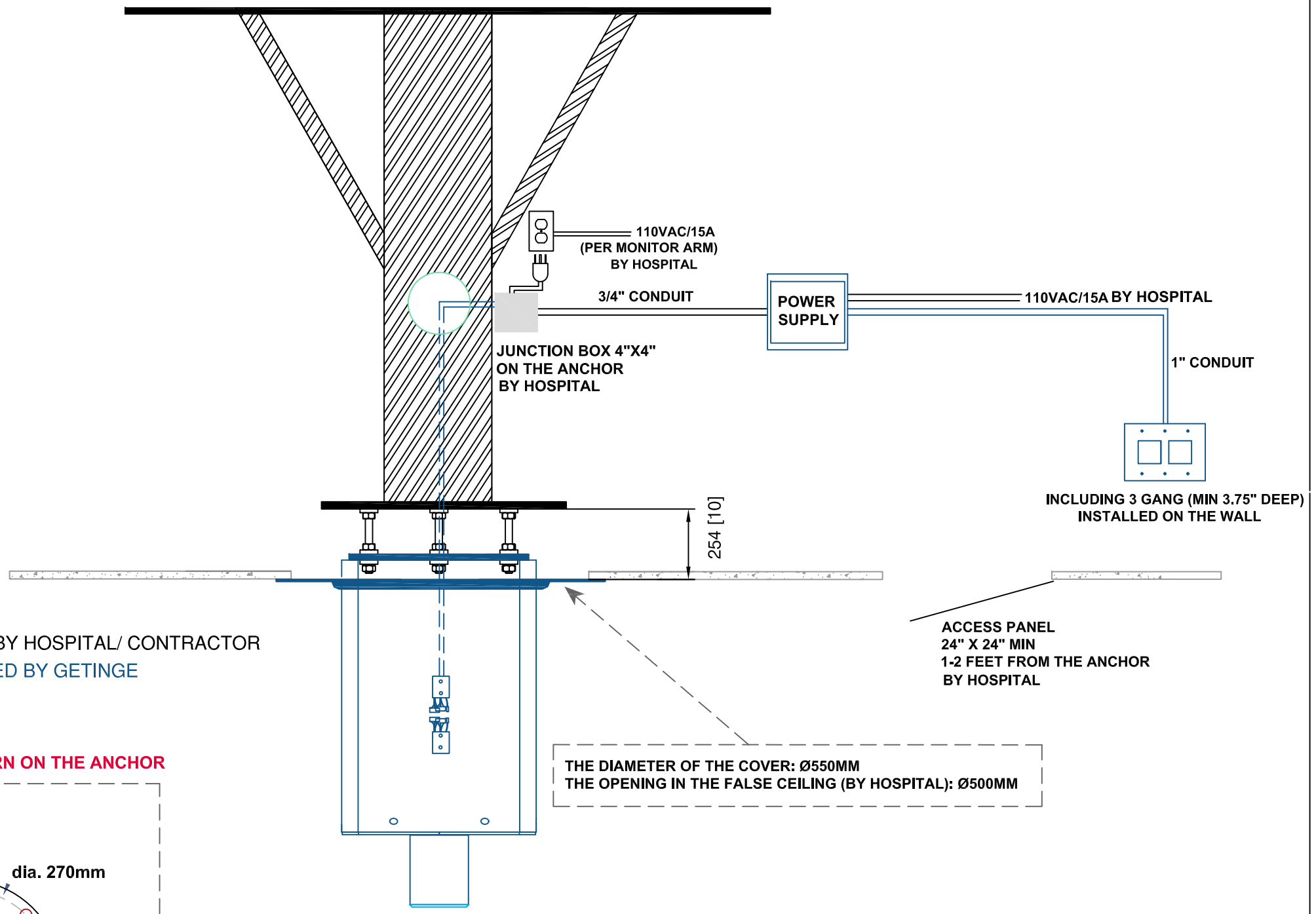
PRINT NAME
NEDA HAGHIGHIAN

SIGNATURE

REVISION	DATE	SCALE
A	02-25-2020	N/A

SAVED AS

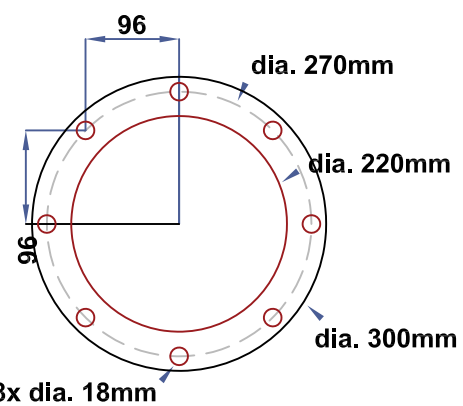
ANESTHESIA ARMS
INSTALLATION CUT SHEET



BLACK PROVIDED AND INSTALLED BY HOSPITAL/ CONTRACTOR

BLUE ARE PROVIDED AND INSTALLED BY GETINGE

REQUIRED BOLT PATTERN ON THE ANCHOR



MODEL	LOADED WEIGHT (LBS)	LOADED MOMENT (FT-LBS)
SATELITE FOR DUO SURGICAL LIGHT AND MONITOR ARM	939	2338

GETINGE

ITEM	ITEM NO.	DESCRIPTION	QTY

PRINT NAME

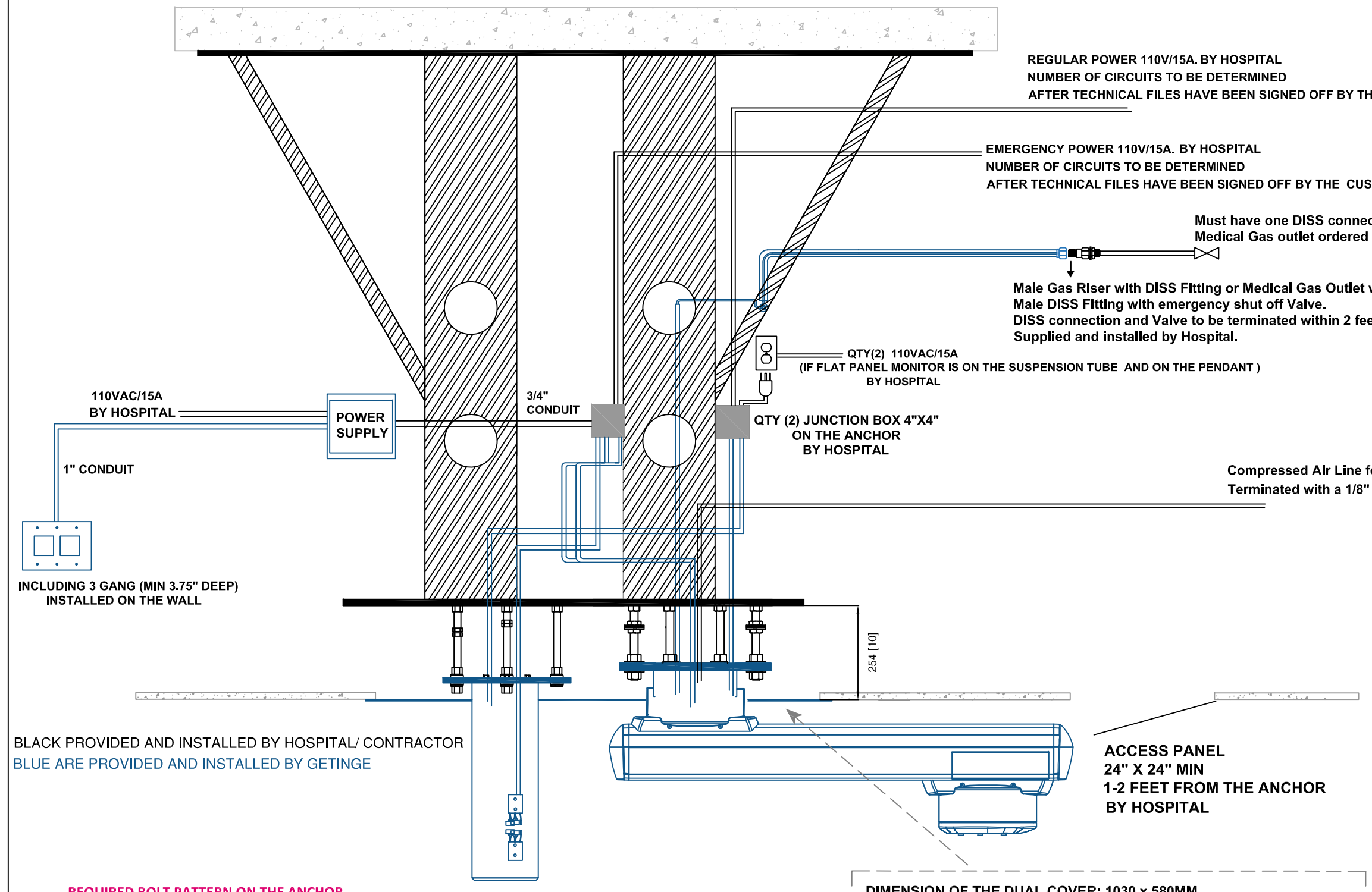
NEDA HAGHIGHIAN

SIGNATURE

REVISION	DATE	SCALE
A	02-25-2020	N/A

SAVED AS

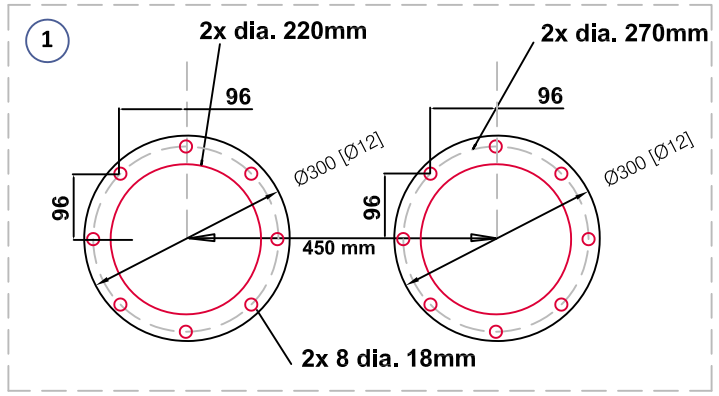
LIGHTS WITH SATELITE SUSPENTION TUBE INSTALLATION CUT SHEET



BLACK PROVIDED AND INSTALLED BY HOSPITAL/ CONTRACTOR
BLUE ARE PROVIDED AND INSTALLED BY GETINGE

DIMENSION OF THE DUAL COVER: 1030 x 580MM
THE OPENING IN THE FALSE CEILING (BY HOSPITAL): 1000 X 550MM

REQUIRED BOLT PATTERN ON THE ANCHOR



MODEL	LOADED WEIGHT (LBS)	LOADED MOMENT (FT-LBS)
MPWR 9-10 MOTORIZED ARM	649	3153
DUAL ARM SURGICAL LIGHT	176	779

GETINGE

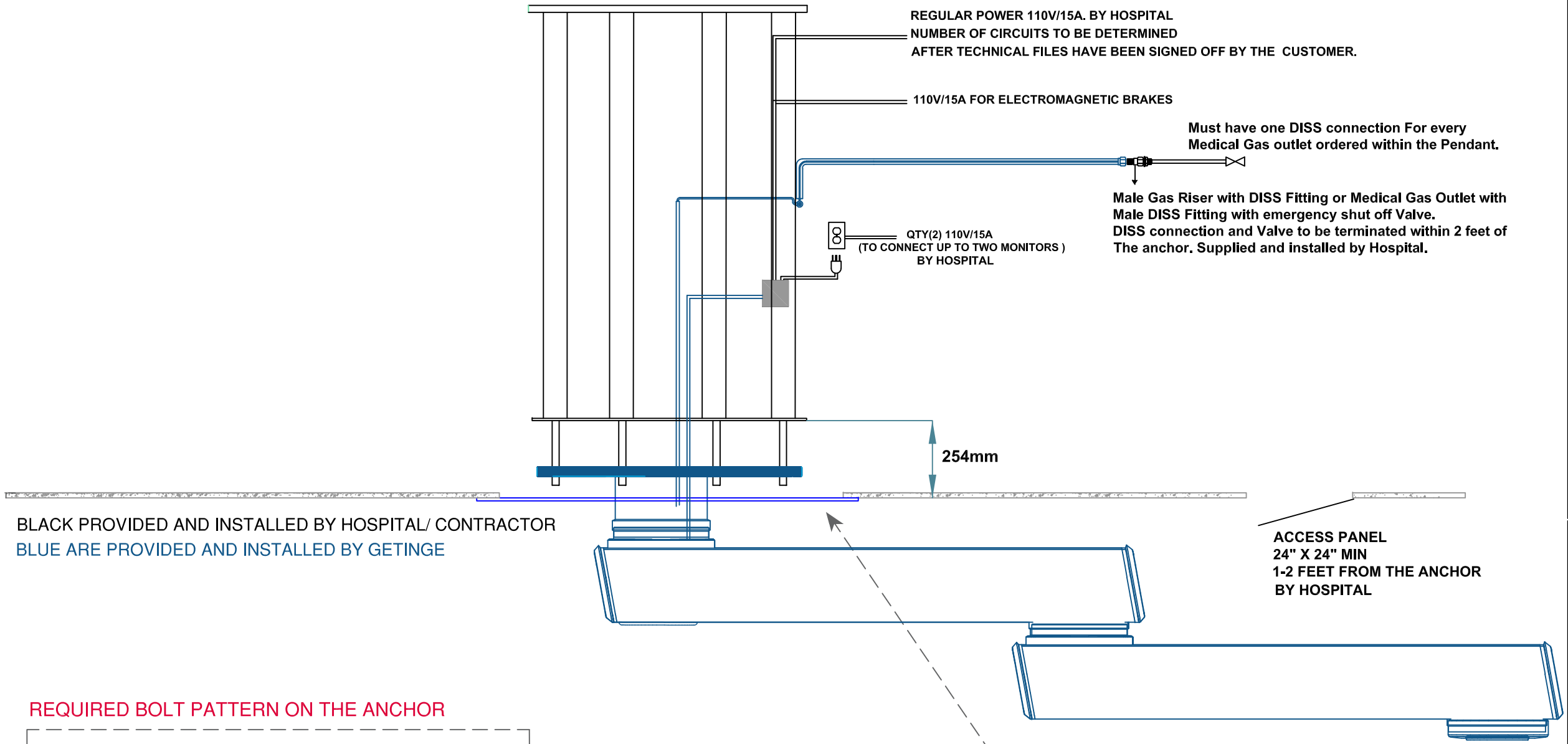
ITEM	ITEM NO.	DESCRIPTION	QTY

PRINT NAME
NEDA HAGHIGHIAN

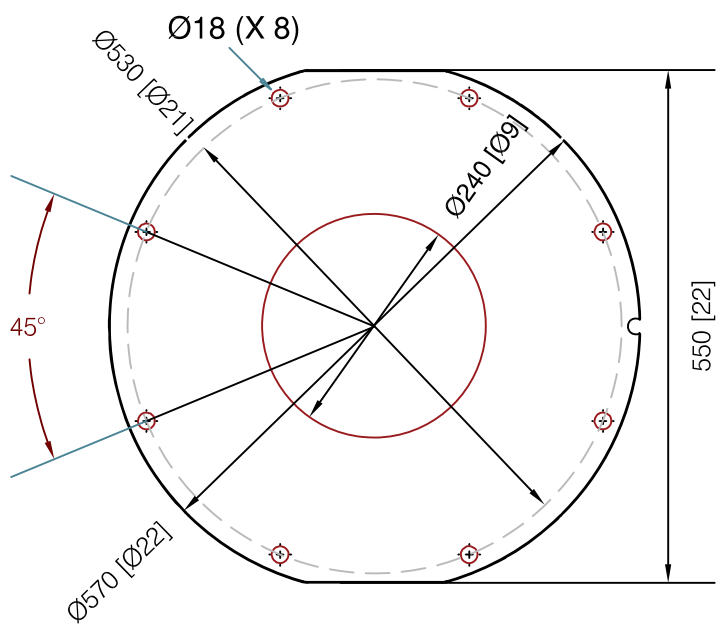
SIGNATURE

REVISION	DATE	SCALE
A	02-25-2020	N/A

SAVED AS
MOTORIZED ARM + DUAL SURGICAL LIGHT INSTALLATION CUT SHEET



REQUIRED BOLT PATTERN ON THE ANCHOR



MODEL	LOADED WEIGHT (lb)	LOADED MOMENT (ft-lb)
MODUEVO HEAVY 15-15	677	5816

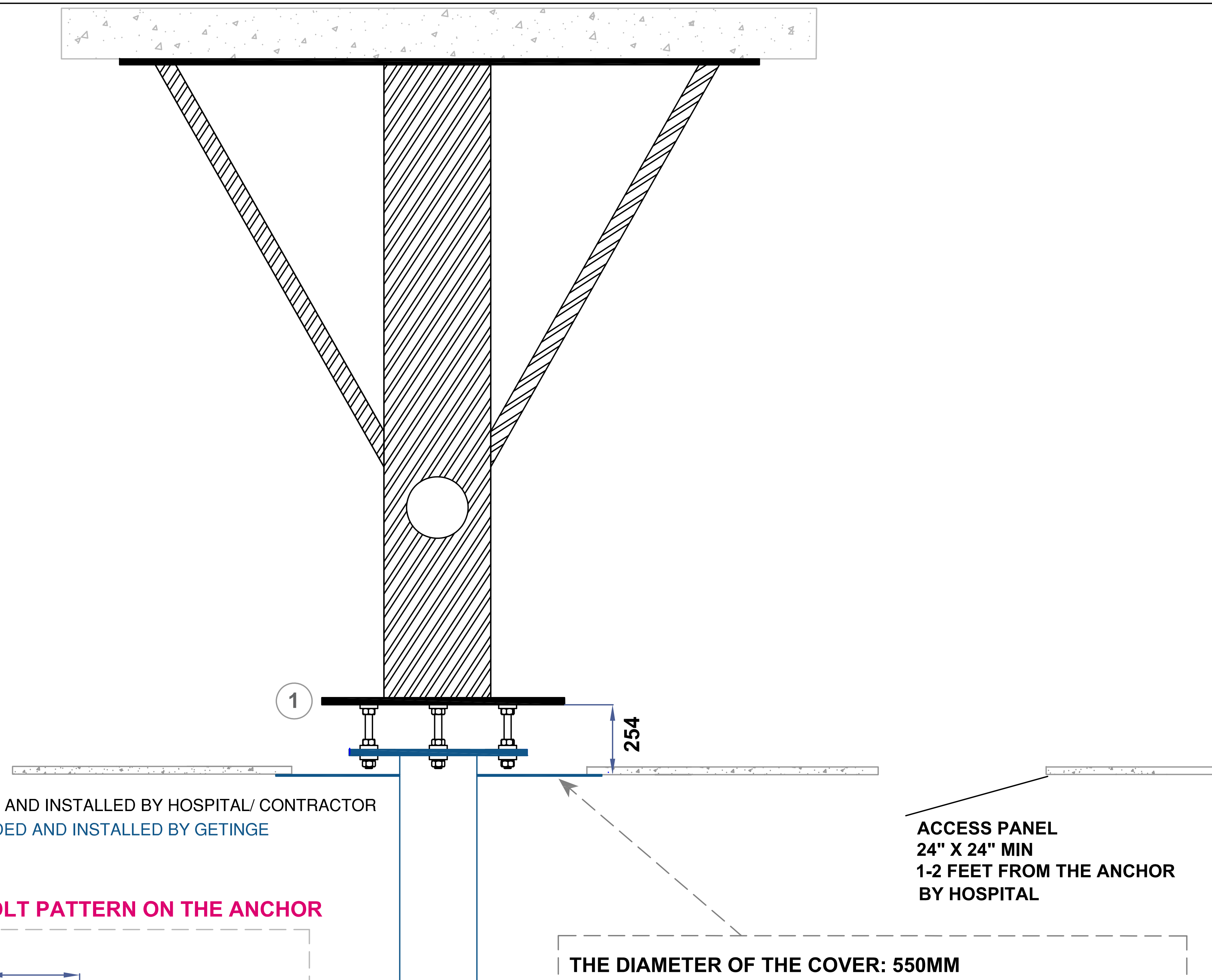
GETINGE

ITEM	ITEM NO.	DESCRIPTION	QTY

PRINT NAME
NEDA HAGHIGHIAN
SIGNATURE

REVISION	DATE	SCALE
A	02-25-2020	N/A

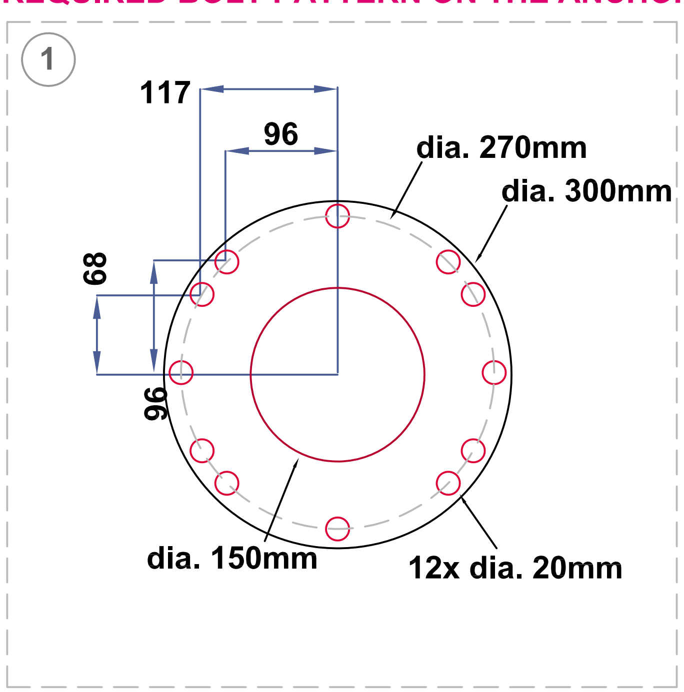
SAVED AS
SINGLE ARTICULATING ARMS
INSTALLATION CUT SHEET



BLACK PROVIDED AND INSTALLED BY HOSPITAL/ CONTRACTOR
BLUE ARE PROVIDED AND INSTALLED BY GETINGE

ACCESS PANEL
24" X 24" MIN
1-2 FEET FROM THE ANCHOR
BY HOSPITAL

REQUIRED BOLT PATTERN ON THE ANCHOR



THE DIAMETER OF THE COVER: 550MM
THE OPENING IN THE FALSE CEILING (BY HOSPITAL): 500MM

MODEL	LOADED WEIGHT (LBS)	LOADED MOMENT (FT-LBS)
X-RAY SHIELD ARM	91	342

GETINGE

ITEM	ITEM NO.	DESCRIPTION	QTY

PRINT NAME: NEDA HAGHIGHIAN
SIGNATURE:

REVISION	DATE	SCALE
A	02-25-2020	N/A

SAVED AS

X-RAY SHIELD ARMS
INSTALLATION CUT SHEET

SHEET 1 OF 1

PHILIPS

www.healthcare.philips.com

Pre-Order Site Preparation Support Document

The equipment components shown in this drawing package are based on the current proposed equipment configuration and are subject to change if modifications are made to the configuration at the time of final equipment purchase.

Revision History

Note for Architects and/or Contractors: If revisions are listed, these drawings must be thoroughly reviewed so that all changes can be incorporated into your project

Rev.	Date	Revision Descriptions	By
A	12/1/2017	Modified CAD background and layout per PM/AM request. Removed A2 layout.	IM
B	4/19/2019	Updated drawings to show FlexArm 6000mm per PM request,	CRF
C	5/31/2019	Updated equipment configuration and CAD background per AM/PM request.	CRF
D	7/15/2019	Placed and combined 3rd Party Booms per conversation with Room Solutions / AM / PM. No other changes.	CRF
E	9/10/2019	Updated CAD file and Equipment loctions per PM / AM request.	CRF
F	9/27/2019	Updated CAD file and equipment locations per PM request.	CRF
G	10/11/2019	Updated document per provided CAD file and PM/AM request.	CRF
H	10/25/2019	Created Pre-Order Site Preparation Document using quote 1-218LNZ1 Rev 1. Located Isocenter per PM request.	CRF
I	11/15/2019	Updated equipment racks to show back boxes. Relocated CB to TBD. Added Double LCD monitor on cart. Relocated Video Wall Connection Boxes per PM request. Relocated PACS. Added third party wall mounted monitor. All changes are clouded in red.	JV
J	2/6/2020	Updated CAD background and boom locations per PM request. Updated equipment notes on A2 as needed/ per PM request. Noted issues with boom placement as required. Clouded changes and issues. Updated equipment configuration using quote #: 1-218LNZ1 Rev. 3.	CRF
J(add)	3/31/2020	Updated drawing background per PM request. Placed electrical boxes as noted by PM/AM.	CRF

Table of Contents

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

C1

General Specifications

1. Responsibility
The customer shall be solely responsible, at its expense for preparation of site, including any required structural alterations. The site preparation shall be in accordance with plans and specifications provided by Philips. Compliance with all safety electrical and building codes relevant to the equipment and its installation is the sole responsibility of customer. The customer shall advise Philips of conditions at or near the site which could adversely affect the installation work and shall ensure that such conditions are corrected and that the site is fully prepared and available to Philips before the installation work is due to begin. The customer shall provide all necessary plumbing, carpentry work, or raceway (conduits, wireways, auxiliary gutters, etc.) required to attach and install products ready for use.

2. Permits
Customer shall obtain all permits and licenses required by federal, state/provincial or local authorities in connection with the construction, installation and operation of the products and related rules, regulations, shall bear any expense in obtaining same or in complying with any ordinances and statutes.

3. Radiation Protection
The customer or his contractor, at his own expense, shall obtain the service of a licensed radiation physicist to specify radiation protection. (X-Ray Tube output 125 KVp max.)

4. Asbestos and Other Toxic Substances
Philips assumes no hazardous waste (i.e., PCB's in existing transformers) exists at the site. If any hazardous material is found, it shall be the sole responsibility of the customer to properly remove and dispose of this material at its expense. Any delays caused in the project for this special handling shall result in Philips time period for completion being extended by like period of time. Philips assumes that no asbestos material is involved in this project in any ceilings, walls or floors. If any asbestos material is found anywhere on the site, it shall be the customer's sole responsibility to properly remove and/or make safe this condition, at the customer's sole expense.

5. Labor
In the event local labor conditions make it impossible or undesirable to use Philips' regular employees for such installation and connection, such work shall be performed by laborers supplied by the customer, or by an independent contractor chosen by the customer at the customer's expense, and in such case, Philips agrees to furnish adequate engineering supervision for proper completion of the installation.

6. Schedule
The general contractor should provide Philips with a schedule of work to assist in the coordination of delivery of Philips supplied products which are to be installed by the contractor and delivery of the primary equipment.

7. Extended Installation or Turnkey Work by Philips
Any room preparation requirements for Philips equipment indicated on these drawings is the responsibility of the customer. If an extended installation or turnkey contract exists between Philips and the customer for room preparation work required by the equipment represented on these drawings, some of the responsibilities of the customer as depicted in these drawings may be assumed by Philips. In the event of a conflict between the work described in the turnkey contract workscope and these drawings, the turnkey contract workscope shall govern.

8. Infection Control and Interim Life Safety Measures
Compliance with all Infection Control and Interim Life Safety Measures shall be the sole responsibility of the customer. The customer shall provide all means and methods necessary for compliance with Infection Control (IC) and Interim Life Safety Measures (ILSM) in connection with the construction and installation/operation of the products shown herein and shall bear any expenses related to same.

(16.0)

Minimum Site Preparation Requirements

A smooth efficient installation is vital to Philips and their customers. Understanding what the minimum site preparation requirements are will help achieve this goal. The following list clearly defines the requirements which must be fulfilled before the installation can begin.

1. Walls to be painted or covered, baseboards installed, floors to be tiled and/or covered, ceiling shall have grid tiles and luminaires installed and operational.

2. Doors and windows, especially radiation protection barriers, installed and finished with locksets operational.

3. All electrical convenience outlets, raceways, wireways, auxiliary fittings, knockouts, cable connectors, terminal and power distribution blocks, cable openings, chase nipples, junction boxes and pull boxes installed and operational.

4. A private supply mains branch circuit with overcurrent protective circuit breaker and manual operable circuit disconnect means shall be present and operational. Definition of "Private supply" means an end-leave of the hospital distribution system after the last overcurrent protective disconnect means from which all equipment included in the Azurion ground domain is powered. Note that only equipment included in the Azurion certification and equipment with which the Azurion has a compatibility statement are allowed to be inside the Azurion ground domain. All other electrical equipment is not allowed to have a functional connection to the Azurion system and shall have no direct galvanic connection to prevent ground loops. 3rd party equipment that does not have a function connection with the Azurion system, but that is intended to be used inside the same patient area as the Azurion System shall be grounded to the PCB inside the ERB with a ground bonding of <= 200 mOhm for plugable equipment.

5. 120V convenience outlets operational.

6. All support structure correctly installed. All channels, pipes, beams and/or other supporting devices should be level, parallel, and free of lateral or longitudinal movements.

7. All contractor supplied cables pulled and terminated.

8. A dust-free environment in and around the procedure room.

9. All HVAC (heating, ventilating and air conditioning) installed and operational as per specifications.

10. Architectural features such as computer floor, wood floor, casework, bulkheads, installed and finished. When technical cabinets are installed in a closet with doors, it is suggested that the customer install a temperature alarm in the event of an air conditional failure.

11. All plumbing installed and finished.

12. Philips does not install or connect developing tanks, automatic processors or associated equipment, built in illuminators, cassette pass boxes, loading benches and cabinets, lead protective screens, panels or lead glass window and frame. This is to be done by the customer/contractor.

13. Clear door openings for moving equipment into the building must be 42" (1067mm) W x 82" (2083mm) H min. 48" (1219mm) W x 82" (2083mm) H rec., Or larger contingent on an 8'-0" (2438mm) corridor width.

14. Countertop is 30" (765mm) for seated height and 36" (915mm) for standing height.

Note
Once Philips has moved equipment into the suite and started the installation, the contractor shall schedule his work around the Philips installation team on site. It is suggested that a telephone be provided in the room to receive telephone calls. This would alleviate facility staff from answering calls for Philips personnel.

Remote Service Diagnostics
Medical imaging equipment to be installed by Philips Medical is equipped with a service diagnostic feature which allows for remote and on site service diagnostics. To establish this feature, a RJ45 type ethernet 10/100/1000 Mbit network connector must be installed as shown on plan. Access to customer's network via their remote access server is needed for Remote Service Network (RSN) connectivity. All cost with this feature are the responsibility of the customer.

(16.0)

HVAC Requirement for General Equipment Locations

Operation	
Temperature	59°F (15°C) to 86°F (30°C)
Temperature gradient	Max. 1°F / Minute (0.5°C / Minute)
Humidity (non-condensing) Humidity shall be stable within 10%	20% to 80%
Exam Room	*6483 BTU/hr
Equipment Room	*8189 BTU/hr
Control Room	*1706 BTU/hr

***Average heat emission during clinical use**
Data applicable for basic system:
Large monitor + 4 x small monitor in Monitor Ceiling Suspension
1 workstation + 2 x small monitor in Control Room

Add 1706 BTU/hr for additional large monitor
Add 273 BTU/hr for additional small monitor
Add 1024 BTU/hr for additional workstation
See AL sheet for additional heat load in case of UPS

Equipment's designed airflow is from front/side to back. Please design the air handling in the rack cabinet equipment area accordingly.

Heating, ventilation, and air conditioning requirements must maintain temperature at 72° +/- 5°F as well as a non-condensing relative humidity at 20-80% with 10% maximum variation. These temperature and humidity levels must be maintained in all (3) rooms (equipment, examination and control rooms).

(19.0)

Electrical Requirements
Mains 40E Cabinet

Maximum Rated Power:	100kW
Supply Configuration:	3 phase, equally sized insulated power conductors and an insulated equipment grounding conductor. Insulated grounding conductor shall have the same or larger size than line conductors. Line wires shall be no smaller than 6 AWG, 90°C or higher temperature rating. The conductor size is dependant on the upstream circuit breaker rating: 4 AWG for 80A circuit breaker rating.
Nominal Line Voltage:	480 VAC, 60 Hz
Branch Power Requirement:	100 kVA (System only; verify UPS power requirements)
Circuit Breaker:	3 phase, Type D 80A with long-time delay and shunt trip

(19.0)

Remote Control of Room Lighting

The control of customer lighting must incorporate an electrical isolation system such as demonstrated on Sheet ED3. Lighting scheme is the responsibility of the customer.

(12.0)

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

AN

Equipment Legend

A Furnished and installed by Philips
B Furnished by customer/contractor and installed by customer/contractor
C Installed by customer/contractor
D Furnished by Philips and installed by contractor
E Existing
F Future
G Optional

	Equipment Designation	Description	Weight (lbs)	Heat Load (BTU/hr)	Detail Sheet
		Items not on Philips Quote/Order			
B	CB	Circuit Breaker	-	-	
B	A	Anesthesia / MedGas Boom			-
B	B	Single XRAY Shield			-
B	B2	Single XRAY Shield			-
B	C	Light and Monitor (for FlexVision) Boom			-
B	D	Nurse Station Boom			-
B	E	Light and Monitor Boom			-
A	DBS	Dose Aware - Base Station	3.2	85	AD5
A	PDR1	Personal Dose Meter Rack	-	-	AD5
A	PDR2	Personal Dose Meter Rack	-	-	AD5

Equipment Legend

A Furnished and installed by Philips
B Furnished by customer/contractor and installed by customer/contractor
C Installed by customer/contractor
D Furnished by Philips and installed by contractor
E Existing
F Future
G Optional

	Equipment Designation	Description	Weight (lbs)	Heat Load (BTU/hr)	Detail Sheet
A	SP	C-Arc Stand	2755	2047	AD2
A	MQT	Maquet Table	1053	102	AD2
A	ME	Certeray iX Generator Cabinet	320	2971	AD3
A	MR	Peripheral 40E Cabinet	441	2049	AD3
A	MA	Mains 40E Cabinet	826	5464	AD3
A	CY	Control Room Connection Box (for optional FlexSpot)	115	567	AD6
A	DB	Documentation Box - Mounted on Wheels (Final location to be coordinated with customer and/or local Philips Service)	176	0	AD4
A	ATY	Exam Room Auxiliary Box	7	1.7	AD4
D	PSU	Stationary Transformer Unit	30	34	AD5
A	XPD	Xper Pedestal	88	0	AD5
A	SWCB	Surgery Wall Connection Box	18	-	AD5
A	TM	Trolley Magnus Maquet	-	-	-
A	TM2	Trolley Magnus Maquet	-	-	-
A	MB	Image 40E Cabinet	441	1877	AD3
A	VB1 ~	Video Connection Box	11	34	AD4
A	VB10	Video Connection Box	11	34	AD4
A	TV	58" LCD Monitor Suspension (To be mounted on third party boom)	-	1020	-
A	MED	Medrad Arterion Injector on Pedestal	185	4095	AD5
A	IVUS	Volcano CORE IVUS - To Be Integrated w/ Pedestal- Not Shown			-
A	SV	Volcano CORE IVUS - Trench Cover (To be mounted on third party boom - Not shown)	-	-	-
A	IH	Interventional Hardware (Integrated with optional FlexSpot - Not shown)	73	1024	-
B	TV2	Live/Reference Slave Monitor (To be mounted on third party boom)	-		
B	TV3	Live/Reference Slave Monitor (To be mounted on third party boom)	-		
A	TV4	Double LCD Monitor on Cart	98	478	AD3
A	VB11	Video Connection Box	11	-	AD3
A	VB12	Video Connection Box	11	-	AD3
B	TV5	Live/Reference Slave Monitor	-		

PHILIPS

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Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
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Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

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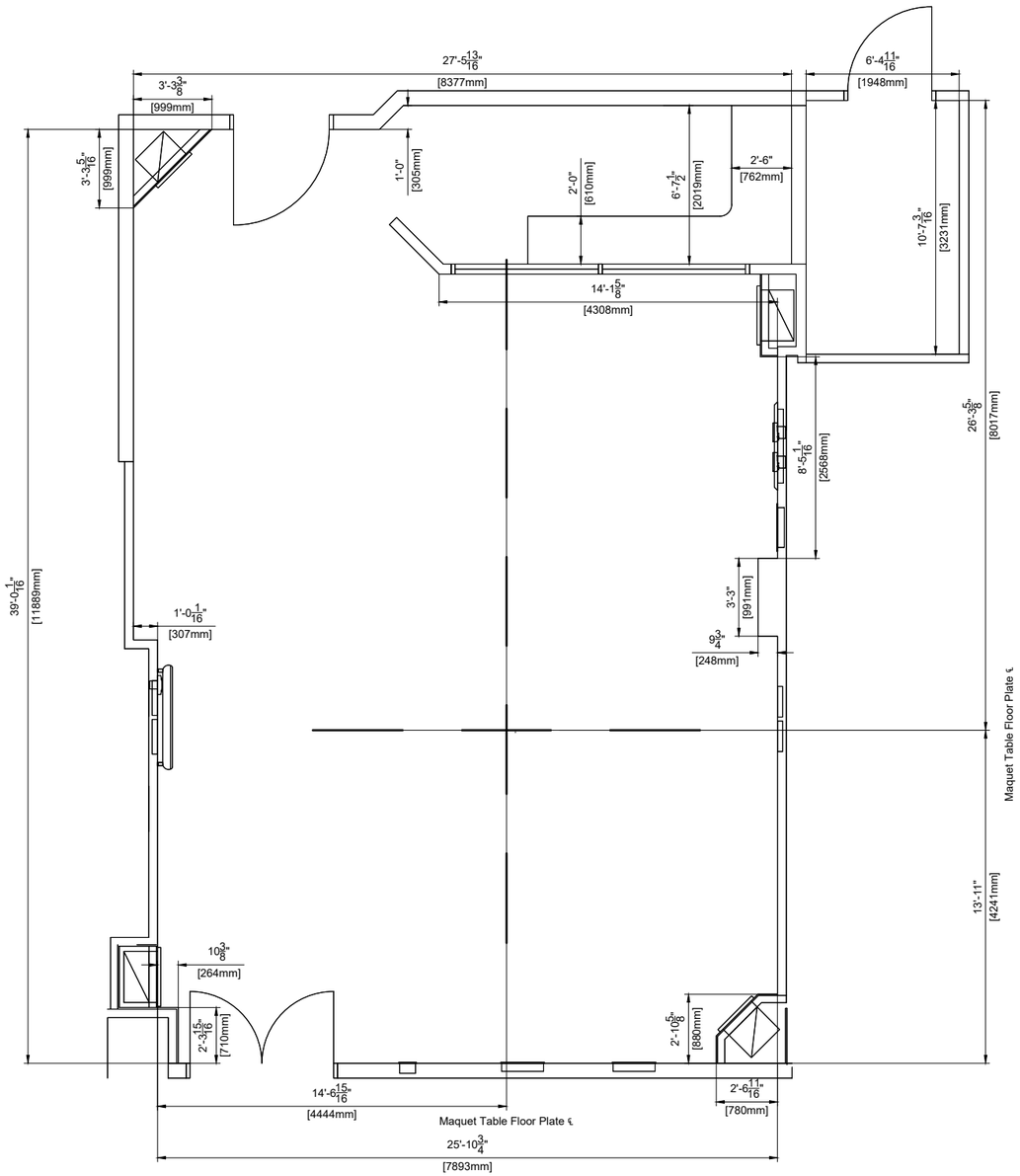
Quote: 1-218LNZ1 Rev. 3
Order: None

AL



Legend

- Walls
- Soffit
- Existing (to be removed)
- Beams or other building construction elements

0 1' 2' 4' 8'
0 .5m 1m 2m

General Notes

* Counters and cabinetry shown to be supplied and installed by contractor.
* Field to verify all room dimensions.

PHILIPS

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Order: None

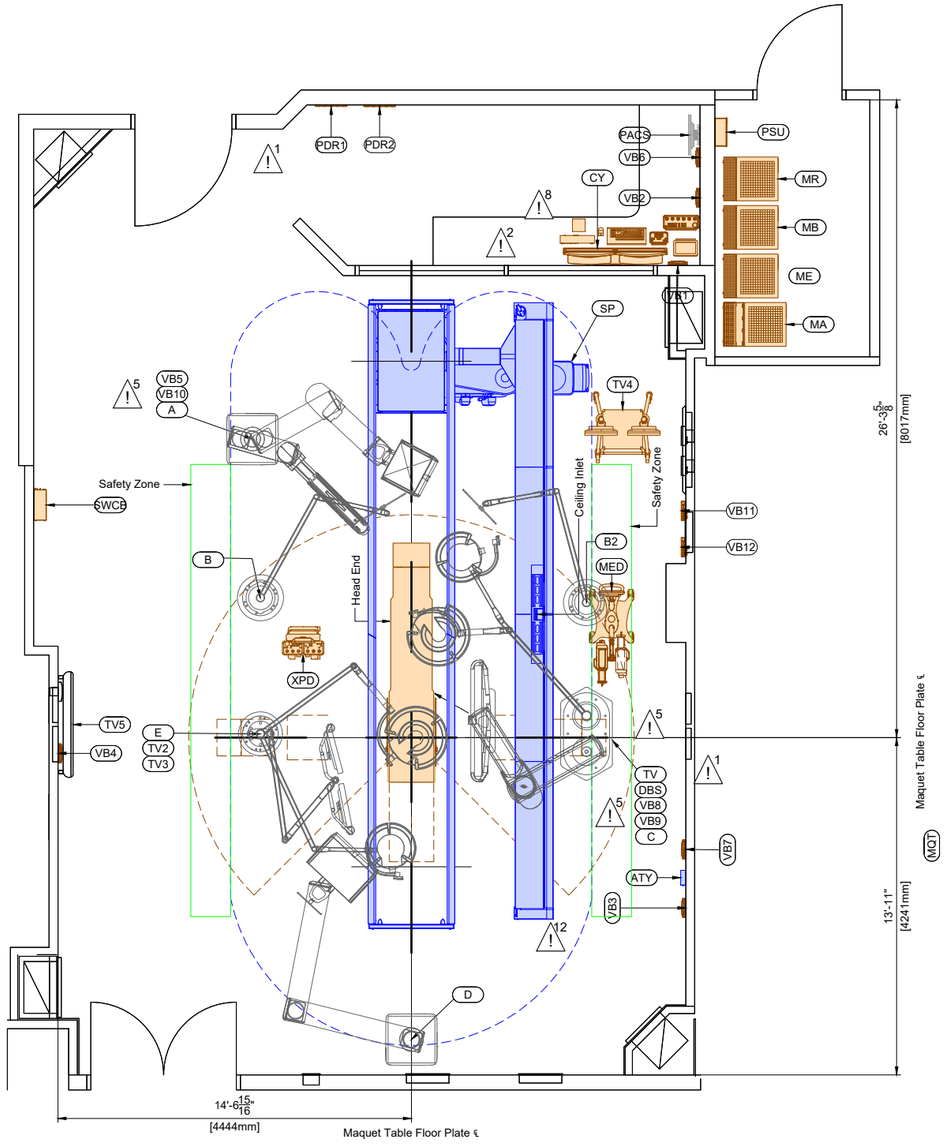
A1

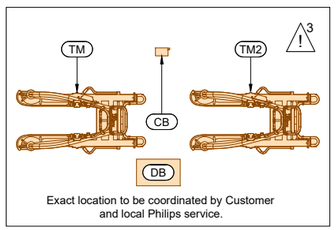
General Notes

* Architect to coordinate with end users/technicians to determine final placement of control desk components prior to installation in order to avoid rework. Architect to coordinate with Philips Project Manager to reflect final placement on Philips drawings.
* FlexArm room must have a minimum of 18'-2 $\frac{1}{8}$" (5540mm). Table centerline must be 9'-1 $\frac{1}{16}$" (2770mm) from each wall or else the safety zone of a side will be impacted.

Planning Issues and Considerations

1. Exact equipment configuration to be verified with local Philips Sales. DoseAware is not listed on quote but shown per PM request.
2. View of patient may be limited. Verify with customer requirement.
3. Exact equipment configuration to be verified with local Philips Sales. Mobile IVUS is listed on quote but not shown per PM request.
4. Verify quantity and designation of Live/Reference slaving monitors with local Philips Service.
5. Boom vendor must give written/documented approval to mount video wall boxes on booms.
6. Exact equipment configuration to be verified with local Philips Sales. Eight VB's are listed on quote but (11) are shown due to AM request.
7. Exact equipment configuration to be verified with local Philips Sales. iE33 / EIPQ video coupling listed on quote but not shown per AM request.
8. Exact equipment configuration to be verified with local Philips Sales. FlexSpot is not listed on quote but is shown as an option per PM request.
9. Exact equipment configuration to be verified with local Philips Sales. IW Hardware listed on quote but shown as integrated with FlexSpot per PM request.





	Source	Location	Displayed
VB1	TBD	Control	FlexVision
VB2	TBD	Control	FlexVision
VB3	TBD	Exam	FlexVision
VB4	TBD	Exam	FlexVision
VB5	TBD	Exam	FlexVision
VB6	PACS	Control	FlexVision
VB7	TBD	Exam	FlexVision
VB8	TBD	Exam	FlexVision
VB9	TBD	Exam	FlexVision
VB10	TBD	Exam	FlexVision
VB11	MB	Exam	TV2
VB12	MB	Exam	TV2

6

0 1' 2' 4' 8'
0 .5m 1m 2m

3 4 7 9

Equipment Layout

1:75

Required Unistrut Height: 9' - 6 $\frac{3}{16}$", +$\frac{3}{8}$" / -0 (2900mm, +10mm / -0)
Unistrut height measured from finished floor to bottom of Unistrut.

PHILIPS

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Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
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Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

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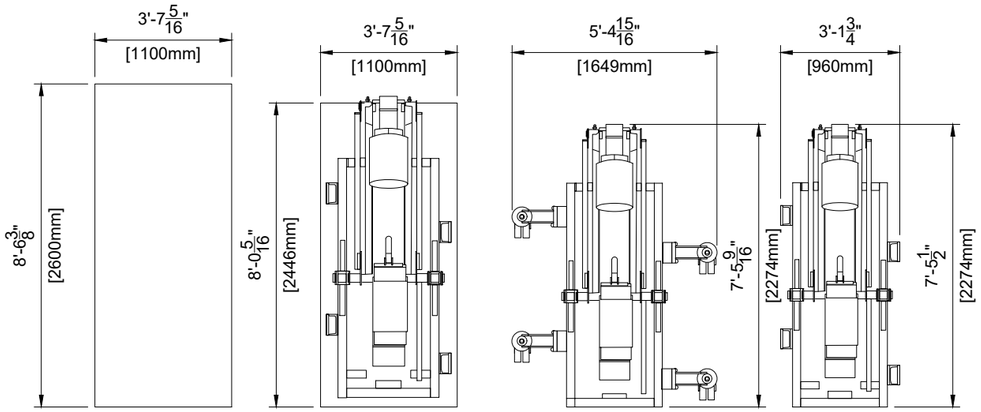
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

A2

Detail - FlexArm Ceiling (C-ARM) Transport Details



Transport Possibilities				
	Crate	**Pallet**	**Kick Wheels Wide**	**Kick Wheels Small**
Height	77.95" (1980mm)	76.22" (1936mm)	69.02" (1753mm)	77.76" (1975mm)
Weight	2050 lbs (930 kg)	1940 lbs (880 kg)	2061 lbs (935 kg)	1764 lbs (800 kg)

(19.0)

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M22285

Philips Contacts
Project Manager: Ty Galloway
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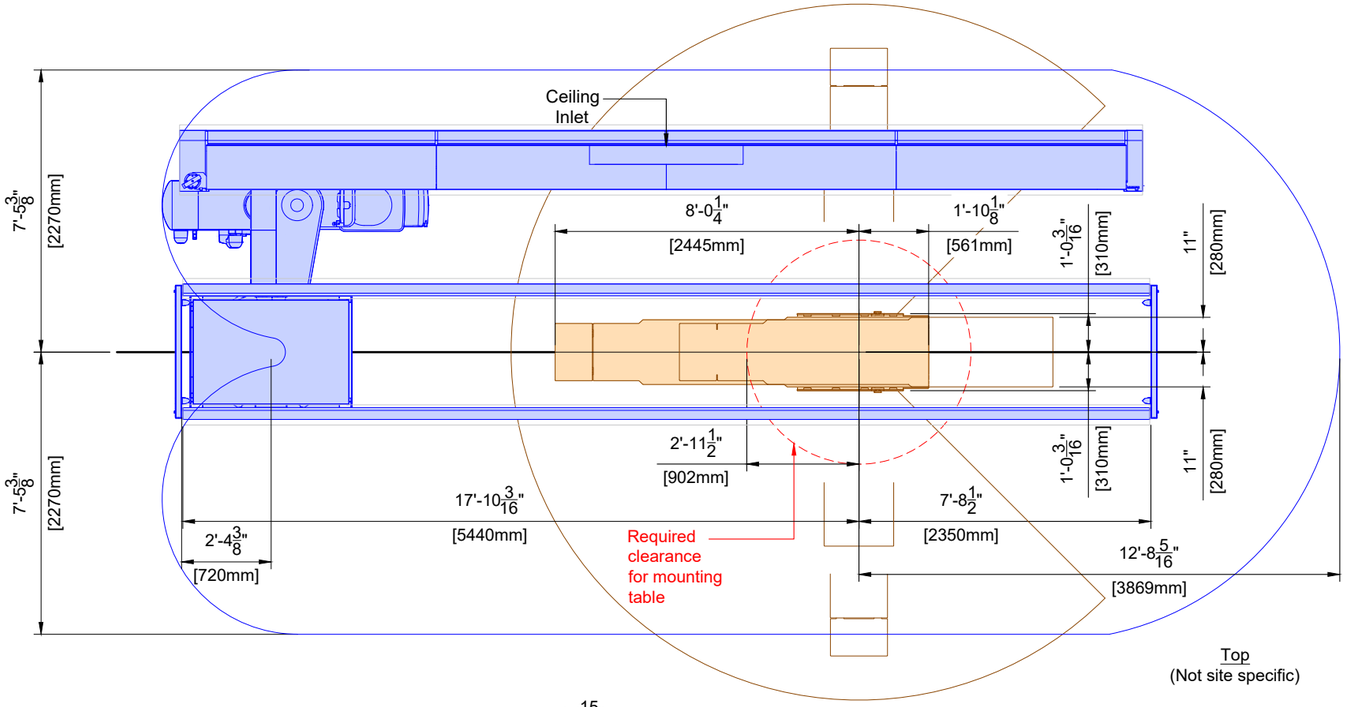
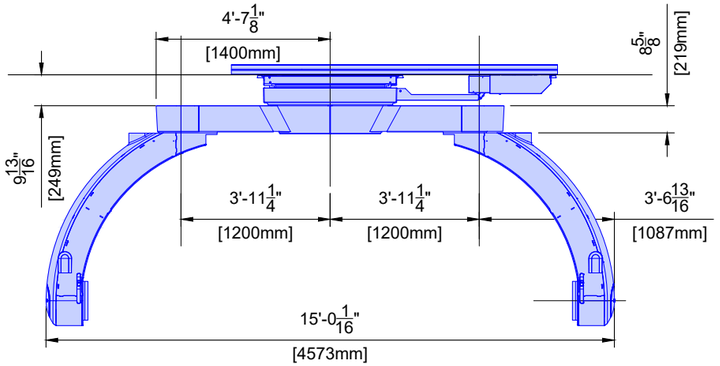
Drawn By: Chris Falkinburg

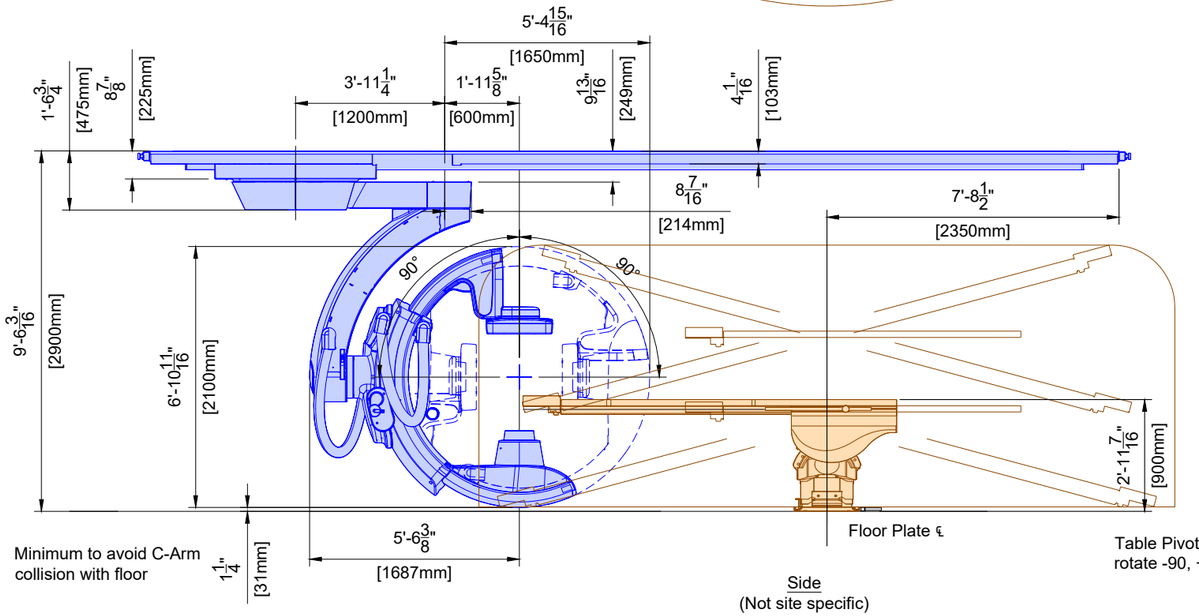
Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

AD1

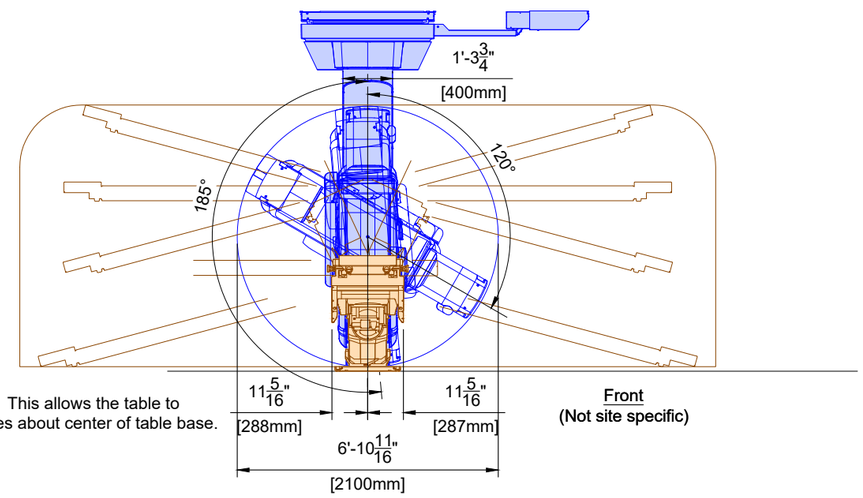


Top
(Not site specific)





Side
(Not site specific)



Front
(Not site specific)

Table Pivot is optional. This allows the table to rotate -90, +180 degrees about center of table base.

(19.0)

	FlexArm Stand	
SP	Weight	Heat Dissipation
	2755 lbs	2047 BTU/hr

Indicates equipment movement

(13.0)

	Maquet Table	
MQT	Weight	Heat Dissipation
	1053 lbs	102 BTU/hr

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
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Drawn By: Chris Falkinburg

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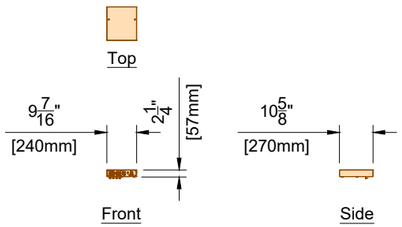
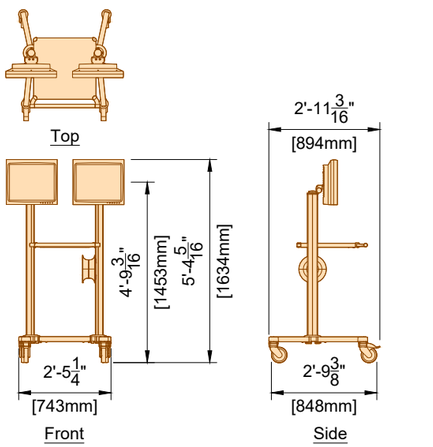
AD2



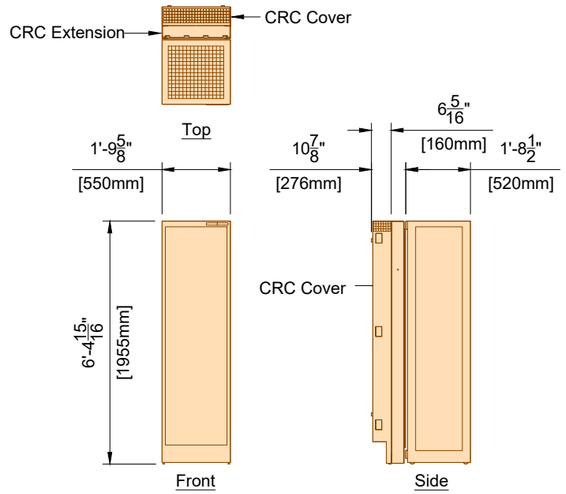
(12.0)

	Video Connection Box	
VB11 ~ VB12	Weight	Heat Dissipation
	11 lbs	34 btu/hr



(12.0)

	Double LCD Monitor on Cart	
TV4	Weight	Heat Dissipation
	98 lbs	478 btu/hr

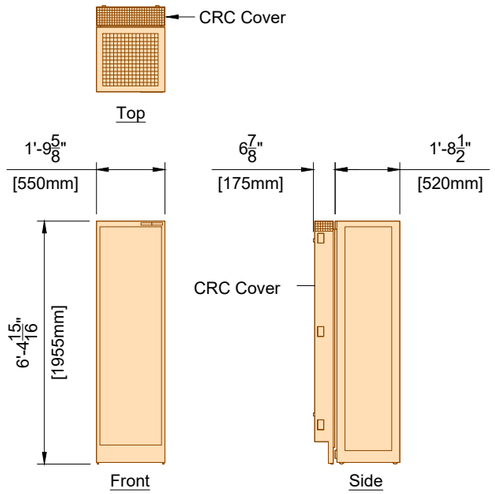


The CRC Cover must be attached to the back box.

Acoustic noise level: <= 55 dB(A) @ 1 meter in front of the rack and 1 meter high (1 meter = 39.37")

(19.0)

	Mains 40E Cabinet	
MA	Weight	Heat Dissipation
	826 lbs	5464 BTU/hr

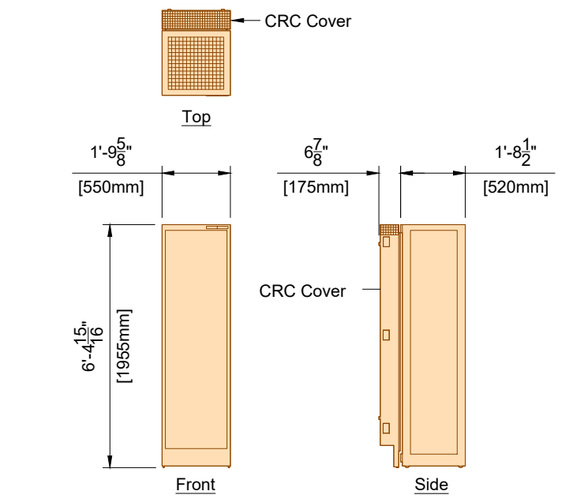


The CRC Cover must be attached to the back box.

Acoustic noise level: <= 48 dB(A) @ 1 meter in front of the rack and 1 meter high (1 meter = 39.37")

(19.0)

	Image 40E Cabinet	
MB	Weight	Heat Dissipation
	441 lbs	1877 BTU/hr

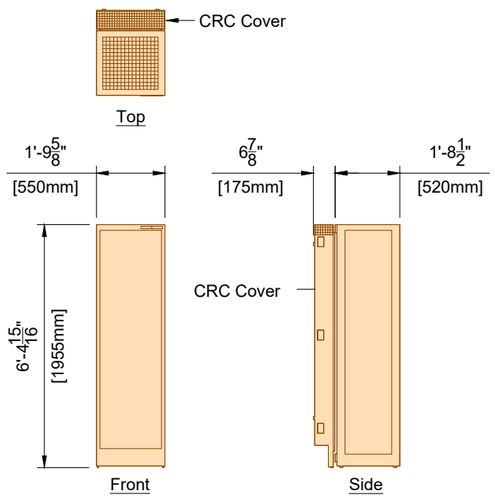


The CRC Cover must be attached to the back box.

Acoustic noise level: <= 65 dB(A) @ 1 meter in front of the rack and 1 meter high (1 meter = 39.37")

(19.0)

	Peripheral 40E Cabinet	
MR	Weight	Heat Dissipation
	441 lbs	2049 BTU/hr



The CRC Cover must be attached to the back box.

Acoustic noise level: <= 55 dB(A) @ 1 meter in front of the rack and 1 meter high (1 meter = 39.37")

(19.0)

	Certeray iX Generator 40E Cabinet	
ME	Weight	Heat Dissipation
	320 lbs	2971 BTU/hr

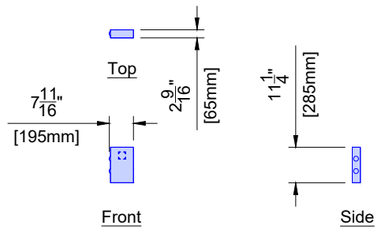
PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

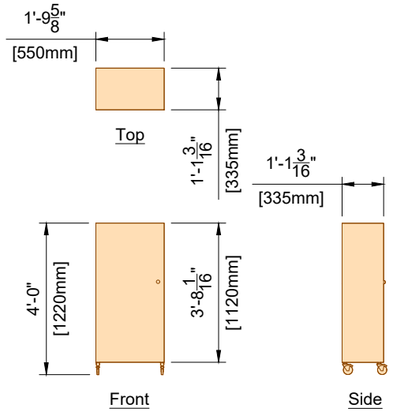
Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

AD3



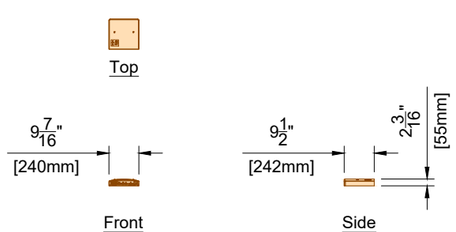
(19.0)

ATY	Auxiliary Box	
	Weight	Heat Dissipation
	7 lbs	1.7 BTU/hr



(19.0)

DB	Documentation Box	
	Weight	Heat Dissipation
	176 lbs	0 BTU/hr



(19.0)

VB1 ~ VB10	Video Connection Box	
	Weight	Heat Dissipation
	11 lbs	34 BTU/hr

PHILIPS

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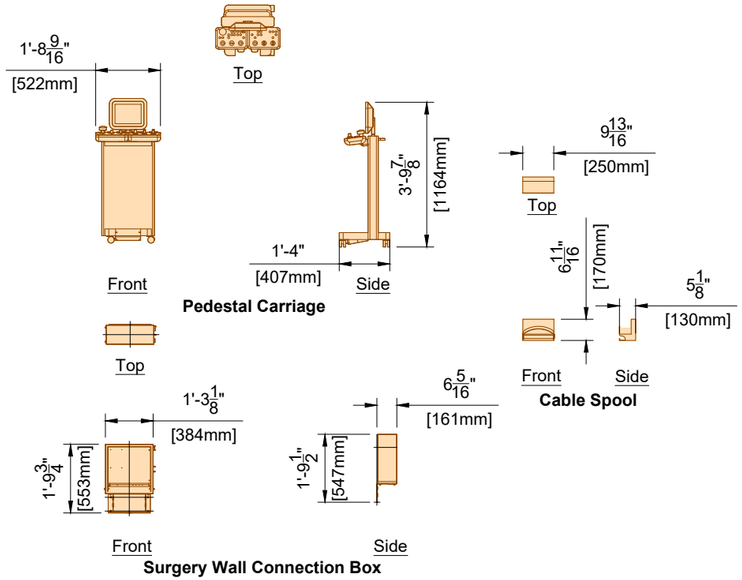
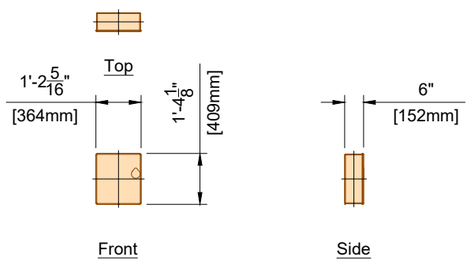
AD4



CS
SWCB

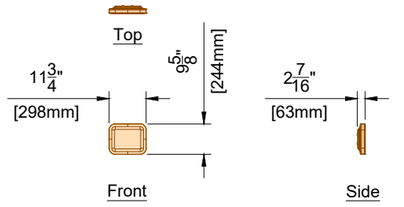
(19.0)

	Xper Pedestal (Pedestal Carriage)	
	Weight	Heat Dissipation
XPD	88 lbs	0 BTU/hr
SWCB	18 lbs	- BTU/hr



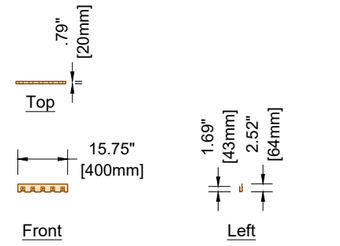
(19.0)

	Stationary Transformer Unit	
PSU	Weight	Heat Dissipation
	30 lbs	34 BTU/hr



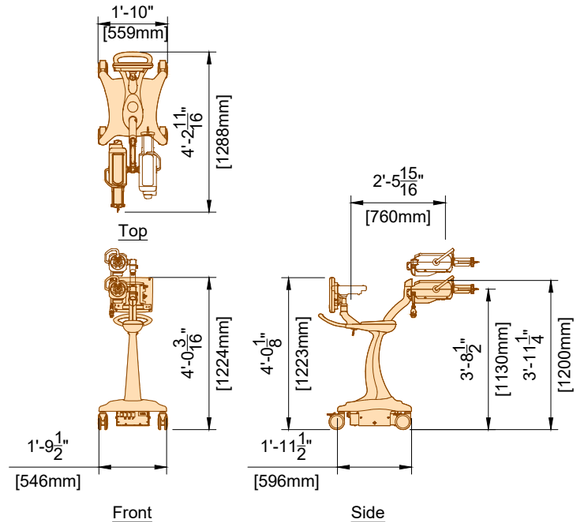
(19.0)

	Dose Aware - Base Station	
DBS	Weight	Heat Dissipation
	3.2 lbs	85 BTU/hr



(15.0)

	Personal Dose Meter Rack	
PDR1-PDR2	Weight	Heat Dissipation
	- lbs	- btu/hr



(12.0)

	Medrad Arterion Injector on Pedestal	
MED	Weight	Heat Dissipation
	185 lbs	4095 btu/hr

PHILIPS

Project
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Room: M2285

Philips Contacts
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Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
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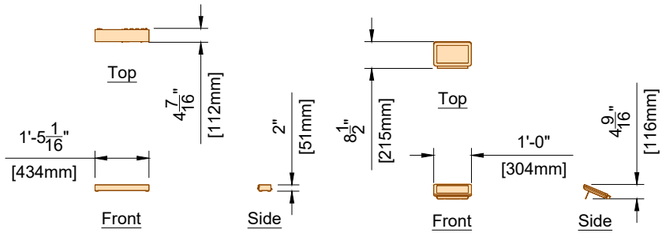
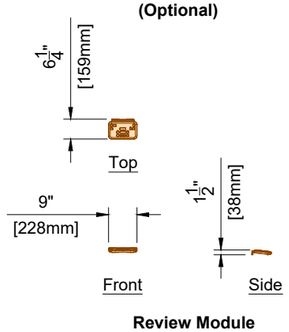
Order: None

AD5

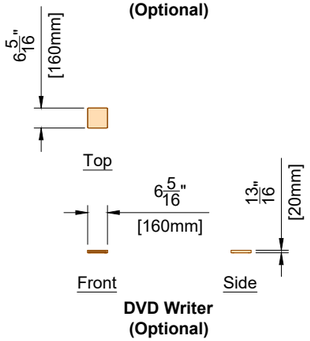


Multiswitch (Optional)

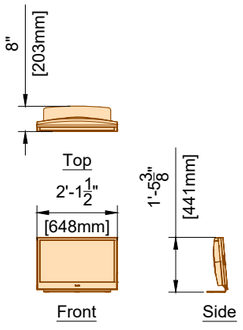
Touch Screen Module (Optional)



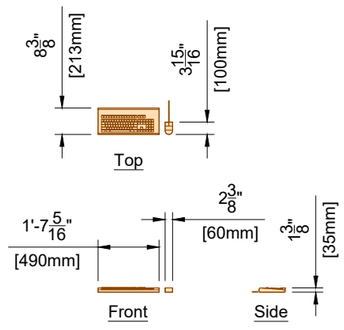
Review Module



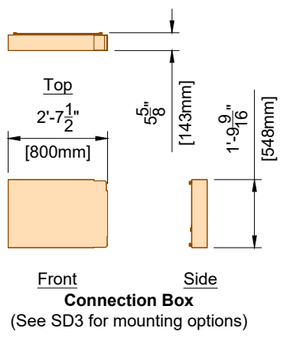
DVD Writer (Optional)



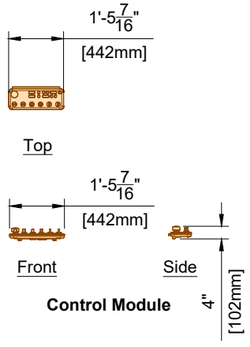
LCD Monitor



Keyboard / Mouse



Connection Box
(See SD3 for mounting options)



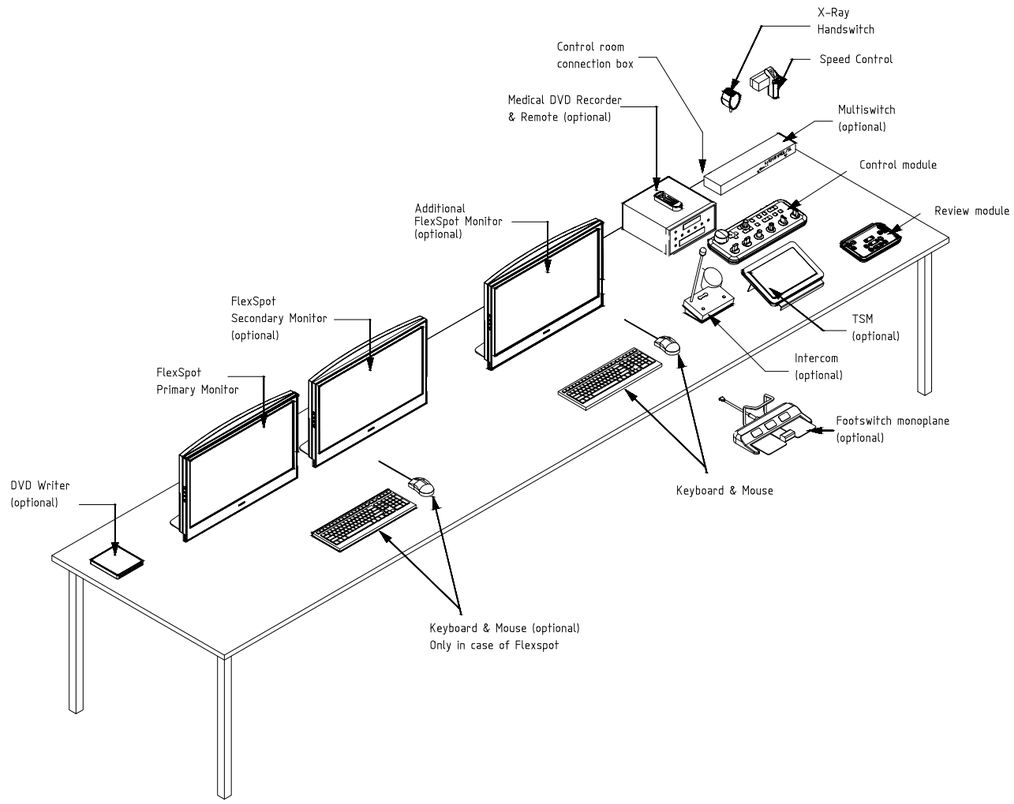
Control Module

(19.1)

CY	Control Room Connection Box (All Components)	
	Weight	Heat Dissipation
	115 lbs	567 BTU/hr

Detail - Typical Control Room Layout with FlexSpot

(Not to scale - Not site specific)



PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

AD6

Equipment Support Information

1. General
The customer shall be solely responsible, at its expense, for preparation of the site, including any required structural alterations. The site preparation shall be in accordance with this plan and specifications, the architectural/construction drawings and in compliance with all safety and building codes. The customer shall be solely responsible for obtaining all construction permits from jurisdictional authority.

2. Equipment Anchorage
Philips provides, with this plan and specifications, information relative to equipment size, weight, shape, anchoring hole locations and forces which may be exerted on anchoring fasteners. The customer shall be solely responsible, through the engineer of record for the building, to provide on the architectural/construction drawings, information regarding the approved method of equipment anchoring to floors, wall and/or ceiling of the building. Any anchorage test required by local authority shall be the customer's responsibility. Stud type anchor bolts should not be specified as they hinder equipment removal for service. Consult with Philips service prior to specifying anchor methods. Philips equipment must be electrically isolated from anchorage.

3. Floor Loading and Surface
Philips provides, with this plan and specifications, information relative to size, weight and shape of floor mounted equipment. The customer shall be solely responsible, through the engineer of record for the building, to provide on the architectural/construction drawings confirmation of the structural adequacy of the floor upon which the equipment will be placed. Any load test required by local authority, shall be the customer's responsibility.
The floor surface upon which Philips equipment is to be placed/anchored shall be flat and level to within $\frac{1}{16}$" (2mm) over a length of 39" (1m).

4. Ceiling Support Apparatus
a. Philips provides, with this plan and specifications, information relative to size, weight and shape of ceiling supported equipment. The customer shall be solely responsible, through the engineer of record for the building, to provide on the architectural/construction drawings, information regarding the approved method of structural support apparatus, fasteners and anchorage to which Philips will attach equipment. Any anchorage and/or load test required by local authority shall be the customer's responsibility. Philips equipment must be electrically isolated from anchorage.

b. Contractor to clearly mark Philips equipment longitudinal centerline on bottom of each structural support.

c. The structural support apparatus surface to which Philips equipment is to be attached, shall have horizontal equipment attachment surfaces parallel, square and level to within .236" (6mm) per entire span.

d. Any drilling and/or tapping of holes required to attach Philips equipment to the structural support apparatus shall be the responsibility of the customer.

e. Fasteners/anchors (i.e., bolts, spring nuts, lock and flat washers) and strip closures shall be provided by the customer.

5. Lighting
Luminaires shall be placed in such a position that they are not obscured by equipment or its movement, nor shall they interfere with Philips ceiling rails and equipment movement or otherwise adversely affect the equipment. Such luminaire locations shall be the sole responsibility of the customer.

6. Ceiling Obstructions
There shall be no obstructions that project below the finished ceiling in the area covered by ceiling suspended equipment travel.

7. Seismic Anchorage (For Seismic Zones Only)
All seismic anchorage hardware, including brackets, backing plates, bolts, etc., shall be supplied and installed by the customer/contractor unless otherwise specified within the support legend on this sheet. Installation of electronic cabinets to meet seismic anchorage requirements must be accomplished using flush mounted expansion type anchor/bolt systems to facilitate the removal of a cabinet for maintenance. Do not use threaded rod/adhesive anchor systems. Consult with Philips regarding any anchor system issues. Philips equipment must be electrically isolated from anchorage.

8. Floor Obstructions/ Floor Coverings
There shall be no obstructions on the floor (sliding door tracks, etc.) in front of the Philips technical cabinets. Floor must be clear to allow cabinets to be pulled away from the wall for service.
Contractor to verify with Philips the preferred floor covering installation method.

9. Safety Factors
Ceiling loads as mentioned in the PRD are worst case loads and excluding safety factors. Proper safety factors need to be applied by Design Professional/Engineer of Record.

10. Stiffness Requirements of Ceiling
Horizontal Stiffness: preferred 10,000,000 Newton/meter - 57.1 klb/in, minimal 6,000,000 Newton/meter - 34.2 klb/in
Vertical Stiffness: preferred 10,000,000 Newton/meter - 57.1 klb/in, minimal 6,000,000 Newton/meter - 34.2 klb/in
Rotation Stiffness: minimal 20,000,000 Newtonmeter/Rad - 177,014 (klb in)/Rad
FlexArm: Max allowed deflection of ceiling structure is 2.1mm (FlexArm weight is 1250 kg and ceiling stiffness is 6,000,000 Newton/meter).

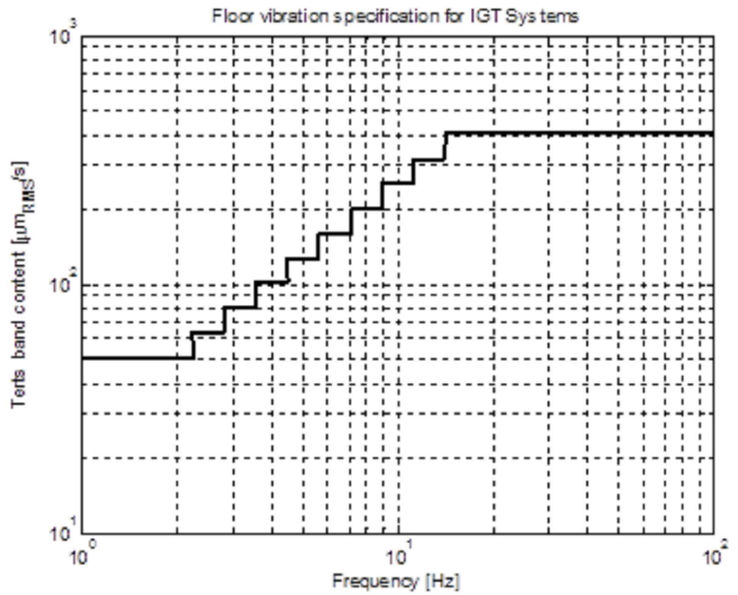
Equipment Support Information

11. Requirements for External Vibration
The maximum allowed external vibration level of floors and ceilings, to which the equipment is mounted that will not adversely affect the image quality, is specified in terms of RMS velocity levels in 1/3-octave or terts bands, as follows:

Center frequency [Hz]	1	1.25	1.6	2	2.5	3.15	4	5	6.3	8
Terts band value [µm/s] (RMS)	50.8	50.8	50.8	50.8	63.5	80.01	101.6	127	160	203.2
Center frequency [Hz]	10	12.5	16	20	25	31.5	40	50	63	80
Terts band value [µm/s] (RMS)	254	317.5	406.4	406.4	406.4	406.4	406.4	406.4	406.4	406.4
Center frequency [Hz]	100	125	160	200						
Terts band value [µm/s] (RMS)	406.4	406.4	406.4	406.4						

Terts Band Specification for External Vibrations

A graphical representation of this specification is given below:



Terts Band Specification for External Vibrations

Terts band spectra shall be calculated on the basis of time traces with a duration of 10 minutes (600 seconds), taken at representative locations and during representative times during working days.

(19.0)

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

SN

See S1 for Floor & Wall Support Layout

Notes:

1. Anchors for items that are installed/anchored by customer/contractor shall be provided by customer/contractor.
2. Anchors for items that are installed/anchored by Philips shall be provided by Philips. If customer's engineering documents specify anchors other than those listed in this document, the anchors shall be provided by customer/contractor and installed by Philips.
3. In all instances, the wall and/or floor support are the sole responsibility of the customer/contractor. The customer's architect/engineer of record shall specify wall and/or floor support sufficient for the bolt forces shown on the details.

See S2 for Ceiling Support Layout

Floor & Wall Support Legend

A Furnished and installed/anchored by Philips (exceptions may exist, see Note 2)
B Furnished and installed by customer/contractor and installed/anchored by customer/contractor
C Installed/anchored by customer/contractor
D Furnished by Philips and installed/anchored by contractor
E Existing
F Future
G Optional

	Item Number	Description	Detail Sheet
B	CY	Support in wall for Control Room Connection Box (CY)	SD3
A	CY	Anchors in wall for Control Room Connection Box (CY)	SD3
A	MQT	Maquet Table Floor Plate	SD1
B	CS	Anchors in wall for Cable Spool (Weight: 4.4 lbs; mount 39.3" above finished floor to bottom of cable spool)	AD5 SD5
B	SWCB	Surgery wall connection box (Weight: 18 lbs; mount 7.8" above finished floor to bottom of surgery wall connection box)	AD5 SD5
B	PDR	Personal Dose Meter Rack (Qty: 2)	SD5

Ceiling Support Legend

A Furnished and installed by Philips
B Furnished by customer/contractor and installed by customer/contractor
C Installed by customer/contractor
D Furnished by Philips and installed by contractor
E Existing
F Future
G Optional

	Item Number	Description	Detail Sheet
A	SP	2 - Philips FlexArm Rails	SD1
A	CD	Philips Cable Duct	SD1
B	UNI	Unistrut (P1000/P1001, P5500/P5501, or equivalent in meeting Philips ceiling requirements, geometry of channel and geometry of fixing block) - Bottom of Unistrut 1/4" (6mm) to 1/2" (13mm) Below Finished Ceiling	SD1

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

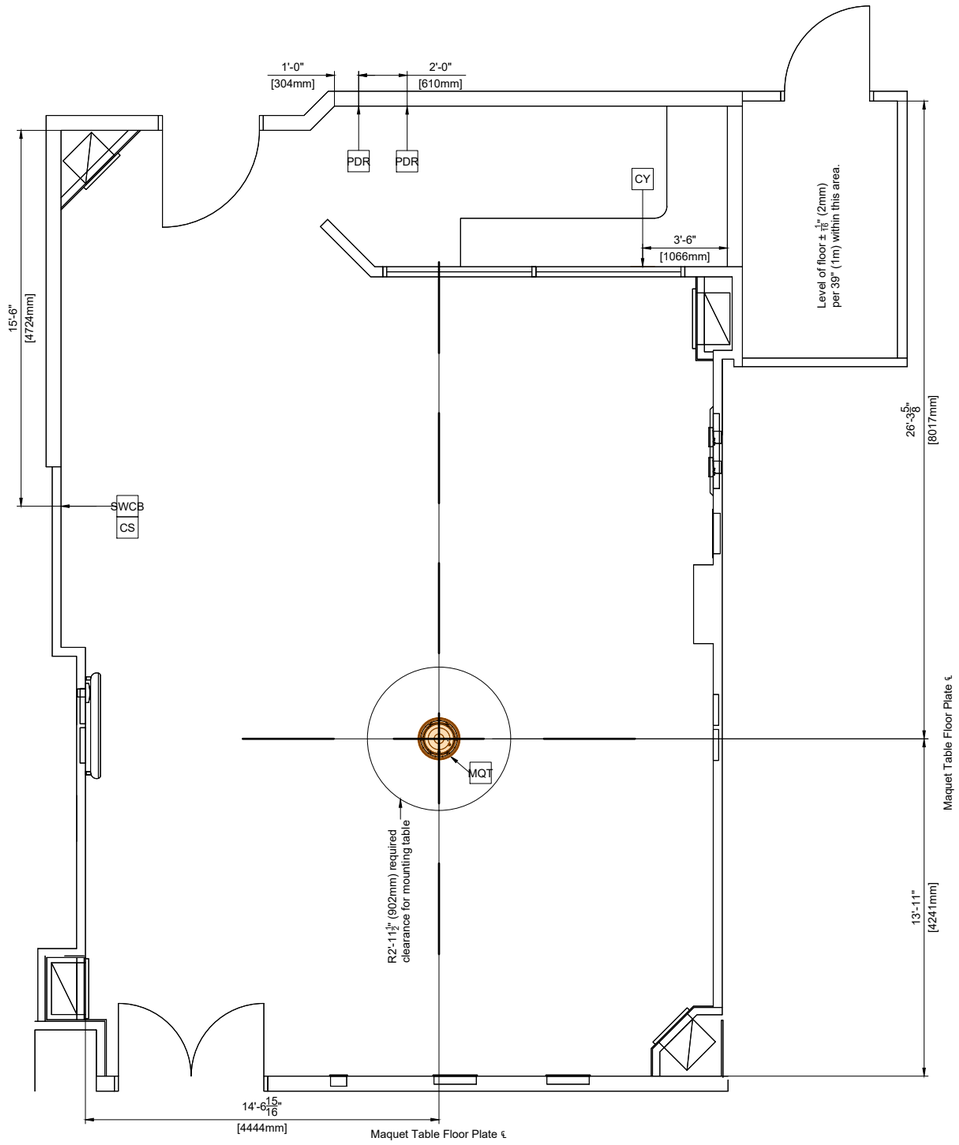
Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

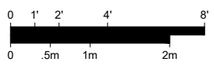
SL

Floor & Wall Support Layout

1:75

Required Unistrut Height: 9' - 6 $\frac{3}{16}$", +$\frac{3}{8}$" / -0 (2900mm, +10mm / -0)
Unistrut height measured from finished floor to bottom of Unistrut.





Refer to Floor/Wall Support Legend - Sheet SL

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

S1

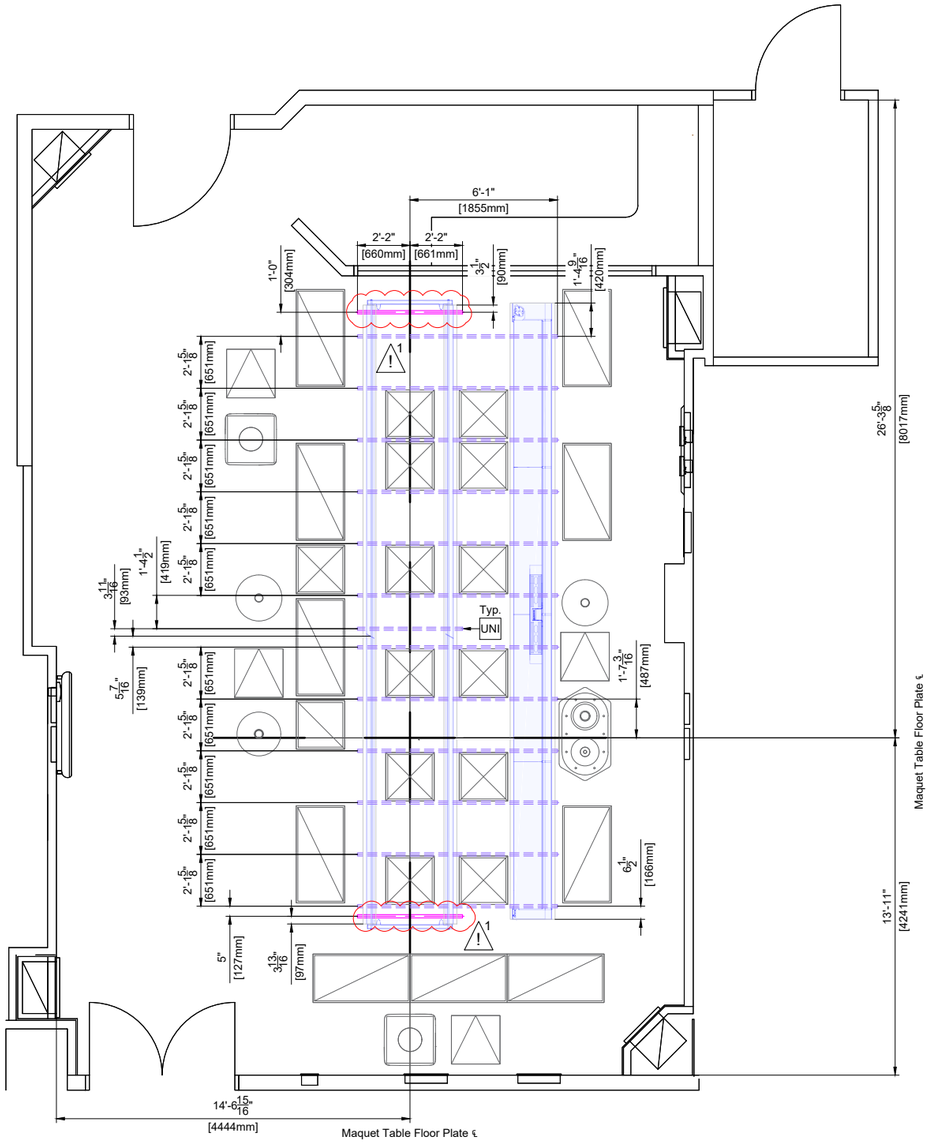
5.14.2019

THIS SHEET IS PART OF THE DOCUMENT SET LISTED ON SHEET C1 AND SHOULD NOT BE SEPARATED.

Ceiling Support Layout - Unistrut

1:75

Required Unistrut Height: 9' - 6 $\frac{3}{16}$", +$\frac{3}{8}$" / -0 (2900mm, +10mm / -0)
Unistrut height measured from finished floor to bottom of Unistrut.



Planning Issues and Considerations

⚠1 System shifted 2" plan North of provided CAD file in order to avoid conflict with placed unistrut and provided ceiling plan. Two (2) unistruts adjusted to meet system requirements. Shifted unistruts clouded in red.

General Notes

* System Ceiling Rails: Overhang max 5$\frac{7}{8}$" (150mm), distance between struts max 2'-3" (685mm) .
* Rail crossing: Distance between two struts supporting rail crossing max 11$\frac{13}{16}$" (300mm), distance between center rail crossing and either strut min 2" (50mm), max 5$\frac{7}{8}$" (150mm).
* Ceiling inlet cable duct must be supported by 2 struts.
* Hybrid cable duct (closed): Overhang min 9$\frac{13}{16}$" (250mm), max 1'-7$\frac{11}{16}$" (500mm) on the side where the strip rolls up and min 6$\frac{1}{2}$" (165mm), max 1'-4$\frac{3}{8}$" (415mm) at the other side.

0 1' 2' 4' 8'
0 .5m 1m 2m

Refer to Ceiling Support Legend - Sheet SL

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

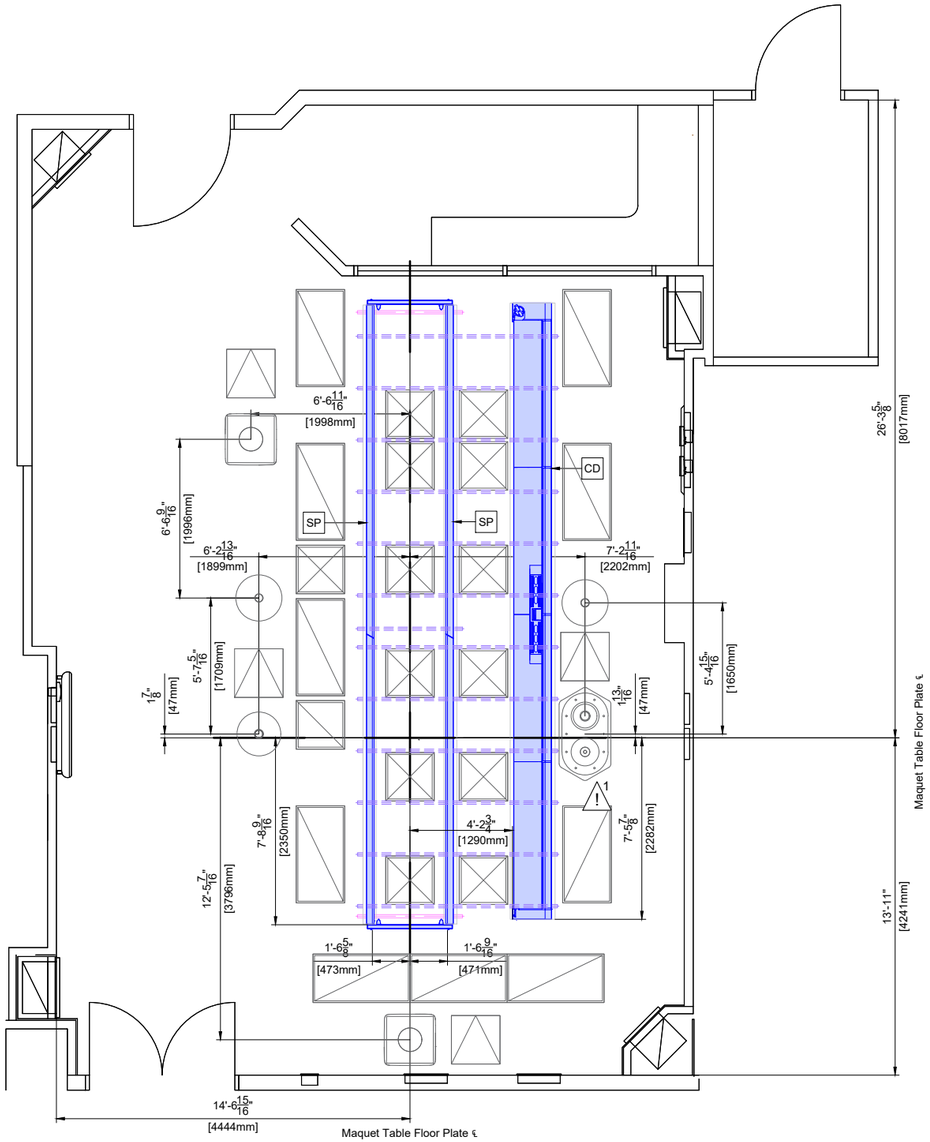
Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

S2

Ceiling Support Layout - Equipment

1:75

Required Unistrut Height: 9' - 6 $\frac{3}{16}$", +$\frac{3}{8}$" / -0 (2900mm, +10mm / -0)
Unistrut height measured from finished floor to bottom of Unistrut.



0 1' 2' 4' 8'
0 .5m 1m 2m

Refer to Ceiling Support Legend - Sheet SL

S3

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

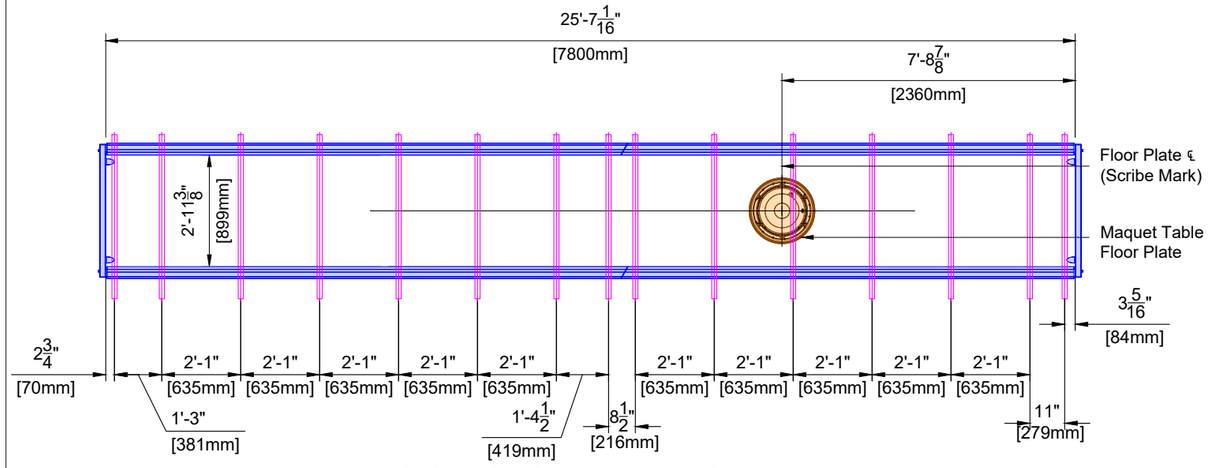
Project
Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

PHILIPS

5.14.2019

Detail - Structural Azurion 7 C20 FlexArm - 7800mm

(Not Site Specific)



27" (685mm) maximum allowed distance between unistrut

Floor plate supplied by Philips / installed by Contractor. Counterbored holes are sized for $\frac{1}{2}$" (12mm) anchors per Seismic requirements.

FlexArm
FlexArm Bearing Forces:
(Tension) Tmax = 2691 lbs/fixing block
(Shear) Vmax = 1227 lbs/fixing block

Maquet Table
Floor Plate to Floor Bolt Forces:
(Tension) Tmax = 2248 lbs/bolt

Note: The bearing force shown for the FlexArm is the maximum instantaneous equipment bearing load that can result from abusive use of the system. This force can occur at two locations (each fixing block) simultaneously on the same Unistrut (or equal) rail.
If seismic forces must be considered, please refer to the seismic calculation sheets provided by Philips for the specific system components.

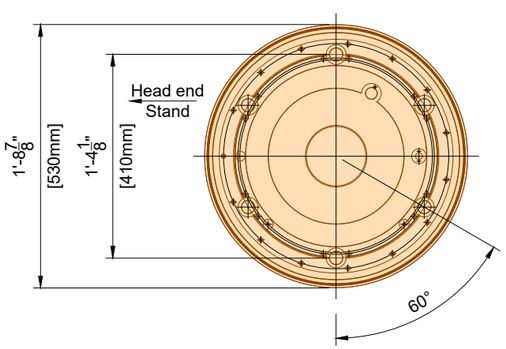
MQT SP

(19.0)

Detail - Maquet Floor Plate - Notes for Installation

(Not to scale)

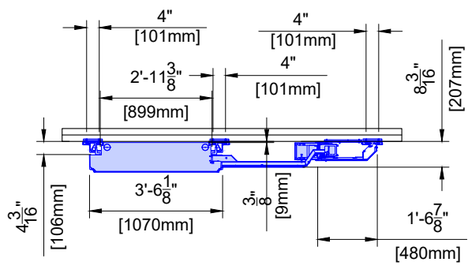
1. 1.18" (30mm) thick floor plate, surface mounted with top of slab.
2. Level within $\frac{1}{16}$" (1.5mm) across surface of plate.



MQT

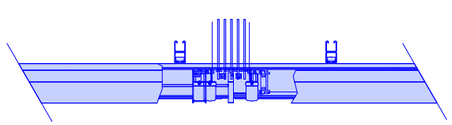
Detail - Clip Rail Spacing

(Not to scale)



Detail - Ceiling Inlet Detail

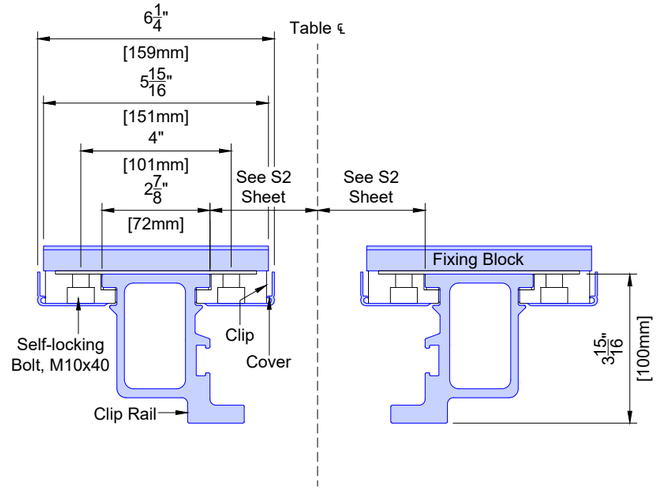
(Not to scale)



(19.0)

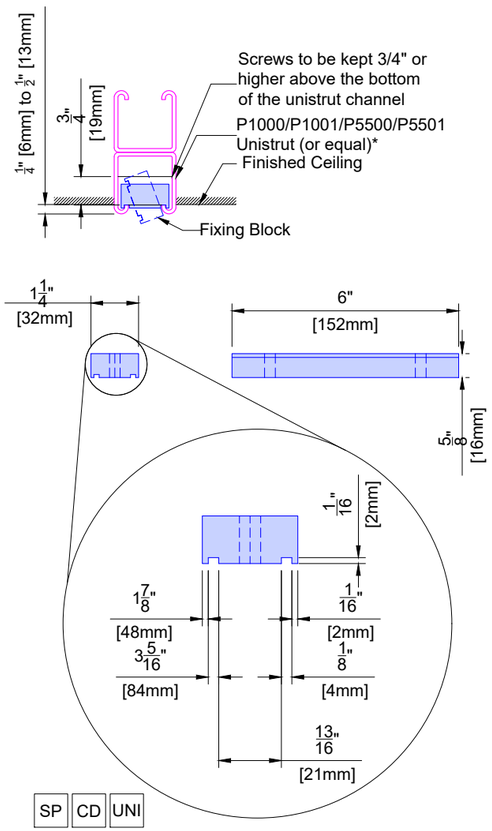
Detail - Clip Rail Cross-Section

(Not to scale)



Detail - Philips Fixing Block for Philips Ceiling Rails (Clip Rails)

(Not to scale)



SP CD UNI

General Requirements:
1. Philips does not specify the overhead equipment support structure. Unistrut may or may not be used. If Unistrut are used, it is up to Unistrut and the structural engineer for the project to determine which of its products are appropriate for each project.
2. *P1000/P1001/P5500/P5501 Unistrut or equivalent is specified. An equivalent may be used as long as it meets Philips ceiling requirements, geometry of channel, and geometry of fixing block to be installed inside unistrut.

Finished Ceiling Requirements:
1. Finished ceiling must **NOT** be lower than the bottom of the Unistrut in order to prevent damage to the finished ceiling during the installation of clip rails. Finished ceiling height to be mounted $\frac{1}{4}$" (6mm) to $\frac{1}{2}$" (13mm) above bottom of Unistrut.

Fixing Block Installation Requirements:
1. Nothing shall be attached to the Unistrut with any fastener that protrudes into the Unistrut which would interfere with positioning of the fixing block.
2. Fixing blocks for Philips ceiling rails (Clip rails) are designed to be installed in P1000/P1001/5500/5501 Unistrut.
3. The inside of the Unistrut must be clear of obstructions (including paint).

Unistrut Requirements:
1. Unistrut elements must be rigid and comply with the ceiling structure requirements. See SN sheet, line #4 "Ceiling Support Apparatus".
2. Welding Unistrut may warp Unistrut and deteriorate the structural integrity of the Unistrut. Consult the Structural Engineer of Record prior to welding any Unistrut.

(19.0)

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

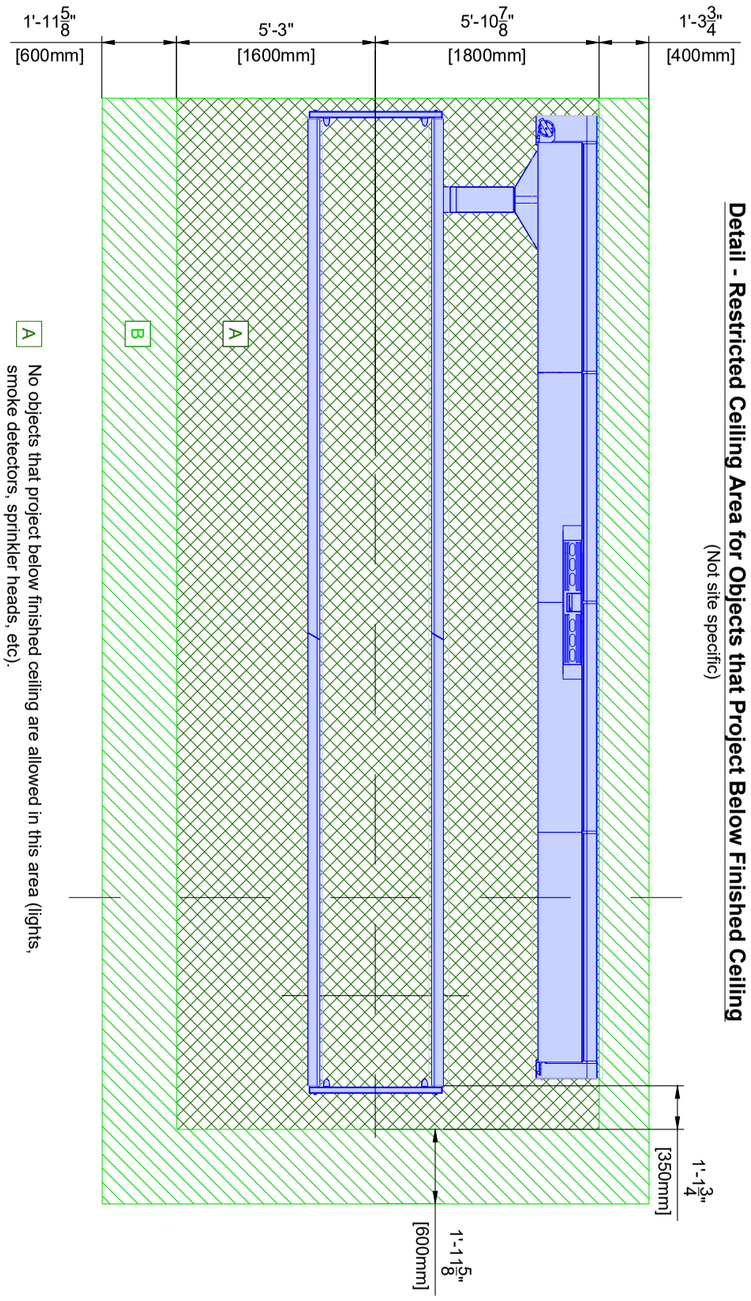
Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

SD1

Detail - Restricted Ceiling Area for Objects that Project Below Finished Ceiling

(Not site specific)



A — No objects that project below finished ceiling are allowed in this area (lights, smoke detectors, sprinkler heads, etc).

B — All objects placed 4 1/2" (114mm) or less below ceiling are clear, but all objects placed past 4 1/2" (114mm) require an elevation check before installation.

(19.0)

SD2

Project Details	Philips Contacts	Project
Drawing Number **N-CAN170118 K** **Date Drawn: 3/31/2020** Quote: 1-218LNZ1 Rev. 3 Order: None	Project Manager: Ty Galloway Contact Number: (416) 315-6920 Email: ty.galloway@philips.com Drawn By: Chris Falkinburg	**Azurion 7 C20 FlexArm - 7800mm - ORT** **Sunnybrook Health Sciences Centre** Toronto, ON Room: M2285

PHILIPS

5.14.2019

Pre-Evaluated and -Approved Anchor Reference List for Philips Installers

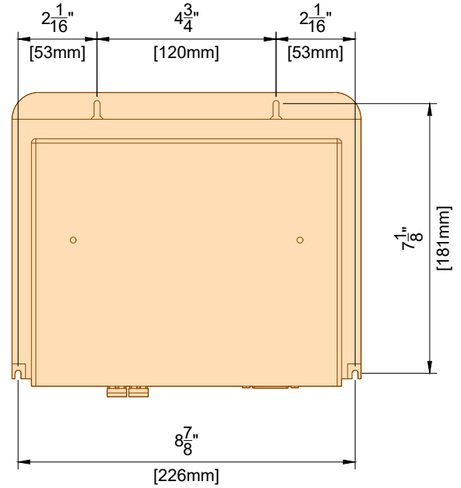
Anchors for items that are installed/anchored by customer/contractor shall be provided by customer/contractor. Anchors for items that are installed/anchored by Philips shall be provided by Philips. If customer's engineering documents specify anchors other than those listed below, the anchors shall be provided by customer/contractor and installed by Philips. In all instances, the wall and/or floor support are the sole responsibility of the customer/contractor. The customer's architect/engineer of record shall specify wall and/or floor support sufficient for the bolt forces shown on the details.

Equipment	Option	Anchor Style (provided by Philips)	Anchor Size (provided by Philips)	Qty.	Support Size & Material (provided & installed by customer/contractor)
Control Room Connection Box (CY)	A	Round Phillips Head Self Drilling Screws	#10-16 x 1 $\frac{1}{2}$" (38mm) L	3	Drywall with minimum 20 gauge Steel backing
	B	SPAX Multipurpose flat head screw	#10 x 1 $\frac{1}{2}$" (38mm) L	3	Drywall with minimum 20 gauge Steel backing
	C	Toggler Snaptoggle and (round head screws)	#BA and (#10-24 x 2 $\frac{1}{2}$" (63.5mm) L)	3	Minimum $\frac{5}{8}$" (16mm) Drywall

(16.0)

Detail - Video Connection Box - Hole Pattern for Mounting

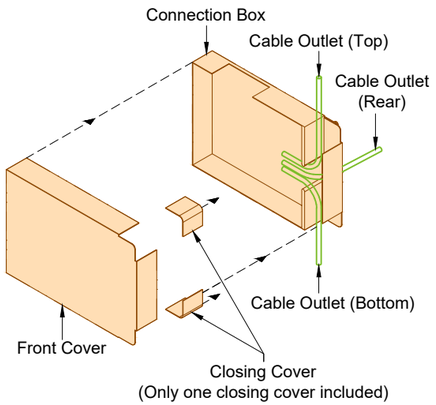
(Not to scale)

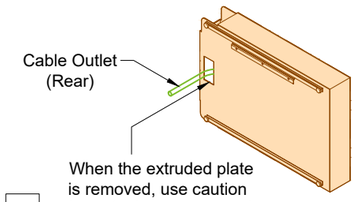


(16.0)

Detail - CY - Cable Outlets

(Not to scale)



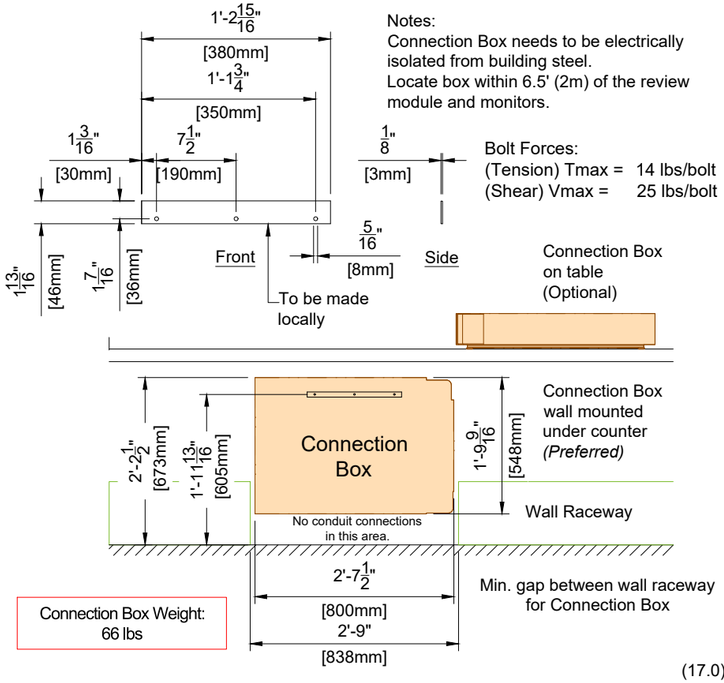


CY

(16.0)

Detail - CY - Wall Mount Template

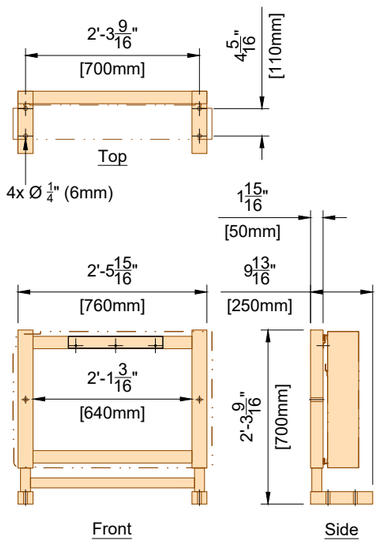
(Not to scale)



(17.0)

Detail - CY Support Frame Option

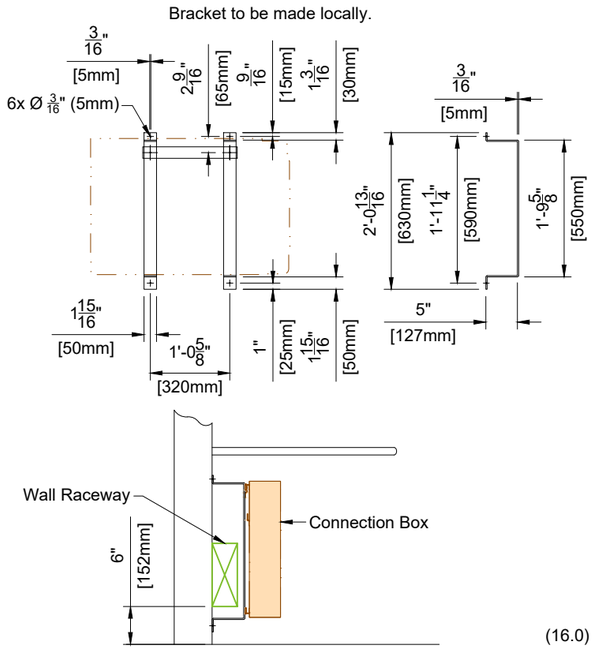
(Not to scale)



(16.0)

Detail - CY - Bracket Mount Option

(Not to scale)



(16.0)

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
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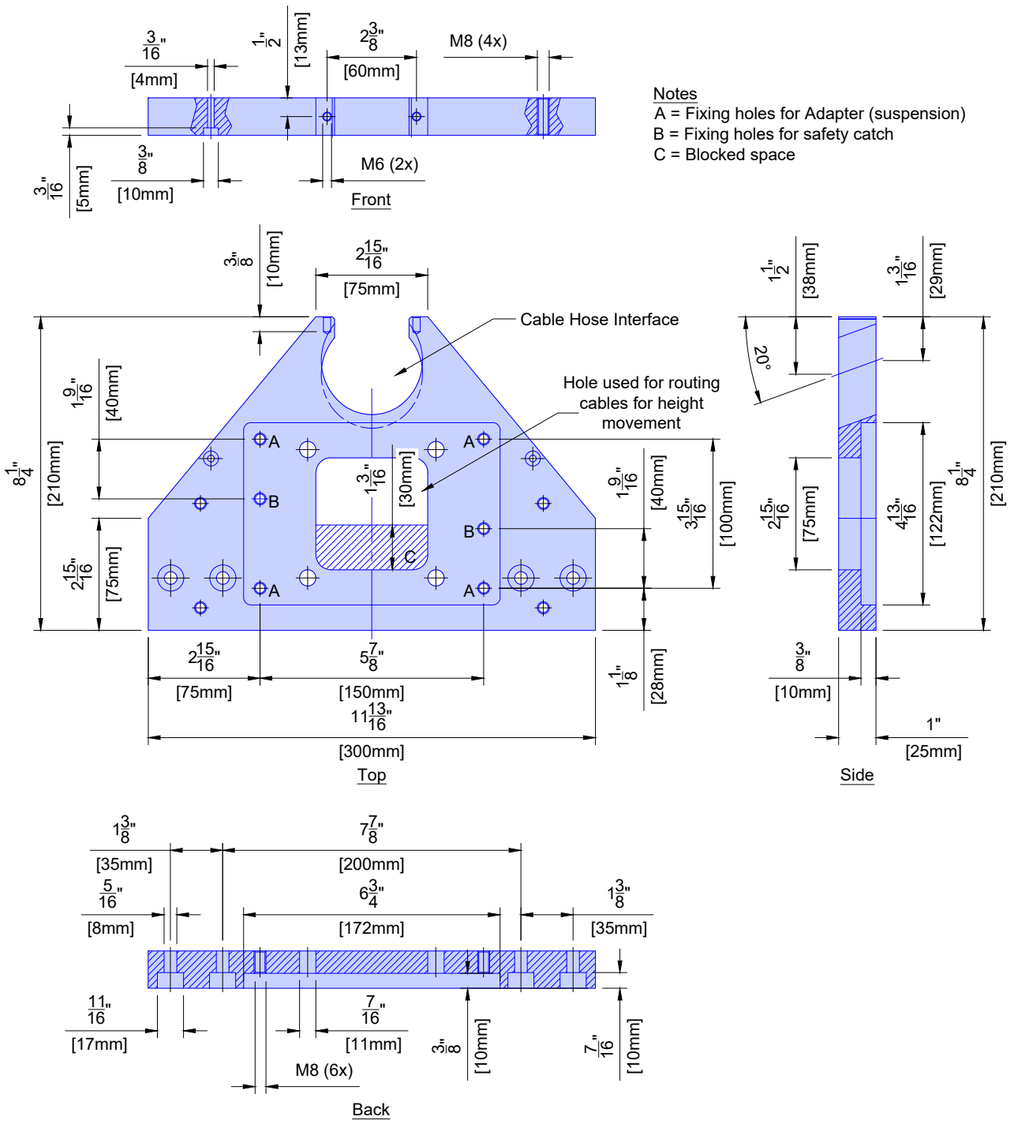
Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

SD3

Detail - Interface Plate - No MCS with 58" FlexVision Monitor

(Not to scale)



(15.0)

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
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Project Details
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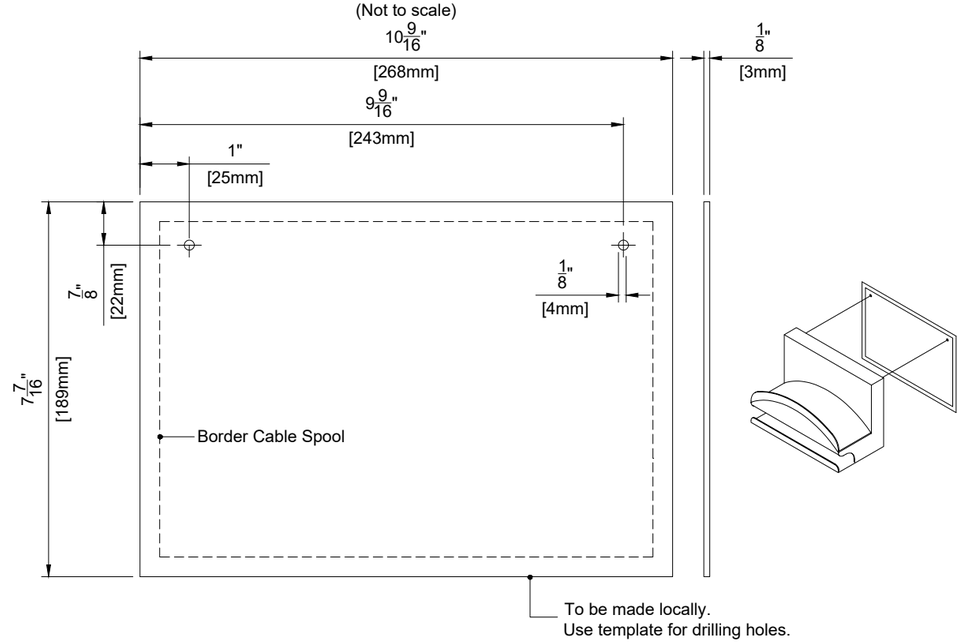
Quote: 1-218LNZ1 Rev. 3
Order: None

SD4

Detail - Cable Spool Template

(Not to scale)

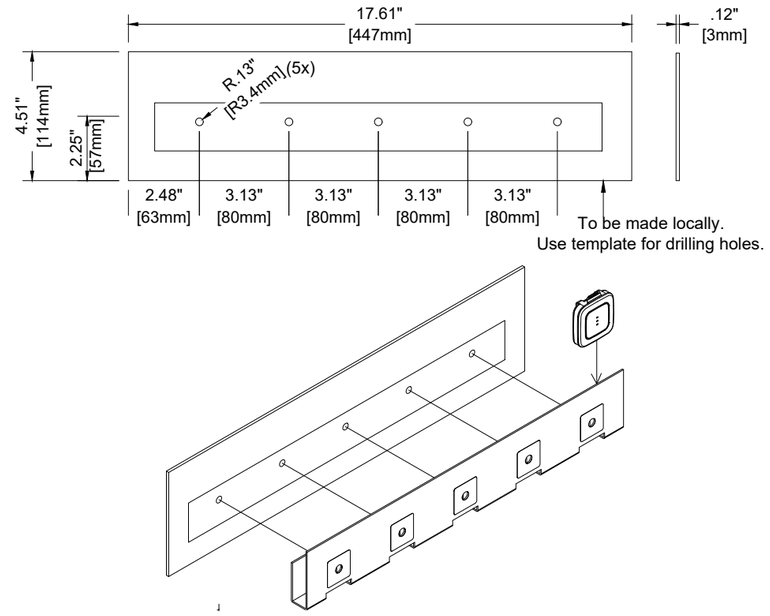


CS

(19.0)

Detail - Personal Dose Meter Template

(Not to scale)

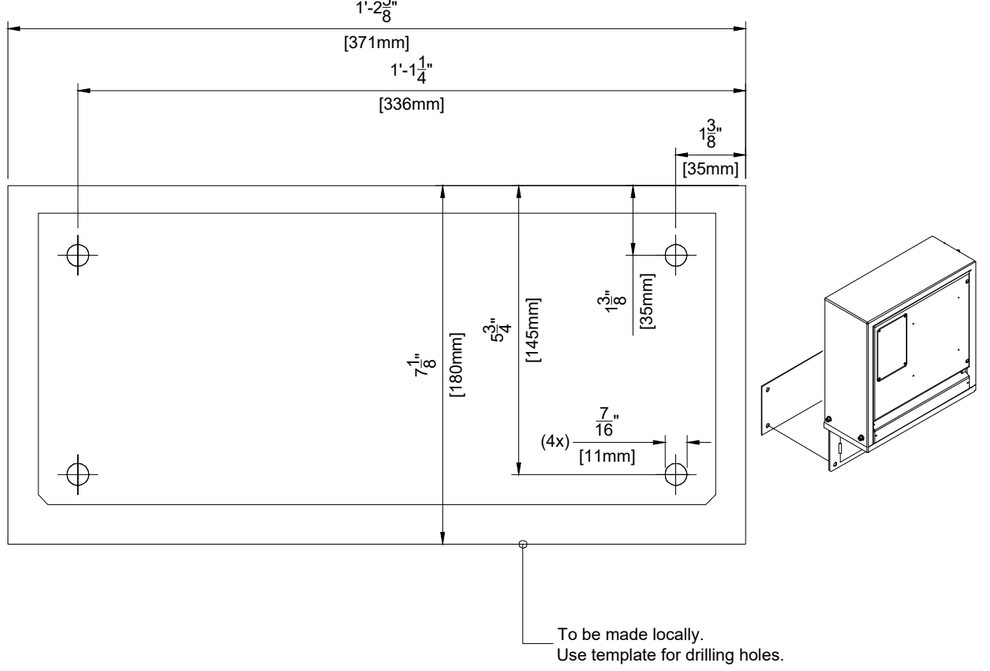


PDR

(15.0)

Detail - Surgery Wall Connection Box Template

(Not to scale)



SWCB

(19.0)

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Order: None

SD5

Emergency Power

Philips does not require equipment to be on emergency power. If the customer deems it necessary for the equipment to be supplied with emergency power, the following specifications must be applied:

The Mains 40E cabinet feeding an Azurion system will have an absolute peak current of <=300A @480V. Maximum momentary current <=80 Arms per phase when averaged over a 5-second window. Note that during acquisition, the current harmonics (including sub- and inter-harmonics) up to 1 kHz can be substantial. Account for : 30% for the mains frequency +/- the frame speed, up to 20% for the 5th harmonics, up to 10% for the 7th harmonics.

To reduce the emergency power generator load demand, Philips equipment can be put into a lower power mode of operation by the connection of a potential free closure, normally open contact, from the transfer switch. This potential free, normally open contact, has to be rated for 24VDC/100mA. For Philips cardio/vascular Azurion equipment, the two wires from this contact have to be routed to the equipment area and connected to the System Coordinator cabinet (MA).

Maximum differential mode induced disturbance voltage on these wires shall be a <3V peak at al frequencies. Maximum common mode current on these wires shall be less than 3 micro-amp at frequencies between 30-1000MHz to meet EMC regulations.

For systems delivered to site before Jan 2016 or with SIB (system interface box) 4522163320978. When this interface is used a Sub-D capacitive filter adapter with 5.6nF between pins and chassis shall be placed on X14 of the SIB input in the MA-cabinet (e.g. Amphenol FCE17B25AD290).

(19.0)

Electrical Requirement Notes for Systems with Mains 40E Cabinet

Electrical power distribution at the facility shall comply with:

Utilization voltages per ANSI C84.1 - 2006 range A.

Voltage to be supplied is 3 phase, Wye or symmetric Delta 3-line +PE.

Phase conductors to be sized for instantaneous voltage drop per NEC 517.73 and Philips recommendations.

All Philips equipment is grounded via the equipment insulated ground wire. Metal raceway bonding shall be used as a secondary ground fault return path only for the supply mains to the equipment. The raceway system ground and isolated equipment ground shall be bonded together via the ERB terminal jumpers.

The Philips system has a private ground domain per clause 250.96B of the NEC. The raceway from the X-ray breaker (CB) to the Mains 40E Cabinet shall be supplemented by an internal insulated equipment grounding conductor installed in accordance with clause 250.146(D) of the NEC. The Azurion equipment ground domain and the branch circuit ground domain are bonded together in the ERB via a ground bonding jumper.

ANSI / NFPA 70 - National Electrical Code
Article 250 - Grounding
Article 517 - Healthcare Facilities
ANSI / NFPA 99 - Healthcare Facilities
NEMA standard XR9: 1984-R2000 - Power Supply Guideline for X-ray Machines

Power Quality Guidelines

1. Power supplied to medical imaging equipment must be separate from power feeds to air conditioning, elevators, outdoor lighting, and other frequently switched or motorized loads. Such loads can cause waveform distortion and voltage fluctuations that can hinder high quality imaging.
2. Equipment that utilizes the facility power system to transmit control signals (especially clock systems) may interfere with medical imaging equipment, thus requiring special filtering.
3. The following devices provide a high impedance, nonlinear voltage source, which may affect image quality: Static UPS systems, Series filters, Power conditioners, and Voltage regulators.
Do not install such devices in the supply mains branch circuit of the Azurion system without consulting Philips installation or service personnel.
4. Line impedance is the combined resistance and inductive reactance of the electrical system and includes the impedance of the power source, the facility distribution system, and all phase conductors between the source and the imaging equipment. Philips publishes recommended conductor sizes based on equipment power requirements, acceptable voltage drops, and assumptions about the facility source impedance. The minimum conductor size is based on the total line impedance and NEC requirements. Unless impedance calculations are performed by an electrical engineer, the recommended values must be used.

(16.0)

General Electrical Information

1. General
The customer shall be solely responsible, at its expense, for preparation of the site, including any required electrical alterations. The site preparation shall be in accordance with this plan and specifications, the architectural/construction drawings and in compliance with all safety and electrical codes, the customer shall be solely responsible for obtaining all electrical permits from jurisdictional authority.

2. Materials and Labor
The customer shall be solely responsible, at its expense, to provide and install all electrical ducts, boxes, raceways (conduits, wireways, auxiliary gutters etc.), fittings, bushing, etc., As separately specified herein.

3. Electrical Ducts and Boxes
Electrical ducts and boxes shall be accessible and have removable covers. Floor ducts and boxes shall have watertight covers. Ducts shall be divided into as many as four separate channels by metal dividers, separately specified herein, to separate wiring and/or cables into groups as follows: Group A: Branch circuit equipment supply mains power wires together with the branch circuit isolated equipment bonding wire. Group B: Equipment Secondary Circuit AC supply and associated isolated ground cable/wire harnesses. Group C: Equipment signal wires and cable harnesses plus equipment low-voltage DC supply cable/wire harnesses. Group D: X-Ray high-voltage cables, the use of 90 deg. ells is not acceptable. On ceiling duct and wall duct use 45 deg. bends at all corners. All intersecting points in duct to have cross over tunnels supplied and installed by contractor to maintain separation of cables based on 725.136 for low voltage signaling cables and conductors and 517.80 for communications and signaling cables in health care applications. Secondary circuits of transformer powered communications and signaling systems are not required to be enclosed in raceways unless otherwise specified by Chapter 7 or Chapter 8. All wire harnesses of the Azurion system are required to be run in a raceway (wireway) dedicated to Azurion wire harnesses. No foreign wiring shall be run in the same wireway together with the Azurion wire harnesses. Separation between Group A and other groups is mandatory along the full run of group A wires. Separation between groups B, C, and D is recommended for the first 3 meters behind the equipment cabinets and for the locations where wire-harness over-length is suspended.

4. Raceways (Conduit)
Raceway (Conduit) point - to - point runs shall be as direct as possible. Empty conduit runs used for cables may require pull boxes located along the run. Consult with Philips. A pull wire or cord shall be installed in each conduit run. Best practice to name the physical conduit. All conduits which enter duct prior to their termination point must maintain separation from other cables via use of dividers, cross over tunnels, or conduit supplied and installed by contractor from entrance into duct to exit from duct. Do not use flex conduit unless approved by Philips Service.

5. Conductors
All conductors, separately specified, shall be 90°C stranded copper, rung out and marked.

6. Disconnecting Means
A disconnecting means shall be provided as separately specified.

7. Warning Lights and Door Switches
"X-ray on" warning lights and x-ray termination door switches should be provided at all entrances to x-ray rooms as required by code.

8. Dimmer Switches
X-ray room lights should be provided with dimmer switches.

(19.0)

Electrical Notes

1. The contractor will supply & install all breakers, shunt trip and incoming power to the breakers. The exact location of the breakers and shunt trips will be determined by the architect or contractor.

2. The contractor shall supply & install all pull boxes, raceway runs, stainless steel covers, etc. Conduit/raceways must be free from burrs and sharp edges over its entire length. A Greenlee pull string/measuring tape (part no. 435, or equivalent) must be provided with raceway runs to validate runs are within length restrictions.

3. All pre - terminated, cut to length cables, will be supplied and installed by Philips. All cables and conductors to the equipment supply mains branch circuit breaker shall be supplied and installed by the contractor, subject to local arrangements.

4. Provide and install 50mm diameter chase nipples between adjacent wall boxes.

5. Electrical raceway ducts shall be installed with removable covers. The raceway should be accessible for the entire length. In case of non - accessible floors, walls and ceilings, an adequate number of access hatches should be supplied to enable installation of cabling. Approved raceways may be substituted. All raceways will be designed in a manner that will not allow cables to fall out of the raceway when the covers are removed. In most cases, this will require above - ceiling raceway to be installed with the covers removable from the top. Raceway systems as illustrated on this drawing are based upon length of furnished cables. Any changes in routing of raceway systems could exceed maximum allowable length of furnished cables. Conduits or raceways installed above ceilings must be kept as near as practicable to finished ceilings and still permit accessibility.

6. Raceway sizes shall be verified by the architect, electrical engineer or contractor, in accordance with local or National Electrical Code, whichever govern.

7. Convenience outlets are not shown on the plans. Their number and location are to be specified by the customer/architect.

8. Electrical contractor shall install grounding and bonding conductors at raceway openings within wall boxes as required by national and local electrical codes. Ground bond wires and lugs shall be installed in such a way to prevent the inadvertent contact with the installed Philips equipment to maintain Philips isolated ground scheme and maintain patient safety.

9. Install an insulated stranded ground wire per feeder/conductor size from the Main Disconnect (CB) to the ERB (recommended size 4 AWG) and from the ERB to the Mains 40E Cabinet (recommended size 4 AWG).

10. Philips equipment must be electrically isolated from conduits, raceways, ducts, seismic anchoring, floor anchoring, etc.

(18.0)

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
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Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

EN

Electrical Legend

A Furnished and installed by Philips
B Furnished by customer/contractor and installed by customer/contractor
C Installed by customer/contractor
D Furnished by Philips and installed by contractor
E Existing
F Future
G Optional

Item Number | Description | Detail Sheet

Wall

		Description	Detail Sheet
B	CB	480V, 3 phase, Type D 80 A circuit breaker with long-time delay and shunt trip (e.g. Square D HDL36080 or equivalent). Run power from breaker to "MA", leaving an 8' (2440mm) tail at "MA". See Sheet "ED1" for power quality requirements. Location per local code or owner requirements.	ED1
B	ST	Shunt Trip (emergency off) - Large mushroom-head button on remote control station with contacts to operate feature of "CB" (if required by local code or owner, and mandatory for VA and D.O.D installations). (Not shown on plan)	
B	GE	Ground electrode (Base building ground) per NEC 250-26 (CSA), building steel preferred. (Not shown on plan)	
B	ERB	Equi-Potential Reference Bar mounted in a 12" (305mm) W x 12" (305mm) H x 4" (105mm) D pull box with hinged cover, surface mounted to the bottom of "WR2" when possible.	ED2
D	ME, MR, MA, MB	19 $\frac{1}{4}$" (490mm) W x 67" (1705mm) H x 4" (105mm including rubber isolation strips) D flanged-edge terminal back box, surface mounted 82" (2085mm) A.F.F. to top of box.	ED3
B	CY, WM, VB1, VB2, VB6	Grommet opening on "WR3". Approximate location shown is recommended and may be changed - verify relocation with local Philips Service.	
B	VB3, VB4, VB7	4" (105mm) W x 4" (105mm) H x 4" (105mm) D pull box with removable screw-type cover plate, flush mounted. Exact height to be determined. Verify location with local Philips Service.	
B	WR1, WR2	10" (255mm) W x 4" (105mm) D wall raceway, surface mounted with removable screw-type cover plate. "WR1" is at 5" (130mm) A.F.F. to bottom of raceway. "WR2" is at 82" (2085mm) A.F.F. to bottom of raceway.	ED3
B	WR3	10" (255mm) W x 3 $\frac{1}{2}$" (90mm) D wall raceway, surface mounted with removable screw-type cover plate. "WR3" is at finished floor. "WR3" may need to be cut at the location of the "CY" connection box.	ED3
B	ATY	Auxiliary Box - 6" (155mm) W x 6" (155mm) H x 4" (105mm) D wall box, flush mounted 70" (1780mm) A.F.F. to the bottom of the box with removable screw-type cover plate. Height and location shown are recommended and may be changed - verify height and relocation with local Philips Service.	
B	DS	Door Switch - 120V/5A switch limited to open when door is open. Mount in upper corner on strike side of main entry door(s) (Cooper no. 1665 or equivalent), if required by local code or physicist of record. See Sheet "ED3" diagram for connection details. (Not shown on plan)	ED3
B	WL	Warning Light - Provide a surface or flush mounted light fixture above door to indicate when X-ray is on, if required by local code or physicist of record. (Not shown on plan)	ED3
D	PSU	Stationary Transformer Unit.	
B	SWCB	8" (205mm) W x 8" (205mm) H x 4" (105mm) D pull box with removable screw-type cover plate, flush mounted 8" (205mm) above finished floor to bottom of the box. Location shown is recommended and may be changed - verify relocation with local Philips Service. A cable spool is provided to drape the 26.24' (8m) cable to the pedestal.	
B	VB11, VB12	6" (155mm) W x 6" (155mm) H x 4" (105mm) D pull box with removable screw-type cover plate, flush mounted. Exact height to be determined. Location shown is recommended and may be changed - verify relocation with local Philips Service. LCD on cart must remain within 25' (7.62m) of "VB11 and VB12".	

Electrical Legend

A Furnished and installed by Philips
B Furnished by customer/contractor and installed by customer/contractor
C Installed by customer/contractor
D Furnished by Philips and installed by contractor
E Existing
F Future
G Optional

Item Number | Description | Detail Sheet

Floor

		Description	Detail Sheet
D	MQT	12" (305mm) W x 12" (305mm) L x 5" (130mm) D floor box, under the floor with a 4" (105mm) core drill up to the underside of the Maquet floor plate. Floor box to be confirmed with Maquet representative (box size may vary depending on site conditions).	

Ceiling

		Description	Detail Sheet
B	SP	18" (460mm) W x 18" (460mm) L x 6" (155mm) D ceiling box, flush mounted with removable screw-type cover plate. Provide one 3" (80mm) diameter knockout.	
B	TV, VB8, VB9, DBS	18" (460mm) W x 18" (460mm) L x 6" (155mm) D ceiling box, mounted above finished ceiling with removable screw-type cover plate. Provide a 2 $\frac{1}{2}$" (65mm) round cutout. (Not shown on plan) VB8 and VB9 to be mounted on back of FlexVision monitor. "DBS" to be mounted on back of FlexVision monitor.	
B	TV2, TV3	6" (155mm) W x 6" (155mm) H x 4" (105mm) D ceiling box, above finished ceiling. Location to be determined, verify location with local Philips Service.	
B	TV5	6" (155mm) W x 6" (155mm) H x 4" (105mm) D pull box. Location to be determined, verify location with local Philips Service.	
B	VB5, VB10	6" (155mm) W x 6" (155mm) H x 4" (105mm) D ceiling box, above finished ceiling. Location to be determined, verify location with local Philips Service.	

Duplexes

		Description	Detail Sheet
B	S	120V/20A dedicated duplex outlet for service in the equipment room. (Not shown on plan)	
B		120V/20A dedicated duplex outlet for each of the Video Connection Boxes. Verify electrical requirements for customer provided equipment.	
G	250	250V/30A dedicated duplex outlet for optional third party equipment (e.g. Spectranetics Laser - Not shown on plan).	
B		120V/20A dedicated duplex outlet for IVUS (CORE Mobile IVUS). (May be combined with Pedestal Injector. Field to verify.)	
B		120V/20A dedicated duplex outlet for Pedestal Injector. (May be combined with CORE Mobile IVUS. Field to verify.)	
B	1	120V/20A dedicated power supply for third party monitor.	
B		120V/20A duplex outlets (qty: 2) for "TV2" and Wall Connection Boxes.	

Network Connectors

		Description	Detail Sheet
B	N1	RJ45 type Ethernet 10/100/1000 Mbit network connector with access to customer's network. Locate within 10' (3050mm) of network card. Network fiber optic and Ethernet cabling, connectors, wall boxes, patch panels, etc. are the responsibility of the purchaser. Philips assumes no responsibility for procurement, installation, or maintenance of these components.	
B	N2	RJ45 type Ethernet 10/100/1000 Mbit network connector. Access to customer's network via their remote access server is needed for Remote Service Network (RSN) connectivity.	N1

See E1 - E3 sheets for conduit and raceway requirements.

PHILIPS

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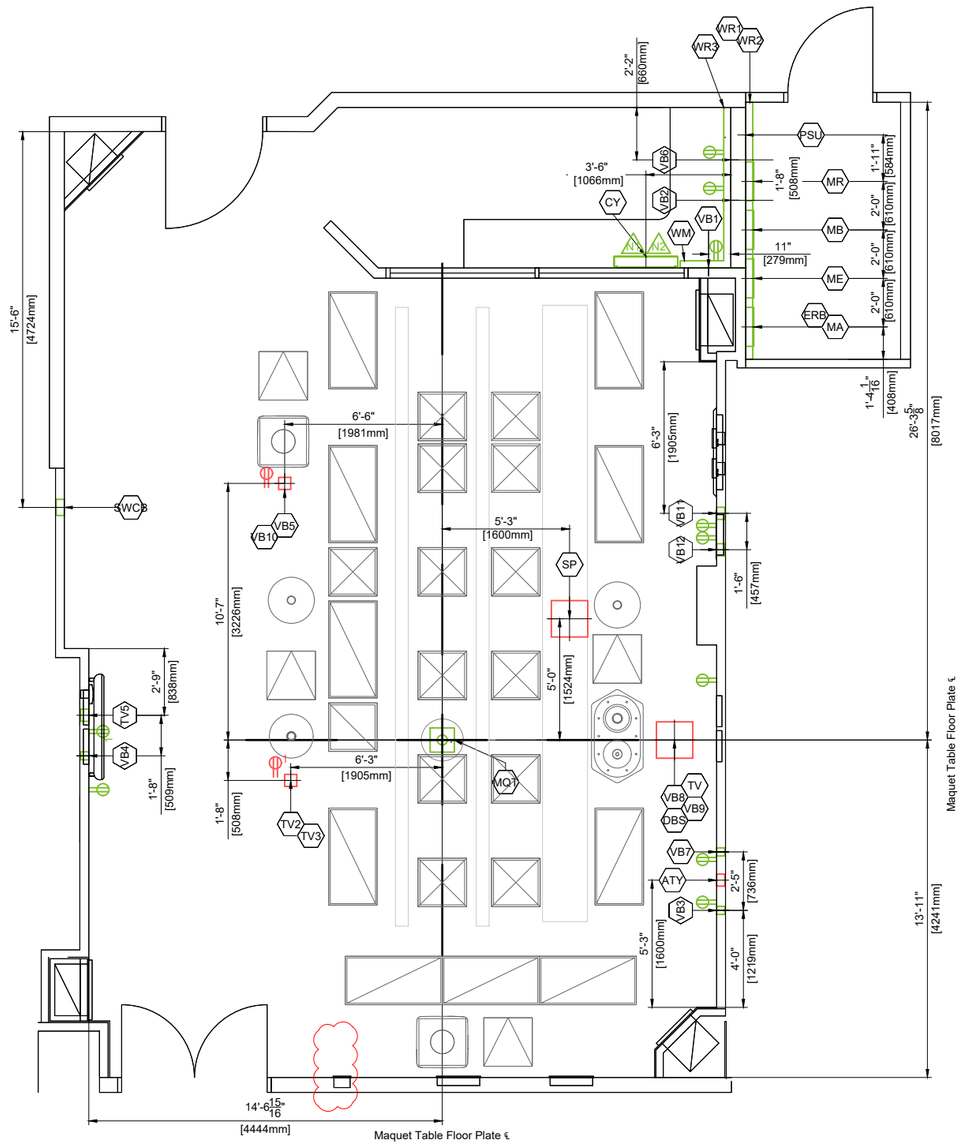
Order: None

EL

Electrical Layout

1:75

Required Unistrut Height: 9' - 6 $\frac{3}{16}$", +$\frac{3}{8}$" / -0 (2900mm, +10mm / -0)
Unistrut height measured from finished floor to bottom of Unistrut.



Exact location to be coordinated by Customer and local Philips service.

0 1' 2' 4' 8'
0 .5m 1m 2m

Refer to Electrical Legend - Sheet EL and Raceway/Conduit - Sheet E2

PHILIPS

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Order: None

E1

5.14.2019

Raceway (Conduit) Required

General Notes

1. All raceway (conduit) runs must take most direct route point to point.
2. A Greenlee pull string/measuring tape (part no. 435, or equivalent) must be provided with raceway (conduit) runs

A Raceway (Conduit) supplied/installed by contractor - Philips cables installed by Philips
B Raceway (Conduit) supplied/installed by contractor - Philips cables installed by contractor
C Raceway (Conduits) and cables supplied and installed by contractor
D Raceway (Conduit) existing - cables supplied and installed by Philips
E Raceway (Conduit) existing - cables supplied by Philips and installed by contractor
F Raceway (Conduit) existing - cables supplied and installed by contractor
G Optional equipment, verify with local Philips Service

* **P** Power (AC), **D** Power (DC), **G** Ground, **S** Signal, **H** High Tension, **C** Cooling Hose, **A** Air Supply Hose

	Raceway (Conduit) Run No.	From	To	Raceway (Conduit) Quantity	Cable Type (*)	Minimum Raceway (Conduit) Size	Maximum (Raceway) Conduit Length	Special Requirements
A	31	MB	WM	1	S	1 1/2"	82'	For FlexSpot. Via Raceway.
A	32	TV	MA	1	P	1 1/2"	52'	
A	33	TV	MA	1	S	2 1/2"	52'	
A	34	TV	MR	1	P	2"	52'	
A	35	TV	MB	1	S	1 1/2"	52'	For FlexVision XL.
A	36	TV	MB	1	P/G	1 1/2"	52'	
A	37	TV	WM	1	S	3/4"	65'	For Intercom.
A	38	VB1	MB	1	S	1"	82'	Via Raceway.
A	39	VB2	MB	1	S	1"	82'	Via Raceway.
A	40	VB3	MB	1	S	1"	82'	
A	41	VB4	MB	1	S	1"	82'	
A	42	VB5	MB	1	S	1"	82'	
A	43	VB6	MB	1	S	1"	82'	Via Raceway.
A	44	VB7	MB	1	S	1"	82'	
A	45	VB10	MB	1	S	1"	82'	
A	46	VB3	CY	1	S	1"	91'	
A	47	VB4	CY	1	S	1"	91'	
A	48	VB5	CY	1	S	1"	91'	
A	49	VB6	CY	1	S	1"	91'	
A	50	VB7	CY	1	S	1"	91'	
A	51	VB10	CY	1	S	1"	91'	
C	52	TV2	MB	1	S	2 1/2"	82'	Live/reference monitors. TV3 to be run in same conduit.
A	53	VB11	MB	1	P	1 1/2"	55'	Monitor on Cart.
A	54	VB11	MB	1	S	1 1/2"	55'	Monitor on Cart.
A	55	VB12	MB	1	P	1 1/2"	55'	Monitor on Cart.
A	56	VB12	MB	1	S	1 1/2"	55'	Monitor on Cart.
A/C	57	TV	WR3	2	S	1 1/2"	-	For equipment (IE. Physio Monitor/ Slave Monitor/ VBs on back of FlexVision)
C	58	TV5	MB	1	S	2 1/2"	82'	Live/reference monitors.

Raceway (Conduit) Required

General Notes

1. All raceway (conduit) runs must take most direct route point to point.
2. All raceway (conduit) runs must have a pull string.

A Raceway (Conduit) supplied/installed by contractor - Philips cables installed by Philips
B Raceway (Conduit) supplied/installed by contractor - Philips cables installed by contractor
C Raceway (Conduits) and cables supplied and installed by contractor
D Raceway (Conduit) existing - cables supplied and installed by Philips
E Raceway (Conduit) existing - cables supplied by Philips and installed by contractor
F Raceway (Conduit) existing - cables supplied and installed by contractor
G Optional equipment, verify with local Philips Service

* **P** Power (AC), **D** Power (DC), **G** Ground, **S** Signal, **H** High Tension, **C** Cooling Hose, **A** Air Supply Hose

	Raceway (Conduit) Run No.	From	To	Raceway (Conduit) Quantity	Cable Type (*)	Minimum Raceway (Conduit) Size	Maximum (Raceway) Conduit Length	Special Requirements
C	1	Power Panel	CB	1	P	Per N.E.C.	Per N.E.C.	
C	2	CB	MA	1	P	2 1/2"	50'	MA CRC Terminal Block can only accept 4 AWG.
C	3	CB	ST	1	P	3/4"	50'	
C	4	ERB	GE	1	G	3/4"	6'	
C	5	ERB	Room Outlets	1	G	3/4"	-	See Sheet "ED2" for details.
C	6	MA	WL	1	P	3/4"	55'	
C	7	ATY	DS	1	S	3/4"	55'	
A	8	ATY	MA	1	S	2 1/2"	41'	
A	9	ATY	TV	1	S	3/4"	65'	
A	10	SP	MA	1	S	2"	33'	
A	11	SP	ME	1	C	2 1/2"	33'	
A	12	SP	ME	1	P/G	1"	33'	
A	13	SP	ME	1	S	1 1/2"	33'	
A	14	SP	ME	1	H	2 1/2"	33'	High Tension Cables.
A	15	SP	MR	1	P/G	2"	33'	
A	16	SP	MR	1	S	1"	33'	
A	17	MQT	PSU	1	P/G	1"	82'	
A	18	MQT	MA	1	S	1"	82'	
A	19	MQT	MR	1	S	3"	82'	
A	20	SWCB	MA	1	P/G	1 1/2"	53'	
A	21	SWCB	MA	1	S	3"	53'	
A	22	SWCB	MR	1	S	2"	53'	
A	23	CY	MR	1	S	2"	55'	Via Raceway.
A	24	CY	MA	1	P/G	1 1/2"	55'	Via Raceway.
A	25	CY	MA	1	S	2 1/2"	55'	Via Raceway.
A	26	MR	WM	1	S	1"	82'	Via Raceway.
C	27	MSA	WR3	2	S	1 1/2"	-	For future options (Patient Monitoring). Verify with local Philips Service if auxiliary box should be used.
G	28	Third Party	Third Party	-	-	-	-	For Injector, Auxiliary Box, Patient Monitoring, Video Networking, etc.
G	29	Third Party	ERB	-	G	-	-	For Injector, Auxiliary Box, Patient Monitoring, Video Networking, etc.
A	30	MR	CY	1	S	1"	91'	For Interventional Hardware in "MR" cabinet. Via Raceway.

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm - ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
Project Manager: Ty Galloway
Contact Number: (416) 315-6920
Email: ty.galloway@philips.com
Drawn By: Chris Falkinburg

Project Details
Drawing Number
N-CAN170118 K
Date Drawn: 3/31/2020
Quote: 1-218LNZ1 Rev. 3
Order: None

E2

Power Quality Requirements (Mains 40E Cabinet)

Maximum Rated Power	100kW
Supply Configuration	3 phase, equally sized insulated power conductors and an insulated equipment grounding conductor. Insulated grounding conductor shall have the same or larger size than line conductors. Line wires shall be no smaller than 6AWG, 90 degrees Celsius temperature or higher temperature rating. The conductor size is dependant on the upstream circuit breaker rating: Minimum 4 AWG for 80 A circuit breaker rating.
Nominal Line Voltage	480 VAC, 60 Hz
Line Voltage Variation	Voltage Variations are never to exceed ±10% when measured using 10 minute mean RMS values with a measurement window of 1 week. At least 95% of all measured 10 minute mean RMS values shall be within ±5% of the configured nominal voltage.
Line Voltage Balance	2% maximum of nominal voltage between phases
Frequency Variation	± 1.0 Hz
Voltage Surges	To 110% of steady-state voltage 100 msecs. Maximum duration, 6 per hour max.
Voltage Sags	To 90% of steady-state voltage 100 msecs. Maximum duration, 6 per hour max.
Line Impulses	1000 VPK above phase-neutral RMS absolute maximum. No more than 1 impulse per hour to exceed 500 VPK.
Neutral-Ground Voltage	2.0 volts maximum RMS value
Neutral-Ground Impulses	No more than 1 per hour that exceeds 25 volts and 1 milli-Joule
High Frequency Noise	3.0 volts steady-state maximum. Over 3.0 volts permitted for 100 msec. maximum, 1 per hour max.
Grounded Conductor Impedance	0.1 Ohms @ 60 hz. maximum

Branch Circuit and Wire Gauge Requirements (Mains 40E Cabinet)

Branch Power	100 kVA (System only; verify UPS power requirements)
Max. Standby Current	8 A per phase
MCCB Breaker Box (CB)	80A, Per Schneider Specifications
For information only. Terminal block accommodates #4 in mains cabinet. **Phase Conductor and Equipment Grounding Conductor Size Chart: Engineer of record responsible for calculating phase conductor and equipment ground conductor sizes. Recommended phase conductor and equipment ground conductor sizes for 1% impedance of supply conductors to circuit breaker (CB).	
Max. Instantaneous Power (at X-ray tube power 100 kV 1000mA current)	100 kW
Max. Inst. Current @ CB (RMS value over half-cycle)	300 A @480V
Max. Phase-phase impedance @ CRC	0.455 Ω
Long Term Rating	63A at 480V
Momentary Rating (using a window of 5 seconds)	125A at 480V

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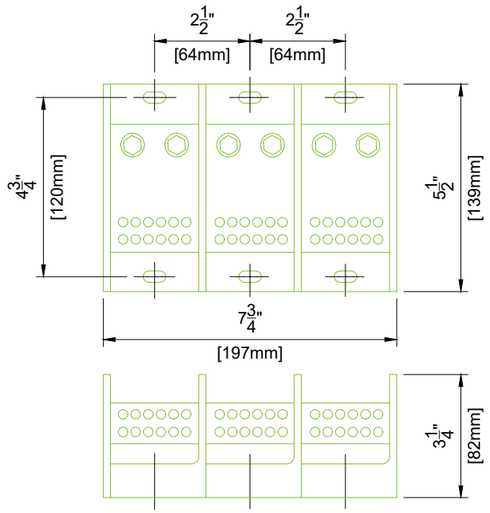
ED1

CB

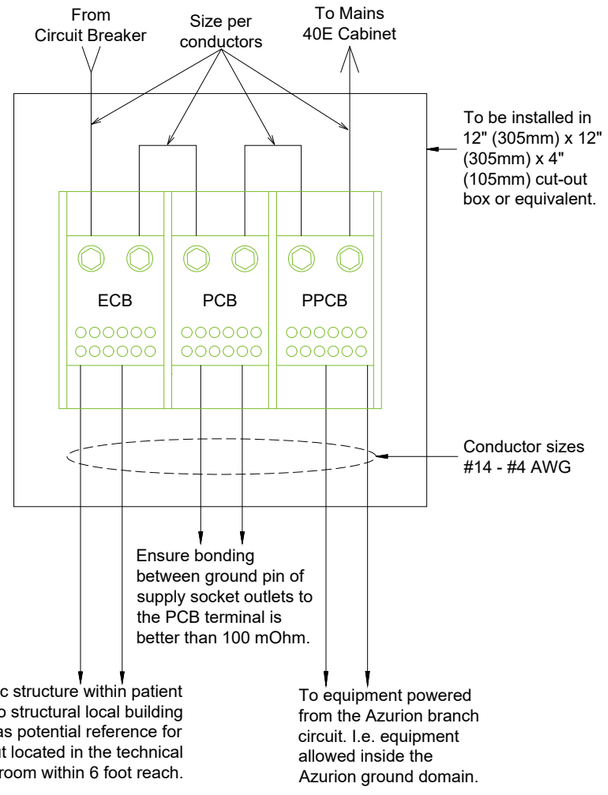
(18.0)

Detail - Equi-Potential Reference Bar Application

(Not to scale)



1. Furnished and installed by Contractor
2. Purchase from local Mersen distributor, https://ep-us.mersen.com/ Catalog #MPDB69143
3. MPDB Series UL 1953 Open-Style Power Distribution Blocks https://ep-us.mersen.com/products/product/mpdb69143



ERB

(19.0)

Invasive Procedures

This equipment may be used for invasive procedures; therefore, the area to be installed is classified as critical care area per NFPA-99 and NFPA-70 (NEC). These documents specify maximum touch voltages and ground impedance in these areas.

Test performed by GSSNA service require that these specifications are met by the GSSNA equipment. It is the facility's responsibility to ensure that these specifications are met by the wall outlet, facility structure, and other equipment not installed by GSSNA.

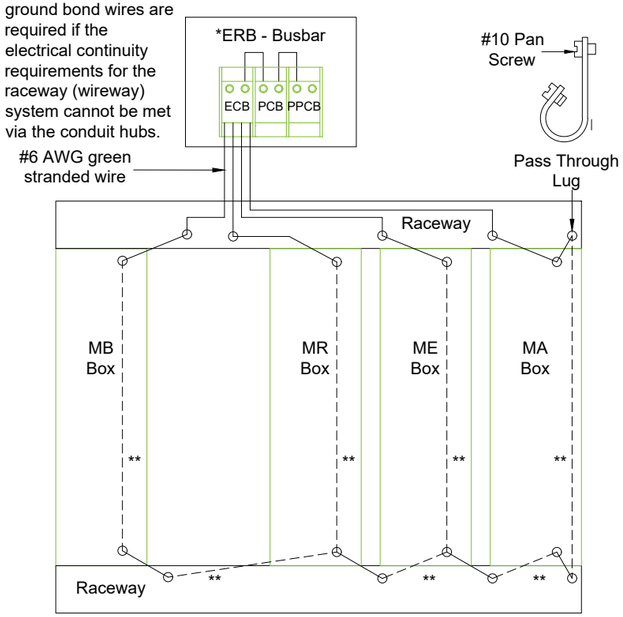
The GSSNA specified "Equi-Potential Reference Bar (ERB)" serves as a ground reference for GSSNA equipment. It may also serve as the "Reference Grounding Point" of the room as defined in NFPA 99-3.3.140 for non-Philips Healthcare equipment.

Equi-Potential Reference Bar (ERB)
A) Equip-Potential Conductor Bar (ECB)
B) Protective Conductor Bar (PCB)
C) Philips Protective Conductor Bar (PPCB)

Detail - Grounding

(Not to scale / Not site specific)

* ERB to be placed at a reachable height.
**Verify with Engineer of Record and local codes if additional ground bond wires are required if the electrical continuity requirements for the raceway (wireway) system cannot be met via the conduit hubs.



(16.0)

PHILIPS

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Sunnybrook Health Sciences Centre
Toronto, ON
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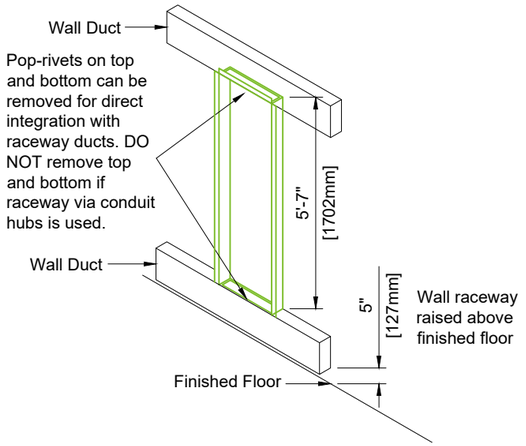
ED2

Detail - Back Box Mounting
(Not to scale)



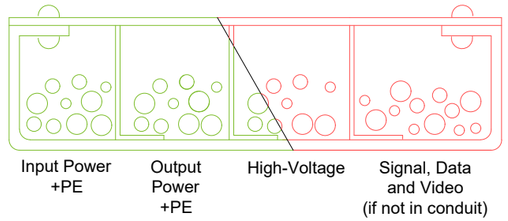
ME MR MA MB

(16.0)

Detail - Cable Trough Divisions
(Not to scale)

Contractors to discuss raceway plan with Philips Project Manager. Raceways (troughs or ducts) may be separated by metal barriers into four sections. Only required separation if for Group A wires that must be separated from other groups. See sheet EN for more information:

1. Supply Mains conductors and associated PE.
2. Secondary Circuit (Azurion equipment internal single phase 230Vac) conductors and associated PE.
3. High-Voltage wire harness to X-Ray stands.
4. Signal, data and video cables.

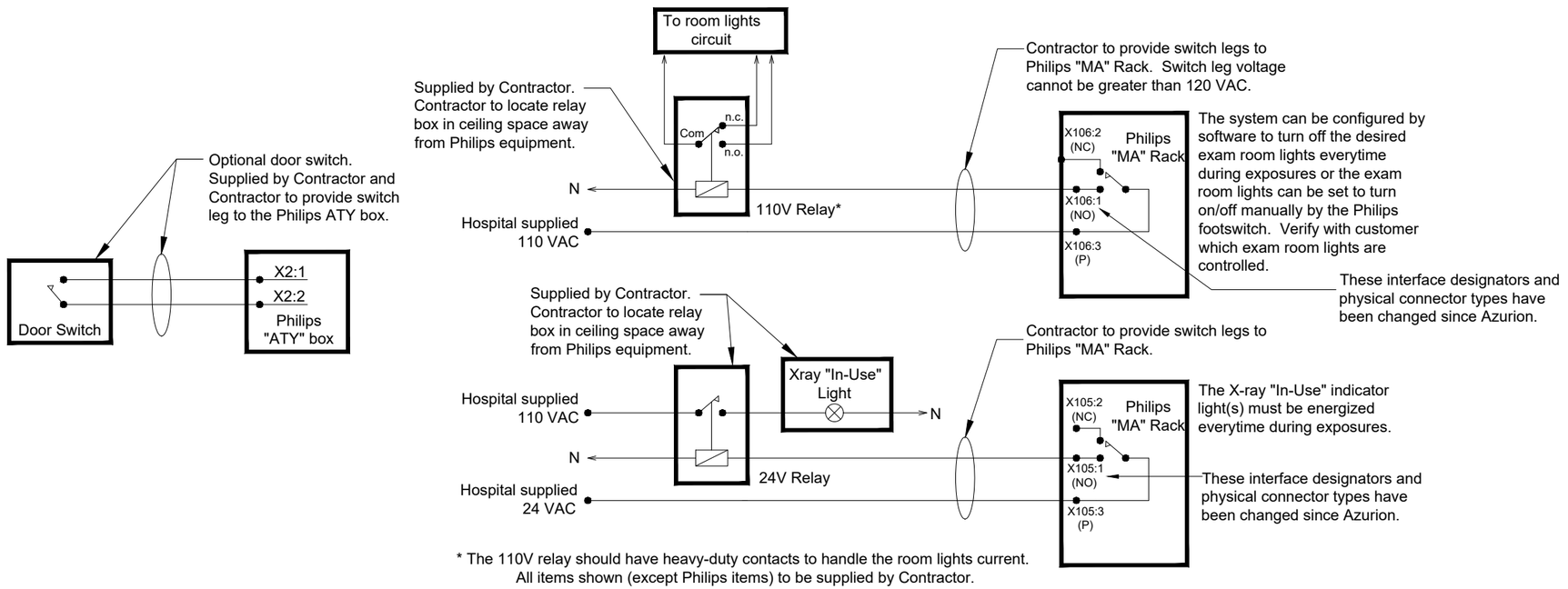


5. It is important that all cables are placed in the appropriate raceway (trough), and at no given point do any cables from one division cross cables from another. Trough separation must be continuous from the beginning.
6. Raceway (trough or ducts): steel with steel dividers grounded to building ground.
7. Contractor to provide cable restraints in all troughs.

WR1 WR2 WR3

(16.0)

Diagram - Typical Connection of X-Ray In-Use Light, Exam Room Lights, & Door Switch



* The 110V relay should have heavy-duty contacts to handle the room lights current.
All items shown (except Philips items) to be supplied by Contractor.

WL DS

(16.0)

PHILIPS

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ED3

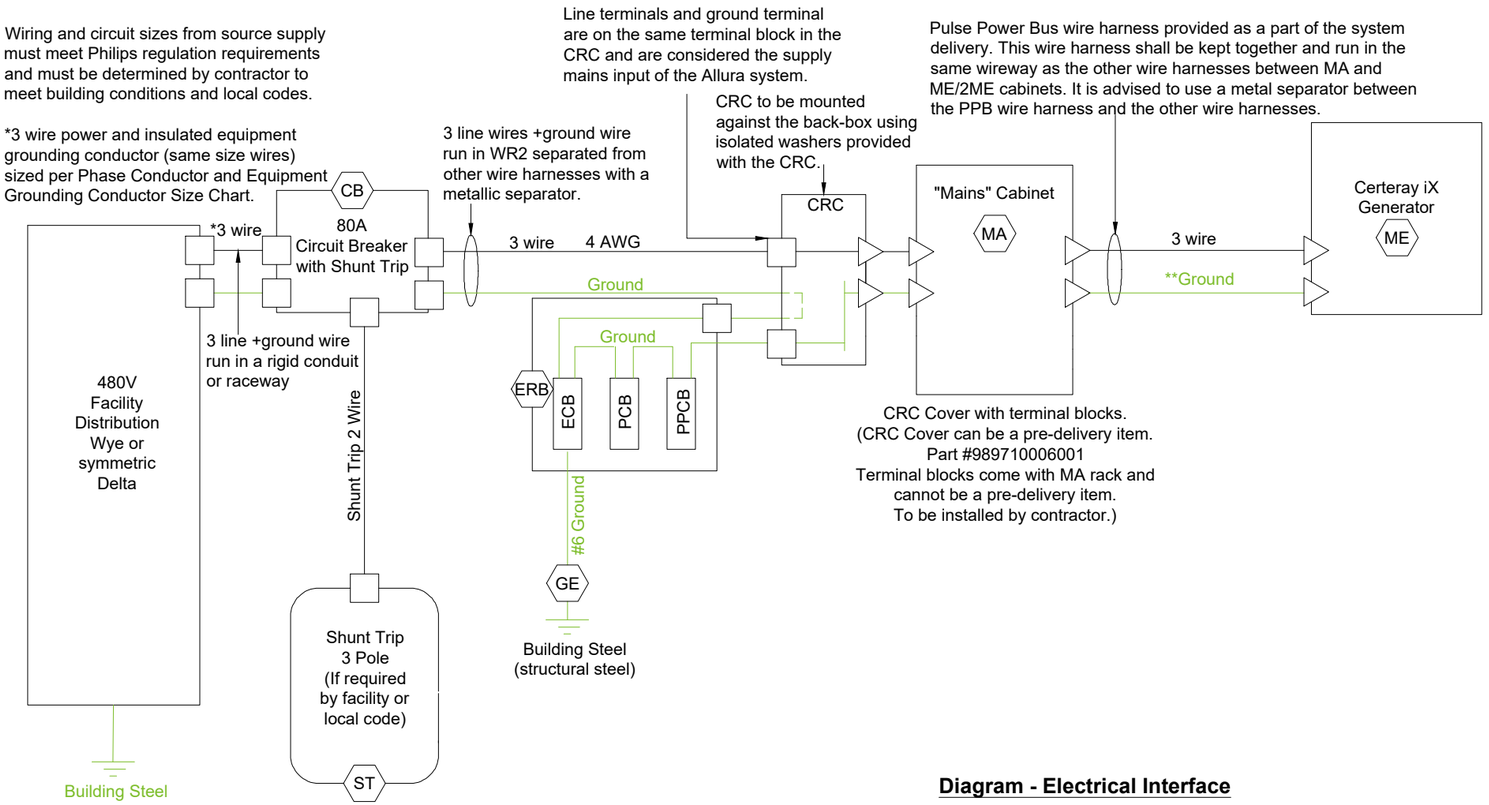

Diagram - Electrical Interface

Note:
All conductors, breakers, splitter, shunt trip, and grounding are provided and installed by contractor.

Size of the conductors is based on the raceway (conduit) length as shown on the Raceway (Conduit) Sheet; the size of the conductors will need to be increased for longer runs.

Conductors, destinations, and number of raceway (conduit) runs will vary from system to system. Consult individual site plans for detailed raceway (conduit) schedules.

Legend
Connections provided and installed by Contractor prior to Start-Up
Connections provided and installed by Philips during Start-Up
Supply conductors installed together with equipment grounding conductor in the raceway (conduit)
** Wire harness for 3 phase supply mains and equipment grounding conductor provided and installed by Philips.
Flex, Liquid tight, etc.
Conduit, rigid EMT, etc.

(18.0)

PHILIPS

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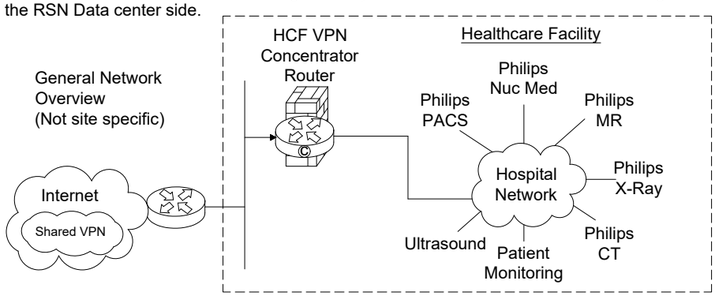
ED4

Philips Healthcare Remote Services Network (RSN)

Secure broadband connection required for Philips remote technical support, diagnostics, and applications assistance

Broadband Site-to-Site Connectivity (Preferred)
This connectivity method is designed for customers who prefer a connection from the RSN Data Center to the Health Care Facility (HCF) utilizing their existing VPN equipment.

Connectivity Details:
- A Site-to-Site connection from the RSN data center's Cisco router will be established to the HCF's VPN concentrator.
- The VPN Tunnel will be an IPSEC, 3DES encrypted Tunnel using IKE as standard, but alternative standards are also available, such as AES, MD5, SHA, Security Association lifetime and Encryption Mode.
- Every system that we will be servicing remotely will have a static NAT IP that we configure on the RSN Data center side.

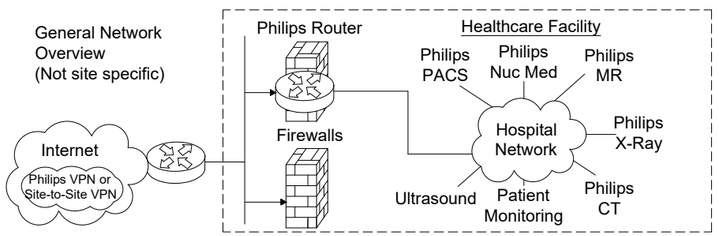


Action Required by Hospital:
- Review and approve connection details.
- Complete appropriate Site Checklist.
- Configure and allow Site-to-Site access prior to setting up connectivity depending on the access criteria that the HCF decides to implement (ex: Source IP filtering, destination IP filtering, NAT assignment, etc.).
- Route traffic from within the hospital network with destination addresses 192.68.48.0/22 to the designed IP provided by Philips.

Broadband Router Installed at Health Care Facility
This connectivity method is designed for customers who have a dedicated high speed connection for Philips equipment.

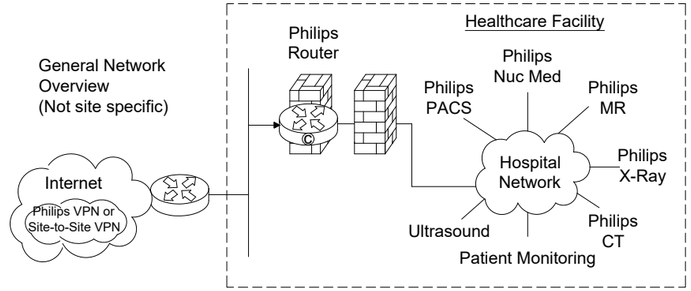
Connectivity Details:
- An RSN Cisco 1711 or 1712 router will be preconfigured and installed at the HCF by Philips in conjunction with the HCF IT representative.
- The VPN Tunnel will be an IPSEC, 3DES encrypted Tunnel using IKE and will be established from the RSN-DC and terminated at the RSN Router on-site.
- One to One NAT is used to limit access to Philips equipment only.
- Router Config and IP auditing is enabled for Customer IT to view via website 24/7.
- Dedicated DSL connections are also supported.

Option 1: Parallel to HCF Firewall Connectivity Method
This connectivity method is designed for customers who prefer a Philips RSN Router installed on site utilizing all the security features provided and managed by Philips.



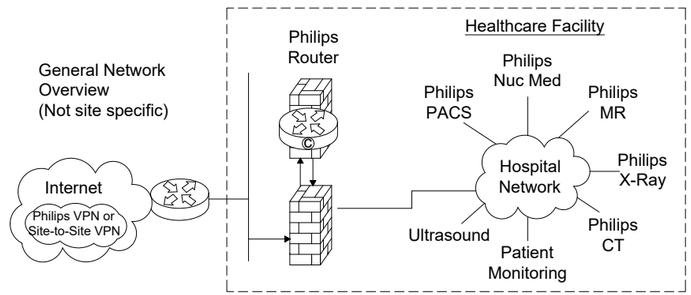
Action Required by Hospital:
- Assign a fixed public IP Address from the ISP to be configured on the Philips router. This is the DOTTED link on the picture connected to the firewall.
- Assign a Back end IP for the Philips router on the Hospital Network.
- Complete appropriate Site Checklist.
- Route traffic from within the hospital network with destination addresses 192.68.48.0/22 to the internal Philips router Ethernet interface. This is the DASHED line connected to the firewall.

Option 2: Back End Connected to the HCF Firewall Connectivity Method
This connectivity method is designed for customers who prefer a Philips RSN Router installed on site by setting up an IP-Based policy allowing access thru existing HCF Firewall to Philips equipment.



Action Required by Hospital:
- Assign a fixed public IP Address from the ISP to be configured on the Philips router. This is the DOTTED link on the picture connected to the firewall.
- Assign a Back end IP for the Philips router on the Hospital Network.
- Complete appropriate Site Checklist.
- Route traffic from within the hospital network with destination addresses 192.68.48.0/22 to internal Philips router Ethernet interface. This is the DASHED line connected to the firewall.
- Configure and allow on the firewall on the DASHED line interface access between the IP address allocated by the hospital to the Philips internal Ethernet router interface and the target modality IP address.

Option 3: Router Installed Inside the HCF's DZM
This connectivity method is designed for customers who prefer the RSN Router installed inside and existing, or new DMZ, allowing access to Philips equipment.



Action Required by Hospital:
- Assign a fixed public IP Address from the ISP to be configured on the Philips router. This is the DOTTED link on the picture connected to the firewall.
- Assign a Back end IP for the Philips router on the Hospital Network.
- Complete appropriate Site Checklist.
- Route traffic from within the hospital network with destination addresses 192.68.48.0/22 to internal Philips router Ethernet interface. This is the DASHED line connected to the firewall.
- Configure and allow on the firewall on the DASHED line interface IPSec protocol communication by opening protocol 500, 50, 51, 47 and port 23 + TACACS. Traffic should be between external IP Address located on the Philips router and the RSN Data center IP address 192.68.48/24 and IP address AOSN TACAS.
- Configure and allow on the firewall on the DASHED line interface access between the IP address allocated by the hospital to the Philips internal Ethernet router interface and the target modality IP address.

(12.0)

PHILIPS

Project
Azurion 7 C20 FlexArm - 7800mm -
ORT
Sunnybrook Health Sciences Centre
Toronto, ON
Room: M2285

Philips Contacts
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Contact Number: (416) 315-6920
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Drawn By: Chris Falkinburg

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N1

System Network Information

IMPORTANT NOTE: *It is the customer's responsibility to coordinate with the local Philips Engineer to provide ALL required network information and install ALL required network cabling & drops according to Philips specifications PRIOR to the scheduled installation start date. Failure to do so may delay system installation and jeopardize the customer hand over date.*

Azurion	IP Sec [ ]yes [ ]no
Physical Location:	
Hostname:	
MAC Address:	
IP Address	
Netmask:	
Gateway:	
AE Title:	
Port Number (5101):	

XtraVision	IP Sec [ ]yes [ ]no
Physical Location:	
Hostname:	
MAC Address:	
IP Address	
Netmask:	
Gateway:	
AE Title XtraVision:	
Port Number (3110):	
AE Title for X-Ray Mod:	
IP for X-Ray Modality:	

EP Navigator	IP Sec [ ]yes [ ]no
Physical Location:	
Hostname:	
MAC Address:	
IP Address	
Netmask:	
Gateway:	
AE Title:	
Port Number:	

View Forum	IP Sec [ ]yes [ ]no
Physical Location:	
Hostname:	
MAC Address:	
IP Address	
Netmask:	
Gateway:	
AE Title:	
Port Number:	

XperIM	IP Sec [ ]yes [ ]no		
	Location 1	Location 2	Location3
Physical Location:			
Hostname:			
MAC Address:			
IP Address			
Netmask:			
Gateway:			
AE Title:			
Port Number (3010):			

Remote Software Installation (RPS)	
Enable Distribution:	[ ] yes [ ] no
Enable Installation:	[ ] yes [ ] no

Dicom Printer				
	Location 1	Location 2	Location3	Location 4
Physical Location:				
Hostname:				
IP Address				
AE Title:				
Port Number :				

PACS	Physical Location:				
	Store/ Import 1	Store/ Import 2	Store/ Export	Query/ Retrieve	Storage/ Commit
Hostname:					
IP Address					
AE Title:					
Port Number :					

PACS	Physical Location:				
	Store/ Import 1	Store/ Import 2	Store/ Export	Query/ Retrieve	Storage/ Commit
Hostname:					
IP Address					
AE Title:					
Port Number :					

Audit Trail	
Physical Location:	
Hostname:	
IP Address	
AE Title:	
Port Number :	

Time Synchronization	
Physical Location:	
Server Name:	

RIS	**Physical Location:**		
	Basic Local RIS	WLM	MPPS
Hostname:			
IP Address:			
AE Title:			
Max PDU Size:	16384 or		
Port Number:		[ ] yes [ ] no	[ ] yes [ ] no
Secure Node:		[ ] yes [ ] no	[ ] yes [ ] no
Encryption:			
Certificate Name:			
PPSM IHE Compatible:			[ ] yes [ ] no

Time Synchronization	
Azurion:	20/21(ftp), 80(http), 443(https), 5900(vnc), 9903(fsf.net)
Allura Xper:	20/21(ftp), 80(http), 443(https), 5900(vnc), 9903(fsf.net)
Allura CV20:	20/21(ftp), 80(http), 4440(fsf)
XtraVision:	20/21(ftp), 80(http), 443(https), 5660(ist/ice), 5900(vnc), 9905(lots)
EP Navigator (R3):	20/21(ftp), 443(https), 5660(ist/ice), 9055(lots)
EP Cockpit (R1.2):	20/21(ftp), 80(http), 443(https), 5900(vnc), 9903(fsf.net)
CX50:	
Xper IM:	
View Forum	

Hospital Network			
	M2M Server (PRS)	Proxy	ePO Server (PRS)
Scheme (https):			
IP Address (192.68.49.50):			
Portnumber (443):			
Use Proxy Server:	[ ] yes [ ] no		
IP Address			
Port Number:			
User Name:			
Password:			

(13.0)

PHILIPS

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N2

Instructions

This form is to be used by Project Manager, Contractor and Service Engineer.

Information is used to develop and determine site ready date.

Items listed are go/no go items for delivery unless noted as delay only items.

Items identified with *** as delayed items must be completed after hours or on weekend. These items cannot be accomplished while installation is in progress. Also, these items must be completed within two days of installation start or they may stop installation.

Site Readiness Checklist

Modality: _____

Order: _____

Site Name: _____

Location: _____

Contact Name: _____

Contact Phone Number _____

- ☐ Customer site preparation verified in general against the Philips final planning drawings.
- ☐ Walls finished including painting.
- ☐ Doors installed.
- ☐ Floor leveled according to Philips drawings and specifications.
- ☐ Floors are tiled/covered finished. Flooring is covered with protective covering (scratch protection).
- ☐ Ceiling lights installed.
- ☐ Cables, raceway (conduit) and ductwork installed and clean. Position checked. Duct covers in place but not finally closed. Cable opening are clear, without sharp edges. Pull strings in conduit. Name the physical conduit. Installation per Philips specifications.
- ☐ HVAC environmental equipment installed and working according to Philips specifications.
- ☐ Ceiling installation completed.
- ☐ Electrical preparation according to Philips specifications.
- ☐ All network cabling, drops installed according to Philips specifications (including hardcopy cameras).
- ☐ All pre-cabling identified on Philips drawings has been installed.
- ☐ Pre-move survey completed - Delivery route identified.
- ☐ Lead glass installed ***.
- ☐ X-Ray warning lights installed ***.
- ☐ Dedicated phone line for modem use***.
- ☐ Room has been cleaned ***.
- ☐ Cabinets and casework installed (with insulation and building steel) according Philips specifications***.
- ☐ RSN survey completed and submitted
- ☐ Philips RSN Champion contacted.

Approved for Delivery

Project Manager Date

Service Engineer Date

Items Specific for the Cardio/Vascular Modality

- ☐ Unistrut installed and level according to Philips specifications.
- ☐ Floor plates installed and level according to Philips specifications.
- ☐ All cover plates have holes punched with nipples and bushings installed.
- ☐ Emergency power requirements installed according to Philips specifications.
- ☐ Building steel ground installed to ECB section of ERB.
- ☐ Non-Philips provided room electrical equipment grounding conductors installed to PCB middle section of ERB.
- ☐ Raceway (conduit) lengths measured according to Philips specifications. Note: Specifications is from source box to destination box (not just conduit run length).
- ☐ Routing of ductwork and conduits must be installed according to Philips specifications.
- ☐ All back-boxes have appropriate electrical continuity to the ECB terminal located inside the ERB via the raceway system.
- ☐ After installation of the Allura all electrical safety performance assurance tests shall pass.
- ☐ 3rd party equipment with a functional connection to the Allura system shall be installed according to the requirements of the compatibility statement.

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CHK