

Project Manual

Sunnybrook Health Sciences Centre

OR 3 & OR 4 Lead Installation

Project No. HS1024-0424

04 March 2025

Issued For Tender & Permit

NORR

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**Sunnybrook Health Sciences Centre
OR 3 & 4 Lead Installation**

The professional seals and signatures below apply to documents, specifications and schedules prepared by the respective architectural and engineering professionals.

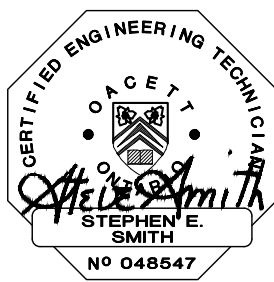
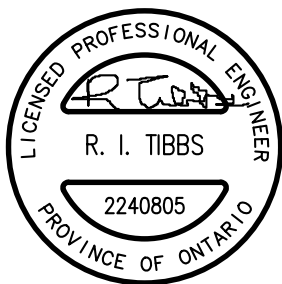
Architect



Mechanical Engineer



Electrical Engineer



Number	Title	Date	Pages
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**Project Manual
For
Sunnybrook Health Sciences Centre
OR 3 & 4 Lead Installation**

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1.01 MANDATORY INSTRUCTIONS TO BIDDERS

Submission Instructions for Suppliers

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://medbuy.bonfirehub.ca/opportunities/private/b49dfde597b78447ff21c9ce58a578e5>

Your submission must be uploaded prior to the Closing Time, **March 27, 2025, at 2:00 PM (EST)**. 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 SHSC OR3 & OR4 Lead Installation for Sunnybrook Health Sciences Centre (the "Owner")

Only Prequalified General Contractors may submit bid submissions on this Tender. The Prequalified General Contractors, from Sunnybrook RFSQ No.2733127893 are as follows:

- Maystar General Contractors Inc.
- REA Construction Ltd.
- Dineen Construction Corporation
- HN Construction Limited
- Gen-eer Construction Ltd.
- BDA Inc.
- P&C General Contracting Ltd.
- Compass Construction Resources Ltd.
- Harbridge & Cross Limited
- Chart Construction Management Inc.
- MJ Dixon Construction Limited
- Elite Construction Management Inc.

Only Prequalified Mechanical Subcontractors from Sunnybrook RFSQ No.2733127893 can be named as subcontractors on this project:

- Black & McDonald Ltd.
- Kelson Mechanical Inc.
- English and Mould Mechanical Systems Ltd.
- Pipe All Plumbing & Heating Limited
- VR Mechanical Services Inc.
- Plan Group Inc.
- Nutemp Mechanical Systems Ltd.
- Canadian Tech Air Systems Inc.

Only Prequalified Electrical Subcontractors from Sunnybrook RFSQ No.2733127893 can be named as subcontractors on this project:

- Black & McDonald Ltd.
- Ontario Electrical Construction Company Limited
- Danik Electrical Construction Company Limited
- Plan Group Inc.
- RPG Electric
- Ainsworth Inc.
- Guild Electric Limited
- Modern Niagara Toronto Inc.

.1 A mandatory formal briefing meeting and site tour will be held at the date and time and location as stipulated in Invitation to Bidders. All Prequalified General Contractors, along with Prequalified Electrical/Mechanical Subcontractors wishing to bid must attend the Mandatory Formal Briefing Meeting and Site Tour. The Formal Briefing and Site Tour is on March 7, 2025, at 7:00 AM (EST). Bidders must RSVP before March 6, 2025, at 4:00 PM stating the name of the attendee (only 1 attendee per contractor) via email to the Bid Administrator (GSoleymani@mohawkmedbuy.ca). Bidders should arrive at least 10 minutes before the meeting time. All Bidders must sign the attendance register prior to commencing the site tour/visit.

.2 Submission requirements: Submission must be in accordance with the SHSC OR3 & OR4 Lead Installation 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 March 27, 2025.
Bids will NOT be opened publicly.

.3 Submission must consist of:

.1 Completed Stipulated Price Bid Form

(a) Note 1:

- Bid Form must be filled out in its entirety; failure to do so may result in disqualification.
- 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

.5 Hazmat Acknowledgement Form

.6 COVID 19 Acknowledgement Form

- .4 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.**
- .5 Bid form must be completed without delineation, alteration or erasures and there is to be no recapitulation of the work to be done.
- .6 Bids must be for a Stipulated Sum without escalation clauses or other qualifications. Bids will be evaluated on the base bid only. Alternative prices will not be considered in determining the lowest compliant Bidder.
- .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 1.1.2 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 1.1.2 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.

1.2 DESCRIPTION OF WORKS

SUNNYBROOK IS IN THE PROCESS OF PROCURING A MOBILE C-ARM FEATURING CUTTING-EDGE CMOS TECHNOLOGY, BUNDLING 2D AND 3D FUNCTIONALITY TO IMPROVE THE ACCURACY OF CLINICAL OUTCOMES AND REDUCE X-RAY EXPOSURE DURING SURGICAL PROCEDURES.

WORK OF THIS CONTRACT INCLUDES THE RENOVATION OF OR 3 AND 4, ADDING LEAD SHIELDING TO THE EXISTING WALLS AND A SMALL RENOVATION IN THE CORRIDOR FOR STORAGE OF THE NEW DI PORTABLE EQUIPMENT.

THE APPROXIMATE AREA OF RENOVATION IS 104 SQ MT (1,120 SQ FT).

1.3 CONTRACTORS/ SUB-CONTRACTORS

- .1** Bidders must submit on the Supplementary 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 Engineer 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

2 QUESTIONS DURING BIDDING

2.1 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.

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

Biddingo Network Sourcing tool: <https://www.biddingo.com/>

- .2 Bidders seeking information with regard to the organization of documents and clarification and interpretation of information on drawings or in specification may contact only through Biddingo.
- .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 directed to Biddingo. All the questions will be answered by published, posted written Addenda.
- .4 **Questions are due no later than March 14, 2024.**
- .5 Bidders must not contact the Owner, its employees, or its agents, including the Engineering Consultant, except via the Tender Calling Authority in regard 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.

3 **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.

4 **EXAMINATION OF SITE**

4.1 **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 Contractors wishing to bid as subcontractors.**

Date/Time/Location:

- **March 7, 2025, at 7:00 AM EST**
 - **RSVP to email: GSoleymani@mohawkmedbuy.ca**
 - **Location: Sunnybrook Health Sciences Centre, Bayview Campus**
 - **2075 Bayview Avenue, Toronto, ON M3N 3M5**
 - **Meet at: M-Wing Ground Floor Entrance**
- .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.
- .9 In addition to paragraph 4.1, 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.
- .10 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.

5 IDENTIFIED PRICES

None

6 SEPARATE PRICES

None

7. ALTERNATE PRICES

None

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 paragraph 12.4 (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 120 days after the time and date fixed for delivering bids, whichever occurs first (the "Bid Acceptance Period").

- .3 The 120 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 120th day thereafter. If the 120th 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 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 Award of Contract will be by written notification to the successful Bidder
- .8 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.
- .9 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

- 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, , Canadian Standard Construction Document CCDC 2-2020 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, **Contractor HAZMAT Acknowledgement Form** and **Construction Delays due to the COVID 19 Acknowledgement Form**.

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 for 50% of the Total Amount Payable (after 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 120 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 120 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 7 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 7 days of the date of receiving notification that the 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.

14. 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 upon request within 48 hours of the request.

15 INSURANCE (MANDATORY REQUIREMENTS)

- 1. Bidders must submit certificate of insurance confirming a general liability insurance of \$5 million to the Owner within 7 days of the date of receiving notification that Bidder has been awarded Contract but before signing Contract.
- 2. Certificates of insurance must be issued by a duly incorporated insurance company authorized to transact business in the Province of Ontario.
- 3. Bidders must submit Builder's Risk Insurance to the Owner within 7 days of the date of receiving notification that Bidder has been awarded Contract but before signing the Contract.
- 4. Insurance documents shall meet the requirements of CCDC 2 – 2020, as amended by 00 73 13 – Supplementary General Conditions.

16 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 a complete set of Specifications and Drawings in addition to the signed and sealed Contract Document set.

17 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.

18 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 considered without legal effect.
4. The Owner and Consultant will not recognize nor participate in any electronic project management program.

19 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.

20 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.

21 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 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.

22 INFECTION CONTROL DURING CONSTRUCTION

- .1 The successful Bidder will be required to provide infection control during the Work in accordance with relevant Spec Section
- .2 Sunnybrook'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.

23 STAFF

- .1 All Contractors and Subcontractors will be expected to maintain the staff team from start to finish. 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. 4 weeks notice is required prior to any proposed change for Owner review during the Work.

24 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.

25 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.

26 SCHEDULING OF WORK (MANDATORY REQUIREMENTS)

- .1 Time is the essence of this Contract. The Bidder must indicate in the space provided on the Bid Form all scheduling information requested. Bids submitted without this information will be deemed Disqualified.
- .2 Prior to award of the Contract, Sunnybrook 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. The revised Construction Schedule must be approved by Sunnybrook and Consultant prior to Contract Award.
- .3 In recognition that the COVID-19 pandemic is affecting current construction in Ontario and globally, Sunnybrook is requesting that the Bidder highlight any anticipated scheduling buffering or anticipated delays to the start date as well as any other changes to the Construction Schedule resulting from COVID 19 or otherwise.

27 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.

28 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's Bid Protest Process is subject to the relevant Bid Protest terms as set out in the AIT and Ontario-Quebec Procurement Agreement.

29 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.

30 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.

31 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.

32 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

COVID 19 ACKNOWLEDGEMENT FORM

Bidder acknowledges that the ongoing COVID 19 Pandemic may cause the Hospital to require to shut down the unit in the event of an outbreak. The Bidder agrees to indemnify the Hospital from any claim delays or extra charges of any kind related to scheduling requirements needed due to Covid 19.

Name

Date

Signature

SUNNYBROOK HEALTH SCIENCES CENTRE

**CONTRACTOR'S ACKNOWLEDGEMENT
(HAZMAT ACKNOWLEDGEMENT FORM)**

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 *OHS*A, 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 brought 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.

TO: Sunnybrook Health Sciences Centre

FROM: _____

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
OR 3 & 4 Lead Installation**

and if notified in writing of the acceptance of this Bid within 120 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 COMPLETION DATE

2.1 I/We agree, if notified of award of Contract, to immediately commence Work on June 16th, 2025, and will attain the following completion dates:

- .1 Substantial Performance of the Work within August 8th, 2025.
- .2 Total Completion Date of the Work by August 22nd, 2025.

3 BONDS AND INSURANCE

3.1 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 a 120 day 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.

3.2 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.

3.3 I/We agree to comply with the requirements of document CCDC2-2020, as amended, with respect to Bonds and Insurance.

4 PROJECT MANAGEMENT

- 4.1 I/We agree to assign _____ (name) as the Project Manager and they will assign _____ (name) as their full-time site superintendent for duration of the Contract.

5 LIST OF SUBCONTRACTORS

- 5.1 I/We propose to use for the above named Project the Subcontractors named herein, and have included the respective costs associated with the below named Subcontractors in our bid price.

- 5.2 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.

Description of Work	Subcontractor's Company Name	Price (\$)
Mechanical		
Electrical		
Sprinkler		

- 5.3 I/We agree to assign _____ (name) as the Mechanical Subcontractor, for the price of \$ _____, and they will assign _____ (name) as their full-time mechanical site superintendent for duration of the Contract.

- 5.4 I/We agree to assign _____ (name) as the Electrical Subcontractor, for the price of \$ _____, and they will assign _____ (name) as their full-time mechanical site superintendent for duration of the Contract.

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 120 days from date of Bid receipt, and that if notified of award of the Contract I/we will:
- .1 execute a Contract with the Owner on the specified Form of Agreement.
 - .2 furnish to the Owner, at time of contract signing, copies of insurance policies as required by the Conditions of the Contract.
 - .3 furnish to the Owner, at time of contract signing, a Performance Bond and a Labour and Material Payment Bond, issued by a Surety acceptable to the Owner, each in the amount of 50% of the Total Amount Payable (after HST).
 - .4 furnish to the Owner evidence that all Worker's Compensation dues, in accordance with the laws of the Province of Ontario, have been paid.

- .5 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.

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

CONDITIONS OF CONTRACT

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 - 2020, 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

GENERAL REFERENCE

The Standard Construction Document, CCDC 2 2020, 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 2020.

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 2020, Stipulated Price Contract. The Stipulated Price Contract, CCDC 2 2020, is amended as follows:

- **GENERAL**

- These Supplementary Conditions and Amendments shall modify, delete and/or add to the Agreement between *Owner* and *Contractor*, Definitions and General Conditions of the Stipulated Price Contract CCDC 22020.
- 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.
- 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.

- **AGREEMENT BETWEEN OWNER AND CONTRACTOR**

- ARTICLE A1 THE WORK

- Delete paragraph 1.3 and inserting 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 *Ready-for-Takeover*, by the *Scheduled Ready-to-Takeover Date*; and attain the *Total Completion of the Work* by the *Scheduled Total Completion Date*.”

- ARTICLE A5 PAYMENT

- Amend paragraph 5.2.1(1) by deleting “for the first 60 days”.
- Delete paragraph 5.2.1(2) and substitute the following: “Intentionally deleted”.

- ARTICLE A8 SUCCESSION

- Amend paragraph 8.1 by in line 4, inserting “permitted” before “assigns”.

- ARTICLE A9 TIME OF THE ESSENCE

- Add new Article A9 as follows:

- “9.1 *Contractor* acknowledges and agrees that one of the reasons *Contractor* was selected for the *Work* is *Contractor’s* representation and warranty that it will attain *Ready-for-Takeover* and the *Total Completion of the Work* by the dates set out in Article A1, paragraph 1.3. *Contractor* acknowledges and agrees that it has been advised by *Owner* that it is critical to *Owner* that *Ready-for-Takeover* be achieved by the prescribed dates and that time is of the essence of this *Contract*.
- 9.2 No approval or consent of, or certification, inspection, review, comment, verification, confirmation, acknowledgement or audit by, any governmental authority, *Owner*, or *Consultant*, or anyone on their behalf, shall relieve *Contractor* from performing or fulfilling any of its obligations under the *Contract*. Without limitation, whenever any drawings, plans, procedures, programs or other work product of *Contractor* requires any review, inspection, comment or approval by any governmental authority, *Owner*, or *Consultant*, or anyone on their behalf, any such review, inspection, comment or approval shall not, in any way, reduce or modify any of *Contractor’s* obligations under the *Contract*.
- 9.3 If any part of the *Contract* or the application of such part to any party, person or circumstance shall, to any extent, be invalid or unenforceable, the remainder of the *Contract*, or the application of such part to any other party, person or circumstance, shall not be affected thereby and each provision of the *Contract* shall be valid and enforceable to the fullest extent permitted by law.
- 9.4 The terms of the *Contract*, which by their nature are continuing, shall survive the termination or other expiration of the *Contract*.
- 9.5 This Agreement, including the *Contract Documents* described herein and the attachments, documents and other agreements to be furnished or executed in connection herewith, supersede all prior negotiations, representations or agreements, either written or oral, with respect to the subject matter hereof. No modification to the *Contract* shall be effective unless made in writing signed by both *Owner* and *Contractor*, unless otherwise provided for herein.
- 9.6 This Agreement may be executed in counterparts, each of which when executed and delivered, including any counterpart executed by a Party and transmitted by email by way of pdf attachment or facsimile transmission, shall be deemed an original, but all of which together will constitute one instrument binding upon the parties hereto, notwithstanding that all such parties may not have executed the same counterpart.”

- DEFINITIONS

- Add the following new definitions:

“Commissioning

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

Completion of Commissioning

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

COVID-19

COVID-19 means the novel coronavirus infectious disease SARS-CoV-2 as referenced by the World Health Organization, including all related viruses, diseases, or variants, and any subsequent waves.

Deficiency List

Deficiency List means the deficiency list prepared by *Consultant* and/or *Owner*, acting reasonably, listing itemized deficiencies in the *Work* and errors and/or omissions in the *Design Services*.

Dispute

Dispute has the meaning ascribed in GC 8.1.1.

Key Personnel

Key Personnel means the project managers, superintendents, coordinators or other personnel of *Contractor*, if any, identified in Schedule “A” – Key Personnel to the *Contract*.

OHSA

OHSA means the *Occupational Health and Safety Act*, R.S.O. 1990 c. O.1, as amended, and all regulations passed thereunder.

Scheduled Ready-for-Takeover Date

Scheduled Ready-for-Takeover Date means [insert date].

Scheduled Total Completion Date

Scheduled Total Completion Date means [insert date].

- **Submittals**

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

Total Completion of the Work

Total Completion of the Work Date means the date that the *Work* is fully complete as prescribed by the *Contract Documents*, including, without limitation, the rectification of all defects and deficiencies.”

- **GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT**

- Amend paragraph 1.1.3 by inserting “Applying the standard of care described in paragraph 1.5.1.1 of GC 1.5 - PROJECT REQUIREMENTS,” at the beginning of the first sentence.
- Amend paragraph 1.1.4 by inserting “Except for its obligations to review under GC 1.1.3 and to report under this GC 1.1.4,” at the beginning of the first sentence and by adding “Neither *Owner* nor *Consultant* will be responsible for oral instructions.” after the second sentence.
- Amend paragraph 1.1.5.1 by moving the reference to “Supplementary Conditions” to the top of the order of priority.
- Amend paragraph 1.1.5.1 by adding a new bullet called “Advance Payment Agreement” as the 2nd bullet point in the order of priority.
- Amend paragraph 1.1.9 by adding the following to the end of the paragraph:
- “The *Specifications* may be divided into Divisions and the Divisions into Sections for the purpose of convenience, but a Section may consist of work of more than one *Subcontractor* or *Supplier*. The *Specifications* are intended to be read as a whole.”
- “Drawings are intended to be read as a whole”.
- Delete paragraph 1.1.10 in its entirety and substitute new paragraph 1.1.10 as follows:

“The design information furnished to *Contractor* as part of the *Contract Documents*, including the *Drawings* and *Specifications*, are the property of *Owner* and/or *Consultant*, and are to be used by *Contractor* only for the purposes of performing the *Work*. *Contractor* shall not copy, alter or utilize the aforesaid design information for any purpose unrelated to the *Work* without written authorization from *Owner* and *Consultant*.”
- Add new paragraph 1.1.12 as follows:
 - “1.1.12 The table of contents, titles, section headings, running headlines and marginal notes contained in the *Contract Documents* are solely to facilitate reference to various provisions of the *Contract Documents* and in no way affect or limit the interpretation or construction of the provisions to which they refer.”

GC 1.4 ASSIGNMENT

- Delete paragraph 1.4.1 in its entirety and insert the following:

“1.4.1 *Contractor* shall not assign the *Contract* or any of its rights or interest in the *Contract*, nor shall *Contractor* subcontract all or substantially all of the *Work* or *Contractor’s* responsibilities under the *Contract* to a single

Subcontractor or any other person, without the prior written consent of *Owner*, which consent may not be unreasonably withheld. *Owner* may assign the *Contract* without the consent of *Contractor* upon providing *Notice in Writing* to *Contractor*.”

GC 1.5 PROJECT REQUIREMENTS

- Add new paragraph 1.5.1:
 - “1.5.1 *Contractor* represents, covenants and warrants to *Owner* that:
 - 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;
 - 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 3.5, subject to *Owner’s* approval, in the event of death, incapacity, termination or resignation. The reference to *Owner’s* approval includes all named Subcontractors and their personnel.
 - there are no pending, threatened or anticipated claims or litigation involving *Contractor* that would have a material adverse effect on the financial ability of *Contractor* to perform the *Work*, and
 - it will achieve *Read-for-Takeover* and the *Total Completion Date* by the date set out in Article A1, paragraph 1.3.”

• GC 2.2 ROLE OF THE CONSULTANT

- Add the following sentence to the end of paragraph 2.2.3:
 - “The presence of such project representatives at the *Place of the Work* or the *Work* shall not relieve *Contractor* from any responsibility to perform the *Work* as required by the *Contract Documents*.”
- Amend paragraph 2.2.5 by (a) adding the word “, schedules” after the word “techniques”, (b) adding the words “to *Contractor*” after the words “*Consultant* will not be responsible” in the first sentence, (c) adding to the following to the end of the second sentence “or to adhere to the construction schedule”, and (d) adding the following sentence to the end of the paragraph: “*Consultant* will not have control over, charge of or be responsible for the acts or omissions of *Contractor*, *Subcontractors*, *Suppliers*, or their agents, employees, or any other person performing any portion of the *Work*.”
- Amend paragraph 2.2.6 by deleting “Except with respect to GC 5.1 — FINANCING INFORMATION REQUIRED OF THE OWNER” and capitalizing “the”.

- Amend paragraph 2.2.7 by inserting “*Contractor* or *Owner* on its own behalf or on behalf of” after the word “by” in the second line.
- Amend paragraph 2.2.12 by (a) deleting the word “will” and replacing with “may”, and (b) adding the following sentence to end of the paragraph:
 - “*Contractor* shall be responsible for requesting any additional instructions or clarifications that may be required from *Consultant* which are needed for the performance of the *Work*, and shall request such instructions or clarifications in time to avoid any delay or additional cost of the *Work*.”
- Amend paragraph 2.2.13 by deleting “submittals” and replacing with “*Submittals*”.
- Amend paragraph 2.2.18 by deleting the words “immediately engage a *Consultant* against whom the *Contractor* makes no reasonable objection and” and replace with “engage a *Consultant*”.

• **GC 2.3 REVIEW AND INSPECTION OF THE WORK**

- Amend paragraph 2.3.2 by inserting in line 1 “, *Commissioning*” after “inspections,”, and inserting in line 3 “and *Commissioning*” after “inspection”.
- Amend paragraph 2.3.3 by inserting in line 1 “, *Commissioning*” after “certificates”.
- Amend paragraph 2.3.4 by inserting in line 2 “*Commissioning*” after “inspections,”, and inserting in line 3 “or *Commissioning*” after “tests”.
- Amend paragraph 2.3.5 by inserting “Subject to paragraph 2.3.4” at the beginning of the third sentence.
- Amend paragraph 2.3.6 and paragraph 2.3.7 by inserting “or *Commissioning*” after “inspection” in all instances.

• **GC 2.4 DEFECTIVE WORK**

- Amend paragraph 2.4.1 by (a) adding the words “or *Owner*” after the word “*Consultant*” in the first line, and (b) by adding the following to the end of the paragraph:

“*Contractor* shall rectify in a manner acceptable to *Owner* all other defective work and like deficiencies throughout the *Work* whether or not they are specifically identified by *Consultant*.”
- Amend paragraph 2.4.3 by deleting the words “the difference in value between the work as performed and that called for by the *Contract Documents*” and inserting the words “the value of such work as is necessary to correct any non-compliance with the *Contract Documents*.”
- Add new paragraphs 2.4.4, 2.4.5 and 2.4.6:

- “2.4.4 *Contractor* shall prioritize the correction of any defective work which, in the sole discretion of *Owner*, adversely affects the day to day operation of *Owner*.”
- 2.4.5 Upon notification of a defect in the *Work*, *Contractor* shall promptly, and no later than five (5) *Working Days*, provide a written statement outlining the proposed remedial measures and a schedule for implementation. Once approved by *Consultant*, *Contractor* shall proceed with the remedial measures without adversely affecting the construction schedule.
- 2.4.6 Notwithstanding any rejection of the *Work* by *Consultant* or *Owner*, or the deduction of an amount otherwise due to *Contractor* by *Owner* as a result of defective work, *Contractor* is required to continue the *Work* in accordance with the *Contract Documents*.”

• **GC 3.1 CONTROL OF THE WORK**

- Amend paragraph 3.1.1 by inserting the words “schedule, coordinate and” after the word “effectively”.
- 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”.
- Add new paragraph 3.1.3:
 - “3.1.3 Prior to commencing procurement, or fabrication construction activities, *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, *Contractor* shall immediately notify *Consultant*, in writing, and obtain written instructions from *Consultant* before proceeding with any part of the affected work.”

• **GC 3.2 CONSTRUCTION BY THE OWNER OR OTHER CONTRACTORS**

- Delete subparagraph 3.2.2.1 in its entirety and substitute the following: “Intentionally deleted”.
- Add new subparagraph 3.2.3.5:
 - “3.2.3.5 Subject to **GC 9.4 CONSTRUCTION SAFETY**, for *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 *OHS*A.”

- Delete the last sentence of paragraph 3.2.5.
- Delete paragraph 3.2.6 in its entirety and substitute the following:
- “Entry by *Owner*, *Owner’s* forces and/or by *Other Contractors* does not indicate acceptance of the *Work* and does not relieve *Contractor* of any responsibility under the *Contract* including the responsibility to complete the *Work*.”
- Add new paragraph 3.2.7 as follows:
 - “3.2.7 Placing, installing, application and connection of work by *Owner*, *Owner’s* own forces, and/or by *Other Contractors*, on and to the *Work* will not relieve *Contractor’s* responsibility to provide and maintain the specified warranties unless a defect has been created by *Owner*, *Owner’s* own forces or *Other Contractors*.”

• **GC 3.3 TEMPORARY WORK**

- Add new paragraph 3.3.4 as follows:
 - “3.3.4 Temporary or trial usage of any mechanical device, machinery, apparatus, equipment or materials shall not be construed as evidence of acceptance of the same and no claim for damage shall be made by *Contractor* for damage to or breaking of any part of such work which may be used.”

• **GC 3.4 CONSTRUCTION SCHEDULE**

- Delete paragraph 3.4.1 in its entirety and substitute new paragraph 3.4.1:
 - “3.4.1 *Contractor* shall,
 - unless it is required to be submitted earlier in accordance with the *Specifications*, then prior to submitting the first application for payment, submit to *Owner* and *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 *Owner* and *Consultant*, the construction schedule submitted by *Contractor* shall become the baseline construction schedule;
 - 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 3.4.1.1 or any successor or revised schedule accepted by *Owner* pursuant to this GC 3.4;
 - monitor the progress of the *Work* on a weekly basis relative to the construction schedule, reviewed and accepted pursuant to paragraph 3.4.1.1, or any successor or revised schedule accepted

in writing by *Owner* pursuant to GC 3.4, update the construction schedule on a monthly basis and advise *Consultant* and *Owner* in writing of any variation from the baseline construction schedule or slippage in the baseline construction schedule; and

- if, after applying the expertise and resources required under paragraph 3.4.1.2, *Contractor* forms the view that the slippage in baseline construction schedule reported in paragraph 3.4.1.3 cannot be recovered by *Contractor*, it shall, in the same notice provided under paragraph 3.4.1.3, indicate to *Consultant* and *Owner* if *Contractor* intends to apply for an extension of *Contract Time* as provided in PART 6 CHANGES IN THE WORK.”

- Add new paragraph 3.4.2:

- “3.4.2 If at any time it should appear to *Owner* or *Consultant* that the actual progress of the *Work* is behind schedule or is likely to become behind schedule, or if *Contractor* has given notice to that effect to *Owner* or *Consultant* pursuant to 3.4.1.3, *Contractor* shall take appropriate steps to cause the actual progress of the *Work* to conform to the schedule and shall produce and present to *Owner* and *Consultant* a recovery plan demonstrating how *Contractor* will achieve the recovery of the schedule. *Owner* may instruct *Contractor*, at *Contractor’s* expense, to employ additional labour and equipment or work overtime or employ any other reasonable procedures, at no expense to *Owner*, to bring the *Work* back to conform with the schedule.”

- **GC 3.5 SUPERVISION**

- Add new paragraphs 3.5.3 and 3.5.4 as follows:

- “3.5.3 *Contractor* shall employ competent *Key Personnel* who will not be removed or replaced during the course of the *Work* without the prior written consent of *Owner*, which approval shall not be unreasonably withheld. Should any of *Contractor’s* personnel prove to be unacceptable to *Owner*, *Owner* shall give written notice to *Contractor* who shall, within seven (7) days of receipt of the written notice, make arrangements to appoint a replacement acceptable to *Owner*.
- 3.5.4 *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 *Consultant* and all deficiencies in the *Work* have been rectified to the satisfaction of *Owner*. The fulltime site superintendent for the *Contract* shall be named in Schedule “A” – *Key Personnel* and any acceptable replacement shall represent *Contractor* at the *Place of the Work* and notices and instructions given to the site superintendent for the *Contract* by *Consultant* shall be held to have been received by *Contractor*.”

- **GC 3.6 SUBCONTRACTORS AND SUPPLIERS**

- Amend paragraph 3.6.2 by inserting the following at the end of the paragraph:
 - “*Contractor* agrees not to change those *Subcontractors* without prior written approval of *Owner*, acting reasonably. Where *Contractor* wishes to change any identified *Subcontractors* or *Suppliers*, *Contractor* shall set out in writing to *Owner* sufficient reasons for the desired change. *Owner* or *Consultant* shall advise *Contractor* if *Owner* agrees to the proposed change. If *Owner* is not satisfied with *Contractor*’s reason for wanting to change an identified *Subcontractor* or *Supplier*, *Contractor* shall be required to proceed with the identified *Subcontractor* or *Supplier*.”
- Amend 3.6.4 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 a proper manner, in which case *Contractor* will not be entitled to any change in the *Contract Price* or *Contract Time*”.

GC 3.7 LABOUR AND PRODUCTS

- Add new paragraph 3.7.4:
 - “3.7.4 *Contractor* is responsible for the safe onsite storage of *Products* and their protection (including *Products* supplied by *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 *Owner* and *Consultant*. *Owner* shall provide all relevant information on the *Products* to be supplied by *Owner*.”

GC 3.8 SHOP DRAWINGS

- Add the words “AND OTHER SUBMITTALS” to the title of GC 3.8 after “SHOP DRAWINGS”.

Add “and *Submittals*” after the words “*Shop Drawings*” in clauses 3.8.1, 3.8.2, 3.8.3, 3.8.3.2, 3.8.5, and 3.8.6.
- Amend paragraph 3.8.2 by adding the following sentence at the beginning of the paragraph:
 - “Prior to the first application for payment, *Contractor* and *Consultant* shall jointly prepare a schedule of the dates for submission and return of *Shop Drawings* and any *Submittals*.”
- Delete subparagraph 3.8.3.1 in its entirety and substitute new subparagraph 3.8.3.1:

“3.8.3.1 *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”

- Delete paragraph 3.8.7 and substitute the following:
 - “3.8.7 *Consultant* will review and return *Shop Drawings* and *Submittals* in accordance with the schedule agreed upon in paragraph 3.8.2, or, in the absence of such schedule, within fifteen (15) *Working Days*. If, for any reason, *Consultant* cannot process the *Shop Drawings* or *Submittals* within the agreedupon schedule or within fifteen (15) *Working Days*, *Consultant* shall notify *Contractor* and they shall meet to review and arrive at an acceptable revised schedule for processing. *Contractor* shall update the *Shop Drawings* and *Submittals* schedule to correspond to changes in the construction schedule.”

- **GC 3.9 DOCUMENTS AT THE SITE**

- Add a new GC 3.9 DOCUMENTS AT THE PLACE OF THE WORK as follows:
- **“GC 3.9 DOCUMENTS AT THE PLACE OF THE WORK**
 - 3.9 *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 *Owner* and *Consultant*.” Should have progressive/current red line as-built drawings (double check).

- **GC 3.10 CLEAN UP**

- .1 Add a new GC 3.10 CLEAN UP as follows:
- **“GC 3.10 CLEAN UP**
 - 3.10.1 *Contractor* shall maintain the *Work* and *Place of the Work* in a safe and tidy condition and free from the accumulation of waste products and debris, other than that caused by *Owner*, *Other Contractors*, or their employees.
 - 3.10.2 Before applying for *Substantial Performance of the Work* as provided in GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK, *Contractor* shall remove waste products and debris, other than that resulting from the work of *Owner*, *Other Contractors*, or their employees, and shall leave the *Place of the Work* clean and suitable for use or occupancy by *Owner*. *Contractor* shall remove products, tools, *Construction Equipment*, and *Temporary Work* not required for the performance of the remaining work.

- 3.10.3 Prior to application for the final payment, *Contractor* shall remove any remaining products, tools, *Construction Equipment*, *Temporary Work*, and waste products and debris, other than those resulting from the work of *Owner*, *Other Contractors*, or their employees.”
- **GC 3.11 USE OF THE WORK**
- .1 Add new GC 3.11 USE OF THE WORK as follows:
- **“GC 3.11 USE OF THE WORK**
 - 3.11.1 *Contractor* shall confine *Construction Equipment*, *Temporary Work*, storage of *Products*, waste products and debris, and operations of employees and *Subcontractors* to limits indicated by laws, ordinances, permits, or the *Contract Documents* and shall not unreasonably encumber the *Place of the Work*.
 - 3.11.2 *Contractor* shall not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety of the *Work*.
 - 3.11.3 Except for those normally used during the performance of the *Work*, such as elevator, mechanical, electrical, hydro, *Contractor* shall not use any service plant or equipment installed as part of the *Work* without prior written consent from *Owner*. On receipt of such consent, *Contractor* shall be subject to any conditions set out as part of such consent and shall be responsible for all costs, damage and compensation for wear and tear.
 - 3.11.4 If storage or other areas are required for the *Work* in addition to the *Work Site*, *Contractor* shall be responsible for making arrangements to obtain the additional areas and obtaining any necessary permits, permission or authorization and, if required, for making permit, rental or other payments that may be required for such purpose.”
- **GC 4.1 CASH ALLOWANCES**
 - Delete paragraph 4.1.4 in its entirety and substitute new paragraph 4.1.4:
 - “4.1.4 Any surpluses in one or more cash allowance may at the election of *Owner* be expended pursuant to paragraph 4.1.3 in respect of other cash allowances or to fund changes in the *Work* by way of *Change Order* or *Change Directive*, as the case may be, but without the imposition of *Overhead* or profit in respect *Work* pertaining to such other cash allowances or changes.”
 - Delete paragraph 4.1.5 in its entirety and substitute new paragraph 4.1.5:
 - “4.1.5 Where the value of the *Work* under cash allowances exceeds the aggregate amount of all the cash allowances stated in the *Contract Documents*, *Contractor* shall be compensated for the approved amount of such excess and for *Overhead* and profit on such approved amount, with

the *Contract Price* being adjusted to reflect such excess, all pursuant to, and only to the extent permitted under, GC 6.1 - CHANGES, 6.2 - CHANGE ORDER and GC 6.3 - CHANGE DIRECTIVE.”

- Delete paragraph 4.1.7 in its entirety and substitute new paragraph 4.1.7:
 - “4.1.7 *Contractor* shall provide a schedule prior to the first application for progress payment that shows when the items called for under cash allowances must be ordered to avoid delaying the progress of the *Work*.”
- Add new paragraph 4.1.8:

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

• **GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER**

- Amend the heading, “GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER” to read, “GC 5.1 FINANCING INFORMATION REQUIRED”.
- Delete paragraph 5.1.1 in its entirety and substitute new paragraph 5.1.1:
 - “5.1.1 *Contractor* shall provide *Owner* with timely *Notice in Writing* of any material change in its financial ability to (a) properly complete the *Work* in accordance with the *Contract Documents* or (b) fulfil its obligations under the *Contract*.”
- Delete paragraph 5.1.2 in its entirety and substitute the following: “Intentionally deleted”.

• **GC 5.2 APPLICATIONS FOR PAYMENT**

- Amend paragraph 5.2.2 by adding the following sentence to the end of the paragraph: “Applications for payment shall be made in a form that is mutually acceptable to *Owner* and *Contractor*.”
- Amend paragraph 5.2.3 by deleting “delivered to” and substitute “incorporated into”.
- Amend paragraph 5.2.4 by inserting the following after the word “*Work*” in the second line: “in a format acceptable to *Owner* and *Consultant*”.
- Delete paragraph 5.2.7 in its entirety and substitute new paragraph 5.2.7:
 - “5.2.7 *Contractor* shall submit, with each application for payment, as a true conditions precedent to *Contractor’s* right to payment under this *Contract*:

- .1 evidence of compliance with workers' compensation legislation at the *Place of the Work*, including a Workplace Safety & Insurance Board Clearance Certificate;
 - .2 after the first payment, a statutory declaration by *Contractor* as to the distribution made of the amounts previously received, on an original form of Statutory Declaration 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; and
 - .3 if the application is for payment of the lien holdback amount, a written request for release of holdback including a declaration that no written notices of lien have been received by *Contractor*."
- Add to the end of paragraph 5.2.8 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 *Contractor* until *Ready-for-Takeover* notwithstanding that title has passed to *Owner* pursuant to GC 14.1 OWNERSHIP OF MATERIALS."
 - Add new paragraph 5.2.9:

 - "5.2.9 *Contractor* shall prepare and maintain current asbuilt *Drawings* which shall consist of the *Drawings and Specifications* revised by *Contractor* during the *Work*, showing changes to the *Drawings and Specifications*, which current asbuilt *Drawings* shall be maintained by *Contractor* and made available to *Consultant* for review with each application for progress payment. *Consultant* reserves the right to retain a reasonable amount for the value of the asbuilt *Drawings* not presented for review."

• **GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK**

- Amend paragraph 5.4.1 by deleting the words "20 calendar days" in the second line and substituting the words "fifteen (15) *Working Days*" therefor, and by adding the following at the beginning of the paragraph:

 - "When *Contractor* considers that the *Work* is substantially performed, or if permitted by the lien legislation applicable to the *Place of the Work* a designated portion thereof which *Owner* agrees to accept separately is substantially performed, *Contractor* shall, within one (1) *Working Day*, deliver to *Consultant* and *Owner* a written application for payment of the lien holdback amount, in accordance with GC 5.3, for review by *Consultant* to establish *Substantial Performance of the Work* or substantial performance of the designated portion of the *Work*."

- Delete paragraph 5.4.2 in its entirety and substitute the following: “Intentionally deleted”.
- Delete paragraph 5.4.3 in its entirety and substitute new paragraph 5.4.3:
 - “5.4.3 Subject to the terms and conditions of the *Contract*, the requirements of any *Payment Legislation*, and any Notice of Non-Payment of Holdback, the holdback amount authorized by the certificate for payment of the holdback shall be due and payable on the first (1st) *Working Day* following the expiration of the holdback period stipulated in the *Payment Legislation* applicable to the *Place of the Work*. *Owner* may retain out of the holdback amount any sums required by law to satisfy any liens against the *Work* or, if permitted by the lien legislation applicable to the *Place of the Work*, other third party monetary claims against *Contractor* which are enforceable against *Owner*.”
- Amend paragraph 5.4.5 by deleting “hereby agrees to release, and shall release,” and substituting “may agree to release”.
- Add new paragraphs 5.4.7 as follows:

“5.4.7 *Contractor* shall publish a copy of the Certificate of *Substantial Performance of the Work* within seven (7) days of receiving a copy of the Certificate of *Substantial Performance of the Work* signed by *Consultant*, and *Contractor* shall provide suitable evidence of the publication to *Consultant* and *Owner*. If *Contractor* fails to publish such notice, *Owner* shall be at liberty to publish and back charge *Contractor* its costs for doing so.”
- Add new paragraph 5.4.8 as follows:

“5.4.8 For the purposes of obtaining *Substantial Performance of the Work* and the lien legislation applicable to the *Place of the Work* relating to the meaning of substantial performance, the *Contractor* acknowledges that the improvements required by this *Contract*, cannot be considered “substantially completed” or “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*, lien legislation applicable to the *Place of the Work*, and the municipal government, utilities and other authorities having jurisdiction.”

- **GC 5.5 FINAL PAYMENT**

- Delete paragraph 5.5.1 in its entirety and substitute new paragraph 5.5.1:
 - “5.5.1 When *Contractor* considers that the *Work* is completed and satisfies the requirements of *Total Completion of the Work* and *Completion of Commissioning*, *Contractor* shall submit an application for final payment. *Contractor*’s application for final payment shall be accompanied by any documents or materials not yet delivered as agreed to in writing by *Owner* pursuant to paragraph 12.1.2 of GC 12.1 - READY-FOR-TAKEOVER together with fully complete asbuilt *Drawings*. Should *Contractor* fail to deliver any of the said documents, or other documents required to be delivered pursuant to the *Contract Documents*, *Owner* shall be at liberty to withhold from amounts otherwise payable to *Contractor*, an amount, in the discretion of *Owner*, up to the full amount otherwise payable to *Contractor* as security for the obligation of *Contractor* to deliver the undelivered documents.”
- Delete from the first line of paragraph 5.5.2 the words, “calendar days” and substitute the words “*Working Days*”.

- Delete paragraph 5.5.4 in its entirety and substitute new paragraph 5.5.4:
 - “5.5.4 Subject to the other requirements of the *Contract*, the unpaid balance of the *Contract Price* shall become payable to *Contractor* on the tenth (10th) *Working Day* following the issuance of *Consultant’s* final certificate for payment, subject to *Owner’s* right to withhold payment from the unpaid balance of the *Contract Price* for any amounts required pursuant to GC 5.6 DEFERRED WORK, and any sums required to satisfy any lien or trust claims arising from the *Work*”.
- Add new paragraph 5.5.5:
 - “5.5.5 As additional preconditions for release of the final payment, *Contractor* shall submit the following documentation:
 - *Contractor’s* written request for release of final payment, including a declaration that no written notices of lien have been received by it;
 - *Contractor’s* Statutory Declaration CCDC 9A2001; and
 - *Contractor’s* Workplace Safety & Insurance Board Clearance Certificate.”

• **GC 5.6 DEFERRED WORK**

- Add new paragraph GC 5.6.2:
 - “5.6.2 Notwithstanding the provisions of GC 5.3 PAYMENT, GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK and GC 5.5 FINAL PAYMENT, *Owner* may withhold payment of any amounts otherwise due under the *Contract* on account of any costs or damages *Owner* has incurred or, is likely to incur, by reason of:
 - defective or incomplete portions of the *Work* or damage to the work of *Other Contractors* not rectified in accordance with the *Contract*;
 - failure of *Contractor* to indemnify *Owner* in accordance with the terms of the *Contract*;
 - failure of *Contractor* to fulfil its obligations in respect of construction liens in accordance with GC 14.2 CONSTRUCTION LIENS;
 - evidence of *Contractor’s* failure to make payments to *Subcontractors* or *Suppliers*;
 - unsatisfactory prosecution of the *Work* by *Contractor* or any *Subcontractor*, and

- failure to attain the *Contract Time*.”

Add new paragraph GC 5.6.3:

“5.6.3 Where *Owner* has withheld payment of any portion of the *Contract Price* pursuant to the provision of paragraphs 5.6.1 or 5.6.2, *Owner* shall be entitled to apply such withheld portion towards any costs or damages suffered by *Owner*.”

• **GC 6.1 OWNER’S RIGHT TO MAKE CHANGES**

- Add the following new paragraphs:

- “6.1.3 *Contractor* shall not be entitled to receive any compensation or extension of *Contract Time*, and *Owner* shall have no obligation or liability to pay compensation to *Contractor*, unless a *Change Order* or *Change Directive* has been issued to *Contractor*, in writing, and before *Contractor* commences with any work in respect of such *Change Order* or *Change Directive*.

- 6.1.4 There shall be no adjustment to the *Contract Time* should *Contractor* fail to present a request for a specific adjustment to the *Contract Time*, if any:

- .1 at the time of first presenting a request for adjustment to the *Contract Price* in response to a *Contemplated Change Order*; or
- .2 within ten (10) *Working Days* of receipt of a *Change Directive*.

- 6.1.5 There shall be no adjustments to the *Contract Time* or *Contract Price* or compensation or payment of any kind whatsoever including potential or contingent costs for matters such as loss of profit, loss of productivity, loss of opportunity or any other such losses based on the quantity, scope or cumulative value or number of changes in the *Work* whether resulting from one or more *Change Orders* or *Change Directives*, unless agreed in writing by the parties in a *Change Order*.

- 6.1.6 There shall be no adjustments to the *Contract Time* or *Contract Price* or compensation or payment of any kind whatsoever relating to a *Contractor* claim unless notice in writing of the claim is given to *Owner*, through *Consultant* not later than twenty (20) *Working Days* after *Contractor* becomes aware of the claim.

- 6.1.7 Any *Change Order* or *Change Directive* shall clearly set out what, if any, extension of the *Contract Time* is anticipated as a result thereof and failing the inclusion of the same, *Contractor* shall be barred in making a claim for extension of the *Contract Time* in respect thereof.

- 6.1.8 With respect to the valuation of any adjustment in the *Contract Price*, subject to any different or additional requirements contained in the *Contract Documents*, the following shall apply:
 - if applicable, unit prices included in the *Contract*, or prices pro rata thereto, will be used to value changes;
 - proposed methods of adjustment should contain itemized breakdowns describing the net actual value of the *Work* (excluding *Value Added Taxes*), *Contractor's* markup for overhead and profit, the markup for overhead and profit of *Subcontractors*, and where appropriate, detailed quotations or cost vouchers from *Subcontractor* and *Suppliers*;
 - all overhead costs are deemed to include both site and head office overhead costs, as well as any applicable insurance and bonding costs;
 - 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 Workplace Safety & Insurance Board coverage, Employment Insurance, Canada Pension, vacation pay, and hospitalization and medical insurance; and
 - 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, *Contractor's* markup for overhead and profit only will be applied to the net value of the change.
- 6.1.9 *Owner*, through *Consultant*, reserves the right to authorize payment for a change in the *Work* by means of *Cash Allowance*. For greater certainty, *Contractor* is not entitled to any markup for overhead and profit on such amounts."

• GC 6.2 CHANGE ORDER

- Delete paragraph 6.2.1 inserting new paragraph 6.2.1 as follows:
 - "6.2.1 When a change in the *Work* is proposed or required, *Consultant* or *Owner* shall provide a notice describing the proposed change in the *Work* to *Contractor*. *Contractor* shall provide:
 - a quotation from the *Contractor*, on the *Contractor's* letterhead and with *Contractor's* signature;
 - quotations from all *Subcontractors*, each on *Subcontractor's* respective letterhead and with *Subcontractor's* respective signature; and

- the following information in quotations from *Subcontractors* and *Contractor*:
 - (1) a complete breakdown for all items of material;
 - (2) a total number of hours for labour;
 - (3) a dollar rate applied against individual material items and labour quantities;
 - (4) stipulated adjustment in the *Contract Time*, if any, for the proposed change in the *Work*;
 - (5) percentage values for overhead and profit by *Contractor* and *Subcontractors*; and
 - (6) all mathematical calculations, which shall be complete.
- Quotations submitted with any of the above items or information in this paragraph 6.2.1 missing or incorrect will be returned for revision.”
- Add new GC 6.2.3 as follows:
- “6.2.3 *Owner* and *Contractor* acknowledge and agree that *Contractor* shall not be entitled to any mark-ups for overhead and profit on any changes in the *Work*, save and except for the following:
 - .1 for changes to the *Work* with a value of less than or equal to \$50,000, *Contractor* shall be entitled to mark-ups for overhead and profit of ten percent (10%) on work performed by *Contractor’s* own forces plus five percent (5%) on work performed by *Subcontractors*; and
 - .2 for changes to the *Work* with a value greater than \$50,000, *Contractor* shall be entitled to mark-ups for overhead and profit of seven and a half percent (7.5%) on work performed by *Contractor’s* own forces plus five percent (5%) on work performed by *Subcontractors*.”
 - .3 for changes to the *Work* for any value, a *Subcontractor* shall be entitled to mark-ups for overhead and profit of ten percent (10%) on work performed by *Subcontractor’s* own forces.
 - .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 6.3 CHANGE DIRECTIVE**
 - Amend paragraph 6.3.7.1 by (a) adding the following to the end of sub-paragraph (1) “carrying out the *Work*, including necessary supervisory services”, and (b) deleting sub-paragraphs (2), (3) and (4) in their entirety.
 - Delete paragraphs 6.3.7.5, 6.3.7.11, 6.3.7.15 and 6.3.7.19.
- **GC 6.4 CONCEALED OR UNKNOWN CONDITIONS**
 - Amend paragraph 6.4.1 by (a) deleting the first line and replacing with “If *Contractor* discovers conditions at the *Place of the Work* that, in *Contractor’s* opinion, are:” and (b) deleting the final two lines and replacing with “then *Contractor* shall give *Notice in Writing* to *Owner* and *Consultant* of such conditions before they are disturbed and in any event no later than two (2) *Working Days* after first observance of the conditions.”
 - Add new paragraphs 6.4.5 and 6.4.6 as follows:
 - “6.4.5 *Contractor* confirms that, prior to entering into the *Contract*, applying the standard of care described in paragraph 1.5.1.1 of GC 1.5 - PROJECT REQUIREMENTS, it carefully investigated the *Place of the Work*. Notwithstanding any other provision in the *Contract*, *Contractor* is not entitled to compensation or to an extension of the *Contract Time* for conditions which could reasonably have been ascertained by *Contractor* by such investigation undertaken prior to the submission of the bid.
 - 6.4.6 *Contractor* shall not be entitled to claim, and waives its rights to make a claim, for any additional compensation or any increase to the *Contract Time* or *Contract Price*, if *Contractor* fails to provide notice to *Owner* as required in paragraph 6.4.1.”
- **GC 6.5 DELAYS**
 - Add the following to the end of paragraphs 6.5.1 and 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”.
 - Add the following to the end of paragraph 6.5.3: “and 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).”
 - Amend paragraph 6.5.3.3 by adding “epidemics or pandemics (except for *COVID-19*),” after the word “conditions,”
 - Add new paragraphs 6.5.6, 6.5.7 and 6.5.8:
 - “6.5.6 *Contractor* shall assume any and all known conditions of *COVID-19* at the time of the execution of this *Contract* during and throughout the performance of the *Work*. Where there is any delay to the *Contract Time*

and/or *Project* or increase to the cost of the *Work*, caused by, resulting from, or related to any stop work order, legislation, measures, or direction, issued by any governmental authority having jurisdiction over the *Project*, in respect to, related to, or resulting from *COVID-19* which arises after the execution of this *Contract*, then:

- .1 *Contractor* shall be entitled to an extension of the *Contract Time* for a reasonable time caused by such stop work order, other order, measure, or direction; and
- .2 *Contractor* shall not be entitled to any increase in compensation whatsoever, including, without limitation, any (a) increase to the *Contract Price*, payment of (b) costs, expenses or damages, and/or (c) any indirect, consequential, or special damages, such as loss of profits, loss of opportunity or loss of productivity.
- 6.5.7 *Contractor* shall at all times perform the services required to perform the *Work* in accordance with the *Contract Documents* diligently and expeditiously, to maintain an orderly progress of the *Work*, and in conformity with the *Contract Time* and any revisions made thereto in accordance with the *Contract Documents*. *Contractor* shall at all times provide sufficient personnel to accomplish its services within the *Contract Time*.
- 6.5.8 If *Contractor* is delayed in the performance of the *Work* by an act or omission of *Contractor* or anyone employed or engaged by *Contractor* directly or indirectly, or by any cause within *Contractor's* control, then *Contractor* shall take appropriate steps, in accordance with paragraph 3.4.2 of GC 3.4 - CONSTRUCTION SCHEDULE, to recover any lost time, and the costs of such recovery efforts shall be to *Contractor's* account. To the extent that *Contractor* caused delay results in *Owner* incurring additional costs and expenses and/or a change in the *Contract Time*, *Contractor* shall be liable to *Owner* for *Owner's* cost and damages arising therefrom, including but not limited to, all services required by *Owner* from *Consultant* as a result of such delay by *Contractor* and, in particular, the cost of *Consultant's* services during the period between the date of *Ready-for-Takeover* stated in Article A1 herein as the same may be extended through the provision of these General Conditions and any later, actual date of *Ready-for-Takeover* achieved by *Contractor*."

• **GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE**

- In paragraph 6.6.5, delete "claim" in the second line and substitute "necessary claim information".
- Add new paragraphs 6.6.7 and 6.6.8 as follows:
 - "6.6.7 *Owner* may make claims arising out of the costs incurred for additional services provided by *Consultant* resulting from *Contractor's* failure to perform the *Work* in accordance with the terms and conditions

of the *Contract*, including *Contractor's* issuance of unnecessary requests for information. *Consultant* will notify *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. *Owner* shall make claims against *Contractor* based on *Consultant's* invoices.

- 6.6.8 *Contractor* shall not make claims arising out of any *COVID-19* conditions known at the time of the execution of this *Contract*.”

- **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 Amend paragraph 7.1.2 by (a) adding the words “or *Owner* determines that sufficient cause exists to justify such action,” in line three after the words “substantial degree”, and (b) deleting the words “including references to applicable provisions of the *Contract*”.
- .2 Delete paragraph 7.1.5.2 and insert new paragraph 7.1.5.2 as follows:
“7.1.5.2 withhold further payment to *Contractor* until *Owner* has completed all *Work* required by the *Contract Documents* and satisfied any of its costs or damages resulting from *Contractor's* default,”
- .3 Amend paragraph 7.1.5.3 by deleting the words “as certified by the *Consultant*”.

- **GC 7.2 CONTRACTOR’S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT**

- Amend paragraph 7.2.2 by (a) adding the words “or related to *COVID-19*” after the first instance of the word “*Contractor*” in the third line, and (b) adding the following second sentence at the end of the paragraph: “If the *Work* is suspended or otherwise delayed as a result of *COVID-19* for a period of ninety (90) *Working Days*, *Contractor* may, upon giving *Owner* twenty (20) days *Notice in Writing*, terminate the *Contract*.”
- Delete subparagraph 7.2.3.1 in its entirety and substitute the following: “Intentionally deleted”.
- Delete subparagraph 7.2.3.3 in its entirety and substitute the following:
“7.2.3.3 *Owner* fails to pay *Contractor* when due the amount certified by *Consultant* or awarded by adjudication, arbitration or a court, except where *Owner* has a bona fide claim for set off, or”
- Delete from line 2 of subparagraph 7.2.3.4, the words, “except for GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER”.
- Amend paragraph 7.2.4 by deleting “5” and substitute “fifteen (15)”.

- Amend paragraph 7.2.5 by (a) deleting “reasonable profit” in line 2, (b) deleting the words “damages” in line 3 and replace with the words “direct and demonstrable costs and expenses”, and (c) by adding the following to the end of the paragraph: “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”.
- Add the following new paragraph 7.2.6:
 - “7.2.6 *Owner’s* withholding of progress payments, holdback payment and/or final payments pursuant to GC 5.6 shall not constitute a default under paragraph 7.2.3 permitting *Contractor* to stop the *Work* or terminate the *Contract*.”

• **GC 8.1 AUTHORITY OF THE CONSULTANT**

- Delete paragraphs 8.1.1, 8.1.2 and 8.1.3 and substitute the following:
 - “8.1.1 Differences between *Owner* and *Contractor* as to the interpretation, application, or administration of this *Contract*, or any failure to agree where agreement between the parties is called for in the *Contract* (the “*Dispute*”) which are not resolved in the first instance by finding of *Consultant* pursuant to the provisions of GC - 2.2 ROLE OF THE CONSULTANT, paragraphs 2.2.6 and 2.2.7 shall be settled in accordance with the requirements of this GC 8.1.
 - 8.1.2 The claimant shall give written notice of the *Dispute* (“*Notice of Dispute*”) to the other party no later than seven (7) days after the receipt of *Consultant’s* finding given under paragraphs 2.2.7 or 2.2.8 of GC 2.2 ROLE OF THE CONSULTANT. The *Notice of Dispute* 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 seven (7) days of receipt of the *Notice of Dispute*, or such longer period as mutually agreed by the parties in writing, setting out the response and any relevant provisions of the *Contract Documents*.
 - 8.1.3 The parties shall make all reasonable efforts to resolve the *Dispute* by amicable negotiations and agree to provide, without prejudice, full, frank, candid, and timely disclosure of relevant facts, information and documents to facilitate the negotiations.
 - 8.1.4 If the *Dispute* is not resolved promptly by amicable negotiations in accordance with GC 8.1.3, *Consultant* may provide instructions that, in *Consultant’s* 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*, *Owner* shall pay *Contractor* verifiable costs incurred by *Contractor* in carrying out such instructions, which *Contractor* was required to do beyond what the *Contract*

Documents correctly understood and interpreted would have required *Contractor* to do including costs resulting from interruption of the *Work*.

- 8.1.5 It is agreed that no act by either party shall be construed as a renunciation or waiver of any of their rights or recourses, provided the party has given the notices in accordance with paragraph 8.1.2 and has carried out the instructions as provided in paragraph 8.1.4, if any.
- 8.1.6 If the parties have not been able to resolve the *Dispute* in accordance with paragraph 8.1.3, the parties may agree to submit the *Dispute* to be finally resolved by arbitration under the rules of arbitration as provided in CCDC 40 in effect at the time of the execution of the *Contract*.
- 8.1.7 If no agreement is made for arbitration, then either party may submit the *Dispute* to such judicial tribunal as the circumstances may required.”

- **GC 8.3 NEGOTIATION, MEDIATION AND ARBITRATION**

- Delete 8.3 in its entirety and substitute the following: “Intentionally deleted”.

- **GC 8.4 RETENTION OF RIGHTS**

- Amend paragraph 8.4.2 by deleting “paragraph 8.3.6 of GC 8.3 – NEGOTIATION, MEDIATION AND ARBITRATION” and substituting “GC 8.1 – AUTHORITY OF THE CONSULTANT”.
- Add new paragraph 8.4.3:
 - “8.4.3 If the parties agree under paragraph 8.1.6 of GC 8.1 - AUTHORITY OF THE CONSULTANT to have a *Dispute* resolved by arbitration, *Contractor* agrees that this paragraph 8.4.3 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 *Contractor* be deprived of its right to enforce its lien against the *Project* should *Owner* fail to satisfy any arbitral award. For greater certainty, nothing in this paragraph 8.4.3 shall prevent *Contractor* from taking the steps required by the *Construction Act*, RSO 1990, c C.30 to preserve and/or perfect a lien to which it may be entitled.”

- **GC 9.1 PROTECTION OF WORK AND PROPERTY**

- Delete subparagraph 9.1.1.1 in its entirety and substitute new subparagraph 9.1.1.1:
 - “9.1.1.1 errors or omissions in the *Contract Documents* which *Contractor* could not have reasonably discovered applying the standard of care described in paragraph 1.5.1.1 of GC 1.5 - PROJECT REQUIREMENTS;”

- Delete paragraph 9.1.2 in its entirety and substitute the following new paragraph 9.1.2:
 - “9.1.2 Before commencing any *Work*, *Contractor* shall determine the locations of all underground utilities and structures indicated in or reasonably apparent or determinable from the *Contract Documents* or that are reasonably discoverable by applying an inspection of the *Place of the Work* to the degree of care and skill described in paragraph 1.5.1.1 of GC 1.5 - PROJECT REQUIREMENTS.”
- Add new paragraph 9.1.5:
 - “9.1.5 *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 *Contractor*, without first consulting *Owner* and receiving written instructions as to the course of action to be followed from either *Owner* or *Consultant*. However, where there is danger to life or public safety, *Contractor* shall take such emergency action as it deems necessary to remove the danger.”

• **GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES**

- Add new paragraph 9.2.5.5 as follows:
 - “.5 comply with *Owner’s* requirements and specifications for *hazardous substances* contained in the *Contract Documents*.”
- Add to paragraph 9.2.6 after the words “is 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 *Contractor* or anyone for whom *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 *Owner* or others,”
- Add to paragraph 9.2.7 after the words “is responsible”, the following:
 - “or that any toxic or *hazardous substances* or materials already at the *Place of the Work* prior to *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 *Contractor* or anyone for whom *Contractor* is responsible in a manner which does comply with legal and regulatory requirements,”
- Add to paragraph 9.2.8 after the words “is responsible”, the following:
 - “or that any toxic or *hazardous substances* or materials already at the *Place of the Work* prior to *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 *Contractor* or anyone for whom *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 *Owner* or others,”

- Add “and *Consultant*” after the word “*Owner*” in subparagraph 9.2.8.4.

- **GC 9.4 CONSTRUCTION SAFETY**

- Delete paragraphs 9.4.1 to 9.4.5 and substitute the following:
 - “9.4.1 *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 *Owner’s* Safety and Infection Control Regulations, Guidelines and Instructions for *Contractors*. *Contractor* shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the *Work*. *Contractor* shall be deemed to be the, accepts the designation of, “constructor” as defined in the *OHSA* for the *Project*, and responsibility for the obligations and liabilities associated therewith. Prior to the commencement of the *Work*, *Contractor* shall submit to *Owner* a copy of the Notice of Project filed with the Ministry of Labour in respect of the *Work*.
 - 9.4.2 Prior to the commencement of the *Work*, *Contractor* shall submit to *Owner*:
 - a current Workplace Safety & Insurance Board Clearance Certificate;
 - copies of *Contractor’s* insurance policies having application to the *Project* or certificates of insurance, at the option of *Owner*;
 - documentation of *Contractor’s* inhouse safetyrelated programs; and
 - a copy of the Notice of Project filed with the Ministry of Labour naming itself as “constructor” under *OHSA*.
 - 9.4.3 *Contractor* hereby represents and warrants to *Owner* that appropriate health and safety instruction and training have been provided and will be provided to *Contractor’s* employees and *Subcontractors*, *Suppliers* and any one for whom *Contractor* is responsible, before the *Work* is commenced and agrees to provide to *Owner*, if requested, proof of such instruction and training.
 - 9.4.4 *Contractor* shall tour the appropriate area to familiarize itself with the job site prior to commencement of the *Work*.

- 9.4.5 *Contractor* shall never work in a manner that may endanger anyone.
- 9.4.6 *Owner* has authority, but not the obligation, to stop the progress of the *Work* whenever in the reasonable opinion of *Owner* or *Consultant* such stoppage is necessary to ensure the safety of life, or of the *Work* or of neighbouring property.
- 9.4.7 *Contractor* shall indemnify and save harmless *Owner*, *Consultant* and their respective agents, officers, directors, employees, consultants, successors and assigns from and against any and all liability, cost, damage or loss, including legal fees and fines, related to or arising out of any and all acts or omissions of *Contractor*, its *Subcontractors*, *Suppliers*, employees, agents or representatives which contravene *Contractor*'s duties and obligations, as constructor, pursuant to the *OHSA*, including the payment of legal fees and disbursements on a solicitor and client basis.
- 9.4.8 Without limiting the generality of paragraph 9.4.7, *Contractor*,
 - .1 agrees to waive and release *Owner* and its agents, officers, directors, employees, successors and assigns from any and all claims, demands, losses, costs, damages, actions, suits, or proceedings as against; and
 - .2 shall indemnify and save harmless *Owner*, *Consultant* and their respective agents, officers, directors, employees, successors and assigns, from and against any and all claims, demands, losses, costs, damages, actions, suits, or proceedings by any *Contractor*'s employees, *Subcontractors*, *Suppliers*, and/or third parties,
- that arise out of, are caused or contributed by, or are attributable to *COVID-19*, including and without limiting the generality of the foregoing, any claims, demands, losses, costs, damages, actions, suits or proceedings arising from, caused or contributed by, or attributable to *COVID-19* outbreaks originating from or on *Owner*'s premises.
- 9.4.9 In the event that *Owner* engages *Other Contractors* at the *Place of the Work* or performs work with its own forces *Owner* undertakes to include in its contracts with *Other Contractors* and/or in its instructions to its own forces the requirement that the *Other Contractors* or own forces, as the case may be, must comply with directions and instructions from *Contractor* as "constructor" with respect to occupational health and safety and related matters."

• GC 9.5 MOULD

- 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 *Consultant* may recommend in consultation with *Contractor*. If, in the opinion of

Consultant, Contractor has been delayed in performing the *Work* and/or has incurred additional costs under paragraph 9.5.1.2, *Owner* shall reimburse *Contractor* for its reasonable costs incurred as a result of the delay as certified by *Consultant*, and”

- **GC 10.1 TAXES AND DUTIES**

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

- **GC 10.2 LAWS, NOTICES, PERMITS, AND FEES**

- Add to the end of paragraph 10.2.4, the following words:

“*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. *Contractor* shall be present at each site inspection by an inspector or registered code agency as applicable under the Ontario Building Code.”
- Delete from the first line of paragraph 10.2.5 the word, “The” and substitute the words “Subject to paragraphs 1.1.3 and 1.1.4 of GC 1.1 - GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT, the”.
- Amend paragraph 10.2.7 by (a) deleting “bid closing” and substituting “execution of the *Contract*”, and (b) adding the following to the end of the paragraph: “, save and except for changes related to *COVID-19* which are provided for under paragraph 6.5.6 of GC 6.5 - DELAYS.”

- **GC 12.1 READY-FOR-TAKEOVER**
 - Amend paragraph 12.1.1.1 by adding “, and all prerequisites for substantial performance under the *Construction Act*, RSO 1990, c C.30 have been satisfied.” after the word “*Work*”.
 - Amend paragraph 12.1.1.4 by (a) adding “spare parts, maintenance materials, warranties, data manuals, and specifications” after the words “maintenance documents” and (b) deleting the word “immediate”.
 - Add new paragraphs 12.1.1.9, 12.1.1.10, and 12.1.1.11:
 - “.9 Local fire authority has inspected and confirmed that life safety systems are acceptable, if required by the *Contract Documents*.”
 - “.10 Elevator inspection and approval by governing authority received by Consultant, if required by the *Contract Documents*.”
 - “.11 Any other prerequisites required by the *Contract Documents*.”
 - Amend paragraph 12.1.2 by deleting “to 12.1.1.6” and substituting “, 12.1.1.5, and 12.1.1.8”.
 - Amend paragraph 12.1.4 by deleting “10 calendar days” and substituting “fifteen (15) *Working Days*, or such longer period as may be reasonably required in the circumstances”.
 - Amend paragraph 12.1.6 by adding “RIGHT OF ENTRY AND ” after “GC 12.2 – ”.
- **GC 12.2 RIGHT OF ENTRY AND EARLY OCCUPANCY BY THE OWNER**
 - Delete GC 12.2 EARLY OCCUPANCY BY THE OWNER in its entirety and substitute the following:
 - **GC 12.2 RIGHT OF ENTRY AND EARLY OCCUPANCY BY THE OWNER**
 - “12.2.1 *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 *Ready-for-Takeover*, if, in the opinion of *Consultant* and *Owner*, such entry or occupation does not prevent or substantially interfere with *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 *Contractor* from responsibility to complete the *Contract* or its obligations under the *Contract*.”
 - 12.2.2 The use or occupancy of the *Work* or any part thereof by *Owner* shall not be taken in any manner as an acceptance by *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 *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 *Owner* or by persons for whom *Owner* is responsible. In particular, without limiting the generality of the foregoing, the use or occupancy of the *Work* or any part thereof by *Owner* shall not release *Contractor* from liability, or waive or impair any rights of *Owner*.”

- **GC 12.3 WARRANTY**

- Amend paragraph 12.3.1 by adding the following sentence to the end of the paragraph: “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 *Consultant*.”
- Delete from the first line of paragraph 12.3.2 the word, “The” and substitute the words “Subject to paragraphs 1.1.3 and 1.1.4 of GC 1.1 - GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT, the”.
- Amend paragraph 12.3.6 by adding the words “, unless otherwise required by the *Contract Documents*” to the end of the third sentence.

- **GC 13.1 INDEMNIFICATION**

- Delete paragraph 13.1.1 in its entirety and substitute the following:
 - “13.1.1 Without restricting the parties obligations to indemnify respecting toxic and hazardous substances, patent fees, and health and safety:
 - .1 *Contractor* shall indemnify and hold harmless *Owner*, *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, *Contractor’s* performance of the *Work* or anyone for whose acts *Contractor* may be liable including *Subcontractor* and, *Suppliers*; and
 - .2 *Owner* shall indemnify and hold harmless *Contractor*, *Contractor’s* agents and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of *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*.”
- Delete paragraphs 13.1.2, 13.1.4 and 13.1.5 in their entirety and substitute the following: “Intentionally deleted”.
- Amend paragraph 13.1.3 by deleting “paragraphs 13.1.1 and 13.1.2” and substituting “paragraph 13.1.1”.

- **GC 13.2 WAIVER OF CLAIMS**

- Delete paragraphs 13.2.3, 13.2.4, 13.2.5, and 13.2.7 and substitute the following: “Intentionally deleted”.
- Amend paragraph 13.2.8 by deleting “party” and substituting “*Contractor*”.
- Amend paragraph 13.2.9 by deleting “paragraphs 13.2.1 or 13.2.3” and substituting “paragraph 13.2.1”.

Add new PART 14 as follows:

“PART 14 OTHER PROVISIONS

• **OWNERSHIP OF MATERIALS**

- 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 *Owner*. All *Work* and *Products* delivered to the *Place of the Work* by *Contractor* shall be the property of *Owner*. *Contractor* shall remove all surplus or rejected materials as its property when notified in writing to do so by *Consultant*.

• **CONSTRUCTION LIENS**

- 14.2.1 *Contractor* shall ensure that *Owner’s* title to the *Project* site is kept free and clear of all construction liens and certificates of action claimed by any person providing services and/or materials to *Contractor* for the *Project*. For greater certainty, this GC 14.2 shall not apply to construction liens or certificates of action that arise as a direct result of the failure by *Owner* to pay *Contractor* in accordance with the terms of this *Contract*.
- 14.2.2 If a construction lien or certificate of action is registered against the title to the *Project* lands, or given with respect to the *Work*, by any person claiming to provide services and/or materials to or through *Contractor*, or *Owner* receives a written notice of lien, *Contractor* shall, within seven (7) *Working Days* of having been notified or becoming aware of the existence of the construction lien, certificate of action or written notice of lien, see to its removal by way of discharge, release or by posting security in accordance with the *Construction Act*, RSO 1990, c C.30, or in the case of a written notice of lien, its written withdrawal
- 14.2.3 In the event that *Contractor* fails to comply with GC 14.2, *Owner* may see to the removal of the construction lien or certificate of action or the withdrawal of the written notice of lien, and in that event, *Contractor* shall be liable to *Owner* for any and all costs and expenses, including legal costs on a full indemnity basis, associated therewith. *Owner* shall be at liberty to set off such costs and expenses against any amount otherwise due to *Contractor* under this *Contract*. If there is no amount owing by *Owner* to *Contractor*, then *Contractor* shall reimburse *Owner* for all of the said costs and associated expenses.

- **CONTRACTOR DISCHARGE OF LIABILITIES**

- 14.3.1 In addition to the obligations assumed by *Contractor* pursuant to GC 3.6 - SUBCONTRACTORS AND SUPPLIERS, *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.

- **DAILY REPORTS/DAILY LOGS**

- 14.4.1 *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 *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.
- *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 *Contractor* in connection with GC 3.4 - CONSTRUCTION SCHEDULE, and comparing that resourcing to the resourcing anticipated when the most recent version of the schedule was prepared pursuant to GC 3.4 - CONSTRUCTION SCHEDULE.

- **HOSPITAL RELATED PROVISIONS**

- 14.5.1 *Contractor* recognizes and understands that *Owner* is a hospital approved under the *Public Hospitals Act*, RSO 1990, c P.40 and is therefore subject to a highly regulated legal and operational environment. Without limiting the generality of any other provision in the *Contract*, *Contractor* shall provide reasonable cooperation and assistance to *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*, RSO 1990, c P.40).
- 14.5.2 *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 *Contractor* or the *Subcontractors* is determined by *Owner* to be a concern for the security or safety of such patients, employees or occupants, *Owner* may require that *Contractor* replace such employee.
- 14.5.3 *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 *Owner*. *Contractor* shall comply with the reasonable instructions provided by *Owner* (including, without limitation, *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 *Contractor* in complying with the said instructions shall be part of the *Contract Price*.

- 14.5.4 Notwithstanding any other provision in the *Contract*, paramountcy of access must be given to emergency vehicles and no claim may be made by *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 *Owner* will use commercially reasonable efforts to avoid and to limit the duration of any temporary lack of access for this reason.
- 14.5.5 *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. *Contractor* shall abide by *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 *Contractor*, *Subcontractors* or *Suppliers*.
- 14.5.6 *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 *Owner* from time to time, provided that a material amendment to the hospital policies and procedures by *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.

1.2 Comply with Section 01 35 33 Infection Control Procedures.

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

1.4 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.

1.5 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 **SPECIFICATIONS**

- 2.1 Specifications are not intended as detailed description of installation methods but serve to indicate particular requirements in completed Work.
- 2.2 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.
- 2.3 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.
- 2.4 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.
- 2.5 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.

- 2.6 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.

3 **DIVISION OF WORK**

- 3.1 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.

4 **REFERENCE STANDARDS**

- 4.1 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.

5 **WORK RESTRICTIONS**

5.1 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", appended to these specifications, 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.
- .3 All building materials and supplies must be in compliance with CSA Z8000, 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.

5.2 Occupancy

- .1 Existing premises outside of the Area of Work will remain occupied 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 on Construction Phasing and Hoarding 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.
- 5.3 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. Make good damage to existing Area of Work and existing building due to Work of this Contract.
 - .3 Maintain temporary entrances to areas of Work and provide enclosed hoardings as required. Maintain access to existing building service entrance(s) at all times.
 - .4 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.
 - .5 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.
 - .6 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.
- 5.4 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.
- 5.5 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.

6 SCHEDULE OF VALUES (VALUE OF SUBMITTALS)

- 6.1 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.
- 6.2 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 1% of Electrical value for Commissioning process including completion and submission of testing forms and reports.
- .4 Contractor shall submit all completed tests, reports and verification forms. The Consultant will use these documents to calculate a percentage completion.
- .5 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.
- .2 Commissioning 20 08 15 for Mechanical and 26 08 15 for Electrical
- 6.3 Revise schedule to list approved Change Orders with each Application for Payment.
- 6.4 Purpose of the cost breakdown is to assist Consultant with evaluation of progress draws and to assist Owner with cash flow arrangements.
- 6.5 The Owner reserves the right to withhold the amounts allocated for Submittals indicated above pending their submission.

7 SPECIAL PROJECT PROCEDURES

- .1 Existing premises will maintain operation during business hours, (06:00am to 06:00 pm) including weekends. Work may be performed during business hours. Be responsible for any overtime work required after business hours in order to meet scheduling requirements. Conform to the requirements of the building management.
- 7.2 Co-ordinate construction activities and use of premises with Owner and building management.
- 7.3 Maintain operations of building services, data, telephone and alarm. Ensure no interruptions of these services during execution of the Work.

- 7.4 Provide written notice to the Owner minimum 14 working days before any system shut downs. Major shutdown requires 25 working days' notice. Do not proceed without written approval from Owner.
- 7.5 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 **CASH ALLOWANCES**

- 8.1 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.
- 8.2 The Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- 8.3 The Owner reserves the right to call competitive tenders for portions of the work to be paid for out of any or all cash allowances. The relationship of the Contractor and the trades performing portions of the work to be paid out of cash allowances shall be such as between the Contractor and his Subcontractors.
- 8.4 Make expenditures out of the cash allowance at the sole discretion of the Owner and only on receipt of a Change Order signed by the Owner and Consultant.
- 8.5 Unexpended amounts of cash allowances may be reallocated to other specific cash allowances at the sole discretion of the Owner.
- 8.6 Unexpended amounts of cash allowances shall be deducted from the Contract Price at completion of the Work.
- 8.7 Include in the Contract Price, cash allowances for the following:
- .1 Unforeseeable Building Conditions
- .1 \$20,000.00

9 **DRILLING OR CORING INTO EXISTING CONCRETE**

- 9.1 Prior to coring and drilling into an existing concrete member (slabs, beams, columns and walls), provide full scanning, X-raying of the surfaces to locate rebars and other embedded items, such as pretensioned strands, electrical and communication conduits. Employ a professional structural engineer registered in the province of Place of the Work to review the Xray scanning report and provide recommendations for coring, drilling, trenching and proposed penetrations.
- 9.2 Once the concrete reinforcement and other obstructions have been located, submit a coring request for review by Consultant, indicating located obstructions layout and proposed penetration locations.
- .1 If obstructions are found, relocate proposed penetrations, anchors and cores in order to avoid damaging embedded items.
- .2 Clearly mark existing concrete to show proposed penetrations.
- .3 In certain cases, it may be necessary for the Consultant to review condition on site. In such cases, arrange a site visit by Consultant to review each proposed location.

- .4 Proceed with coring and drilling only upon obtaining written approval for each condition.
- 9.3 Indicate penetration locations on As-Built Drawings, showing the size of each hole and the distance in relation to grid lines.
- 10 **INSTALLATIONS IN EXISTING HOSPITAL NETWORK HUB ROOMS**
- 10.1 Access to Sunnybrook Hospital Network Rooms is severely restricted and Contractors will not be allowed to access these rooms un-escorted / un-supervised. The Electrical Subcontractor is responsible for arranging any access they require as specified in Electrical Specification Section 27 15 00.
- 10.2 To complete this installation, the following applies:
 - .1 Contractor must provide to the Hospital a minimum of 10 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 ten days written request
 - .4 The Hospital's Security Department will charge \$50.00 (fifty dollars) per hour for a minimum four hours at any one time.
 - .1 Payment to Security Department will be paid by the Hospital and the Contract Price will be adjusted to reflect payment amount.
- 10.3 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.
- 10.4 Refer also to Sunnybrook 'Data Centre and Hub Room Access Policy' appended at the end of the Specifications.
- 11 **PROTECTION AND SECURITY**
- 11.1 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.
- 11.2 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.
- 11.3 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.

- 11.4 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.
- 11.5 Cover openings in equipment, ducts and pipes until final connections are made.
- 11.6 Protect exposed live electrical equipment during construction for personal safety.
- 11.7 Shield and mark live electrical parts with appropriate warnings.
- 11.8 Wherever practical lock or barricade finished areas.
- 11.9 As soon as construction is sufficiently advanced, enclose accessible openings to provide security. Provide temporary doors with security hardware.
- 11.10 Ensure continuous security of the Work and construction equipment.
- 11.11 Provide protection against the elements to maintain Products and installations from damage and deterioration.
- 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 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 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.
- 19.4 Undertake dust control measures to prevent dust nuisances resulting from any phase of the construction operation.
- 19.5 Carry out dust control practices at all locations on site.
- 19.6 Provide air scrubbers for equipment, including trucks, to prevent exhaust fumes from entering nearby buildings' air intakes. Provide documentation to the Consultant confirming installation of scrubbers prior to equipment arriving 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.

25.4 Keep a Fire/No Fire log once an hour for every hour the Fire Alarm Bypass is turned off. Provide previous month's Fire Log to Hospital on the first of every month.

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 The Owner shall provide a physical location on Site to conduct bi weekly construction 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. Identify Drawing Number and Specification Section number to which the submittal applies.

- .2 Unless otherwise specifically permitted by the Consultant, make submittals in groups containing associated items; the Consultant may reject partial submittals as not complying with the provisions of the Contract Documents.
 - .3 Make submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary reviews, for possible revision and re-submittal, and for placing orders and securing delivery so as to cause no delay in the Work or in the work of other contractors. Costs of delays occasioned by tardiness of submittals shall not be borne by the Owner.
 - .4 Do not proceed with Work affected by submittal until review is complete.
 - .5 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.
 - .6 Verify field measurements and affected adjacent Work is coordinated.
- 28.2 Submittals Processing Time: Allow time for submittal review, including time for re-submittals, as follows:
- .1 Time for review shall commence on Consultant's receipt of submittal. If a shop drawing is received after 12 noon, it will be considered as received the next working day for the purposes of the processing time.
 - .2 For scheduling purposes allow minimum 10 working days following submission and minimum 10 working days following resubmission. Consultant will advise Contractor if additional time is required for technical or co-ordination review.
 - .3 Concurrent Review: When concurrent review of submittals by Consultant's subconsultants, Owner, or other parties is required, allow a minimum of fifteen (15) working days for initial review of each submittal. Direct transmittal to Consultant's subconsultants will not be permitted.
 - .4 If at any time the Contractor submits unusually large number of shop drawings, the Consultant will, within 5 working days of receipt of such drawings, provide the Contractor with an estimate of time necessary for processing such shop drawings.
 - .5 Failure to provide submittals in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension will be allowed.
- 28.3 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 Shop drawings and Product Data in electronic format as a PDF or DWG file via the project website or other means of electronic file delivery. Scanned drawings will only be accepted if legible. Illegible drawings will be rejected.
 - .5 Product Data catalogue cuts showing all aspects, design, sizes, components and rough-in information for equipment may be submitted where shop drawings will not be prepared

due to standardized manufacture of product. Supplement standard information to provide details applicable to project. Generic documents will be rejected.

28.4 Samples

- .1 Submit samples for review as requested in respective specification Sections.
- .2 Deliver samples prepaid to Consultant's business address.
 - .1 When requested in respective specification Sections provide samples to Owner's business address in addition to Consultant.

28.5 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 AND RECORD DRAWINGS**

- 29.1 After award of Contract, obtain a set of drawings from the Consultant. Make sets of white prints 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. On a weekly basis, scan marked-up drawings to Adobe PDF format and provide a copy to Owner and Consultant.
- 29.4 On completion of Work and prior to final inspection, submit a copy of record documents to Consultant in PDF format.
- 29.5 Prior to testing, balancing and adjusting, obtain a current set of Revit files from the Consultant and transfer record drawing information to the Revit files, to record final as-built condition.
- 29.6 Drawings are to remain set to and follow Consultants Revit Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.
- 29.7 The Consultant's Revit files may not reflect all or any construction changes.
- 29.8 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the Revit files to record these changes. "Bubble" these revisions, and place these annotations on a separate and easily identified drawing layer.
- 29.9 As-built drawings to show the final as-built condition.
 - .1 Identify each drawing in lower right hand corner in letters at least 12 mm ($\frac{1}{2}$ ") high and as follows:

"AS-BUILT DRAWINGS. This drawing has been revised to show all systems and conditions as installed". [Signature of Contractor] and [Date]

- .2 Provide "AS BUILT DRAWINGS" to Consultant for review. Transfer Consultant's comments to the Revit files. Return Drawings modified to "As Built" condition to Consultants on CD, DVD, or USB flash drive.
- .3 Submit three (3) sets of final "AS BUILT DRAWINGS" white prints with Operating and Maintenance Manuals.
- .4 Submit full set of final "AS BUILT DRAWINGS" to Owner in digital format: Revit and PDF files, on CD or DVD Rom, or USB flash drive, in triplicate.

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 Conveying Equipment

- .1 Provide and maintain conveying equipment such as cranes, hoists, derricks and the like as required for the proper execution of the project.
- .2 Assume complete responsibility for construction, strength, placing, anchoring and operation of derricks, cranes, hoists, guy and operating cables and any other mechanical contrivance used for the work, to ensure that any load carried thereon can be safely supported and be free from accidents.
- .3 Provide air scrubbers for crane equipment, including trucks, to prevent exhaust fumes from entering nearby buildings' air intakes. Provide documentation to the Consultant confirming installation of scrubbers prior to equipment arriving on site.
- .4 Where local by-laws and regulations or any authorities having jurisdiction require drawings and specifications on accessory and conveying equipment, obtain and pay for same and assume responsibility for their adequacy.

32.4 Hoisting and Delivery

- .1 Deliveries shall be scheduled between 7:30 am to 3.30 pm. Any deliveries to be made on weekends must be scheduled with the hospital a minimum of three business days in advance. Large deliveries, which could affect the operations of the hospital, shall be scheduled with the hospital a minimum of 10 business days in advance.
- .2 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.

- .3 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.
- 32.5 Security Provisions
 - .1 Maintain and conform to existing security provisions required by the building management. Do not compromise such provisions.
- 32.6 Hoarding and Barricades
 - .1 Erect modular hoarding and barricades to protect public, workers, public and private property from injury or damage. Provide lockable doors within hoarding for access to site by workers.
 - .2 Locks shall be Best construction core. Provide spare keys to Sunnybrook Security.
- 32.7 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.
- 32.8 Parking
 - .1 Construction parking is extremely limited. Construction personnel may park in the designated construction parking lot and only with a valid parking permit.
 - .2 Parking Permit cost is based on Owner's set fees and is on a first come first serve basis.
 - .3 Permits can be purchased at the Parking Service Office.
- 32.9 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 assembly description of the hoarding / tarps / dust barriers and 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.

- 32.10 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.
 - .3 Storage outside the construction zone is not permitted.
- 32.11 Sanitary Facilities
 - .1 Existing facilities as designated may be used during construction period.
 - .2 Maintain in clean condition.
- 32.12 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, valves, 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.
- 32.13 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.
- 32.14 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.
- 32.15 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.
- 32.16 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.

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 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.
- .3 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.
- .4 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 **EQUIPMENT MAINTENANCE, EQUIPMENT OPERATION AND WARRANTY**

- 36.1 Contractor to provide ongoing review and maintenance to all equipment and associated infrastructure as required, prior to the Substantial Performance of the Work. Refer to Mechanical and Electrical specifications for additional information and requirements.

- 36.2 All Equipment and system warranties to start after Substantial Performance of the Work even though equipment may be operating during early phases.
- 36.3 At the beginning of the 12th month after Substantial Performance of the Work, the Owner, Contractor and Consultant, along with the key Subcontractors, shall carry out a complete review of the Work and all building systems to determine which deficiencies are to be rectified under warranty. Contractor shall be responsible for timely written notification of Owner and Consultant prior to such end of warranty period inspection. Any delay in such notification shall extend such warranty period until proper notification is received by Owner and Consultant.

37 **GENERAL COMMISSIONING REQUIREMENTS**

- 37.1 The Owner will retain and pay for an Independent Commissioning Agent (CA) who will provide Commissioning Services including witness Testing and Commissioning Services as required.
- 37.2 The Owner's designated Commissioning Agent will provide the commissioning procedures and checklists for use by the Contractor and his Subcontractors.
- 37.3 Contractor's Roles and Responsibilities
- .1 Prepare the commissioning schedule in conjunction with construction schedule.
 - .2 Lead the coordination and scheduling of commissioning work.
 - .3 Schedule and attend commissioning coordination meetings.
 - .4 Ensure cooperation and participation of all sub-contractors, major equipment manufacturers, and suppliers.
 - .5 Ensure deficiencies are corrected.
 - .6 Upon completion of all phases of the commissioning program, provide a final commissioning report.
 - .7 Provide testing of integrated life safety and fire protection systems and related equipment in accordance with CAN/ULC S1001 Integrated Systems Testing of Fire Protection and Life Safety Systems and Fire Protection Commissioning.
- 37.4 For additional requirements, refer to individual technical specifications for each affected Division of the Work, specifically to sections 20 08 11, 20 08 15, and section 26 08 15.

38 **CONTRACT CLOSEOUT**

- 38.1 Final Cleaning
- .1 When the Work is Substantially Performed, remove surplus products, tools construction machinery and equipment not required for performance of remaining Work.
 - .2 Leave work broom clean before inspection process commences.
 - .3 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

- .4 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls ceilings.
- .5 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .6 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- 38.2 Systems Demonstration / Training
 - .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.
 - .3 Provide training to Owner's personnel on operations and maintenance of all systems and equipment.
 - .1 The training session must be video-recorded by a professional media company acceptable to the Owner (no cell phone recording).
- 38.3 Documents
 - .1 Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers, and manufacturers.
 - .2 Organize contents within Operation and Maintenance Data binder into applicable sections of work to parallel project specification breakdown using broad scope headings: Architectural, Mechanical, Electrical, etc.
 - .3 Submit material prior to final application for payment.
 - .4 Submit three (3) print copies and three (3) CD-ROM or USB flash drives with electronic files of Project Record Manual consisting of operation and maintenance manuals in PDF format, three (3) sets of final "MAS BUILD DRAWINGS" white prints; and full set of final "AS BUILT DRAWINGS" in digital format: AutoCAD and PDF files on CD-ROM or USB flash drives (in triplicate).
 - .5 Provide warranties fully executed and notarized.
 - .6 Execute transition of Performance Bond to warranty period requirements.
- 38.4 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

1 SUBSTITUTIONS

- 1.1 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.
- 1.2 No substitutions will be permitted without prior written approval of the Consultant.
- 1.3 Proposals for substitutions may only be submitted after award of Contract.
- 1.4 Substitutions submitted on shop drawings without following requirements of this Section prior to submission of the shop drawings will cause the shop drawings to be rejected at any time. Consultant's review of shop drawings shall not be construed as approval of substitutions.
- 1.5 Requests for substitutions must include statements of:
 - .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.
- 1.6 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 not change the Contract Price and Contract Time; or
 - .3 If substitute materials and products to those specified, which are brought to the attention of and considered by the Consultant as superior to those specified, will not change the Contract Price and Contract Time; or
 - .4 If a material or product is specified together with a requirement for performance and, in the opinion of the Contractor, the specified material or product will not produce the required results.
- 1.7 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 Subcontractor's responsibility under the Contract.
- 1.8 Should proposed substitution be accepted either in part or in whole, bear full responsibility and costs when substitution affects other work on the project. Pay for design and contract document changes required as result of the substitution.
- 1.9 Amounts of all credits arising from acceptance of substitutions will be determined by the Consultant and the Contract Price adjusted accordingly.

- 1.10 Wherein the expression "other acceptable equivalents" or similar expressions in specification Sections, submissions under the expression shall be as specified in this Section.

End of Section

Substitution Request No: _____ Date: _____

Project: _____ Project No: _____

Contractor: _____

Specified Product Specification Reference

Section Number	Section Title	Paragraph Number
_____	_____	_____

Proposed Substitution

**Manufacturer and
Product Trade Name**

Address

Phone Number

Contact Name

Model Number

History of Product

New Product ____ 2-5 years old ____ 5-10 years old ____ More than 10 years old ____

Similar Installation

Project Name & Address

Consultant

Owner

**Proposed
Substitution Affects
Other Parts of Work**

No ____ Yes, explain:

**Differences Between
Proposed Substitution
and Specified Product**

**Reason For Not
Providing Specified
Product**

**Changes to Contract
Price**

Add/Deduct \$ _____

**Changes to Contract
Time**

Add/Deduct _____ days

Contractor's Declaration

The Contractor Declares that:

- Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to specified product, and complies with requirements of authorities having jurisdiction.
- Same warranty will be furnished for proposed substitution as for specified product.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Proposed substitution is compatible with adjacent materials and assemblies.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Signed By: _____ Date: _____

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Reports ☐ Other _____

Consultant's Review

- ☐ Substitution Accepted – Provide submittals in accordance with Specification requirement.
- ☐ Substitution Accepted as Noted – Provide submittals in accordance with Specification requirement.
- ☐ Substitution Not Accepted – Use specified product.

Signed By: _____ Date: _____

Owner's Acceptance

Signed By: _____ Date: _____

Additional Comments:

☐ Consultant _____

☐ Contractor _____

☐ Owner _____

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.
 - .7 Use of premises by Owner and Contractor.
 - .8 Owner's requirements and partial occupancy.
 - .9 Construction facilities and controls provided by Owner.
 - .10 Temporary utilities provided by Owner.
 - .11 Security and housekeeping procedures.
 - .12 Procedures for maintaining record documents.

4 PROGRESS MEETINGS

- 4.1 Schedule and administer meetings throughout progress of the Work at maximum bi-weekly intervals.
- 4.2 Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within two 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 Identification of problems which impede planned progress.
 - .5 Review of submittals schedule and status of submittals.
 - .6 Review of off-site fabrication and delivery schedules.

- .7 Maintenance of progress schedule.
- .8 Corrective measures to regain projected schedules.
- .9 Planned progress during succeeding work period.
- .10 Coordination of projected progress.
- .11 Maintenance of quality and work standards.
- .12 Effect of proposed changes on progress schedule and coordination.
- .13 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 Two-week 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 SCHEDULE

- 3.1 The Construction Schedule shall be in the form of a series of activities and milestones that are logically linked utilizing Critical Path Methodology. The Construction Schedule shall identify early dates and late dates as well as the Project critical path of activities and completion milestones through the Project
- 3.2 Coordinate the construction schedule with the Owner.
 - .1 Develop and submit Construction Schedule to the Consultant and regularly review the progress of the work with the Consultant.
 - .2 Allow for facilitating the work of the Consultant who will be monitoring the progress of activities within the Master Project Schedule and reporting to the Owner on a monthly basis the schedule status of the project.
 - .3 Master Project Schedule: The Master Project Schedule is the schedule which facilitates the Owner's planning or activities and requirements for the Project, of which this work is part. In addition to the major milestones for the Work from the Construction Schedule provided by the Contractor, the Master Project Schedule contains activities to be performed by the Owner, the Consultant, and Authorities of Jurisdiction.

4 SUBMISSION

- 4.1 Submit initial schedules within 15 days after award of contract.
- 4.2 Submit digital document in both PDF and Microsoft Project formats.
- 4.3 Consultant will review schedule and return review copy within 10 days after receipt.
- 4.4 Resubmit finalized schedule within 7 days after return of review copy.
- 4.5 Submit revised progress schedule with each application for payment.

- 4.6 Distribute copies of the revised schedule to:
 - .1 Job site office.
 - .2 Subcontractors.
 - .3 Other concerned parties.
- 4.7 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 Abatement.
 - .3 Framing.
 - .4 Special procedures.
 - .5 Special Subcontractor work.
 - .6 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.
- 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 **TWO-WEEK LOOK-AHEAD SCHEDULE**

6.1 Format: agenda style calendar, to fit 8 1/2" x 11" pages

6.2 Indicate each trade activity on each day, including deliveries, submittals, and coordination activities.

6.3 Indicate coordination activities with Owner, Consultant, Subcontractors.

6.4 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

6.5 Two-week period shall commence on the first working day of the week following the Progress Meeting at which it is submitted.

6.6 Submit up-to-date two-week look-ahead schedule at each Progress Meeting and at maximum two-week intervals.

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 Construction Personnel: Protective clothing is to be removed when exiting through patient areas or vacuumed when exiting through other areas as categorized by IPCS as specified in Appendix "I". Construction personnel will not pass through clinical areas of the hospital without approval from the IPCS or Owner.
 - .1 Daily outer garments must be clean and maintained at all times.
 - .2 Daily footwear will be maintained clean and dust free at all times.
 - .3 Daily protective headgear will be maintained clean and dust free at all times.
 - .4 Hospital identification will be worn and displayed in a manner visible to any individual or passer-by.

1.10 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.

1.11 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, Special requirements for heating, ventilation, and air-conditioning (HVAC) systems in health care facilities.

.2 CAN/CSA-Z317.13, 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 Sunnybrook 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 cleaning 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 Contractor shall:
 - .1 When constructing the hoarding, install an electronic magnehelic gauge complete with recording capability and local audible alarm.
 - .2 Maintain a daily log for full duration of the construction and provide the data to the Consultant and Owner upon request.
 - 5.9 Ensure that mandatory vacuuming and cleaning of Contractors and Subcontractors clothes is done, 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

1 DEFINITION

- 1.1 Containment Areas: Include all areas of construction activities, including staging and storage areas, and passage areas for workers, supplies and waste. It also includes ceiling spaces above and adjacent to construction activities.

2 PROJECT CLEANLINESS

- 2.1 Airborne contaminants control is critical in all hospital areas. Contractor shall limit dissemination of airborne contaminants produced by construction-related activities, including dust, chalk, powders, aerosols, fumes, fibers and other similar materials.
- 2.2 Clean interiors of the containment areas on a continuous basis daily to provide suitable conditions for Work and remove mud and dirty footprints.
- 2.3 Use wet cleaning methods and HEPA-filtered vacuum cleaners to minimize release of airborne contaminants in work area, adjacent hallways and passage areas. No sweeping allowed
- 2.4 Regardless of containment strategies, execute work by methods to minimize raising dust from construction operations. Water may be used to assist in controlling airborne dust.
- 2.5 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.
- 2.6 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.
- 2.7 Implement airborne contaminants control in accordance with Section 01 35 33 Infection Control Procedures.
- 2.8 Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to closing such spaces
- 2.9 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- 2.10 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Owner.
- 2.11 Provide on-site covered containers for collection of waste materials and debris.
- 2.12 Provide and use marked separate bins for recycling.
- 2.13 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- 2.14 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- 2.15 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

3 **FINAL CLEANING**

- 3.1 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.
- 3.2 Remove waste products and debris and leave Work clean and suitable for occupancy.
- 3.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
- 3.4 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.
- 3.5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.
- 3.6 Clean lighting reflectors, lenses, and other lighting surfaces.
- 3.7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- 3.8 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- 3.9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- 3.10 Broom clean and wash exterior walks, steps and surfaces.
- 3.11 Remove dirt and other disfiguration from exterior surfaces.
- 3.12 Clean light wells.
- 3.13 Clean equipment and fixtures to sanitary condition; replace filters of mechanical equipment used for temporary heat and ventilation.
- 3.14 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- 3.15 Prior to hospital use of premises, Contractor and Owner with jointly conduct an inspection of sight-exposed surface to verify that the entire Work is clean. Correct conditions found to be inadequate. If Contractor fails to correct inadequate conditions, Owner will proceed with the thorough cleaning and deduct the cost from the final payment.

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 to Consultant for review of demolition of structural elements.
 - .1 Make sure drawings bear the seal and signature of a licensed Professional Engineer, registered to practice in the Province of Ontario.
 - .2 Drawings to indicate extent of demolition and method of temporary shoring of existing structure where required.

1.5 PROTECTION

- .1 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 property and for the protection of public.
- .2 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.
- .3 Provide protection required to enable existing building and equipment to remain in continuous and normal operations, and maintain construction schedule.
- .4 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

PART - 2 PRODUCTS

2.1 MATERIALS

- .1 Temporary braces, tie-rods, clamps, supports and cratings: constructed in accordance with plans prepared by Contractor.

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 Comply with Infection Control Procedures, Section 01 35 33.

PART - 3 EXECUTION

3.1 PREPARATION

- .1 Notify the Consultant at least seven (7) days prior to commencing of the work.
- .2 The drawings do not purport to show all objects existing on the site. Before commencing the Work, carefully check drawings and verify with the Consultant regarding all objects to be removed and all objects to be preserved.
- .3 Schedule all Work in a careful manner with all necessary consideration for the requirements of Owner, his employees and the public.
- .4 Avoid interference with the use of, and passage to and from, adjacent buildings and facilities.
- .5 Before shutting-down any system verify with the Owner and schedule acceptable shut-down date with minimum 14 days' notice.
- .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 and protect against damage all materials and equipment to be salvaged or relocated for reuse in the new work as directed by the Owner.
- .5 Take possession of all other materials arising from the demolition work and remove from the site daily.
- .6 Demolished materials become Contractor's property, unless such materials are identified on Contract Documents to be reused or turned over to Owner.
- .7 Demolish work into sections of practical size for removal without alteration or damage to the existing building remaining in place.
- .8 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.
- .9 Cut to accommodate new structural steel members.
- .10 Sawcut floors, walls, ceiling and other elements before demolition is started, to minimize damage. Make cuts with clean, true, smooth edges. New openings required in existing walls and partitions shall be carefully cut and formed to blend into existing work.
- .11 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.
- .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 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.
- .15 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 Consultant's approval at no additional expense to Owner.
- .16 Materials and other equipment not required for re-use shall not be stored or sold from the site. Maintain the existing building in a weather and watertight condition at all times. Maintain security of existing building.
- .17 Upon completion of demolition, leave interior surfaces clean and dust free.

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. 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.
- .2 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 Cut rigid materials using power saw or core drill. Pneumatic or impact tools not allowed.
- .3 Remove and replace defective and non-conforming work.
- .4 Perform work to avoid damage to other work. Prepare proper surfaces to receive patching and finishing.
- .5 Restore work with new products to match existing in accordance with Contract Documents.
- .6 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .7 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with fire rated material, full thickness of construction element.

- .8 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 A53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- .2 ASTM A307: Standard Specifications for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- .3 ASTM A325M: High-Strength Bolts for Structural Steel Joints
- .4 ASTM A653/A653M: Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
- .5 ASTM F436: Hardened Steel Washers (for Use with High Strength Bolts)
- .6 CSA-G40.20/G40.21-M: General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
- .7 CAN/CGSB-1.181: Ready Mixed Organic Zinc Rich Coating
- .8 CAN/CSA G164-M: Hot Dip Galvanizing of Irregularly Shaped Articles
- .9 CAN/CSA-S16.1: Limit States Design of Steel Structures
- .10 CSA W47.1: Certification of Companies for Fusion Welding of Steel Structures
- .11 CSA W48 Series: Electrodes
- .12 CSA W59-M: Welded Steel Construction (Metal Arc Welding)
- .13 CSA-W117.2: Safety in Welding, Cutting and Allied Processes
- .14 CGSB 85-GP-16M: Painting Galvanized Steel
- .15 CISC/CPMA 2.75: Canadian Institute of Steel Construction/Canadian Paint Manufacturers Association "A Quick-Drying Primer for Use on Structural Steel"
- .16 CISC: Canadian Institute of Steel Construction, "Code of Standard Practice"
- .17 SSPC: Steel Structures Painting Council, "Steel Structures Painting Manual, Vol. 2"

1.3 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 Clearly show and describe all items; sections, dimensions, erection details, anchors and fastenings, connection and jointing details.
- .4 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 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.

1.4 **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 Employ welding operators licensed per CSA W47.1 for types of welding required by the Work.

1.5 **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.

1.6 **COORDINATION**

- .1 Supply to 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.

1.7 **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 Fasteners: Type 304 or Type 316 to suit.

- .4 Galvanizing, steel shapes: CSA G164 Table 1, hot dip galvanized and passivated after fabrication of individual components.
- .5 Galvanizing, 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.
- .6 Welding Materials: Conforming to CSA W48.1-M and CSA W59-M.
- .7 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.
- .8 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.
- .9 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.

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.

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 **GALVANIZING**

- .1 Unless otherwise specified galvanize exterior 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 steel, in accordance with CSA G164 coating weight as prescribed for type of article, or ASTM A525M coating weight of 380 g/sq.m. as applicable. Galvanize

- after fabrication where possible. Follow recommended precautions to avoid embrittlement of the base metal by overpickling, overheating or during galvanizing.
- .3 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.
 - .4 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.
 - .5 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.
 - .6 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 (8 mils) 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.

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 masonry 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 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 This work shall include, without being limited to -
 - .1 Steel struts to support suspended lead shielding
 - .2 Steel posts to counters.
 - .3 Stainless Steel Items
 - .1 Supply and install stainless steel items indicated on drawings, complete with fastenings and other incidentals required and as detailed. Refer to 'Materials' articles for alloy.
 - .2 Stainless steel finish: as specified under 'Finishes' article of this section, unless specified otherwise below.
 - .3 This work shall include, without being limited to:
 - .1 1.6 mm stainless steel corner guards for plaster walls.
 - .4 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 the 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. Design supports with a safety factor of 3. Design supports further as required to accommodate structural deflection.
 - .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, pre-cast concrete connections, 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.
 - .5 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.
- 3.6 **RECONSTRUCTION, ALTERATIONS AND MAKING GOOD**
- .1 Do 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 QUALITY ASSURANCE

- .1 Lumber identification: By grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Fire-rated treated lumber: to ULC S102
- .3 Plywood identification: By grade mark in accordance with applicable CSA standards.
- .4 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .5 Regulatory requirements: Provide finished wall assemblies flame spread rating of not more than 150 and finished ceiling assemblies flame spread of not more than 25.

1.3 SUBMITTALS

- .1 Test reports: Duplicate copies of flame spread classification test reports by independent testing agency to requirements of ULC S102.

PART - 2 PRODUCTS

2.1 MATERIAL

- .1 Lumber: Acceptable to authorities having jurisdiction and unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with CSA-O141 and NLGA Standard Grading Rules for Canadian Lumber.
- .2 Furring, blocking, nailing strips, grounds, and rough bucks: S2S, Standard or better grade.
- .3 Douglas fir plywood: CSA O121, standard construction.
- .4 Canadian softwood plywood: CSA O151, standard construction.
- .5 Poplar plywood: CSA 0153, standard construction.
- .6 Interior mat-formed wood particleboard: ANSI/NPA-A208.1
- .7 Hardboard: CAN/CGSB-11.3.
- .8 Nails, spikes and staples: CSA B111.
- .9 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .10 Galvanizing: CSA G164, use galvanized fasteners for interior highly humid areas, pressure-preservative and fire-retardant treated work.
- .11 Fire retardant treated wood: To ULC S102, flame spread, fuel contributed and smoke developed ratings of 25 or less, pressure treated.
 - .1 Lumber and plywood: FirePro FRTW by Osmose, or Dricon FRT by Arch Wood Products Inc., or other acceptable equivalents.
 - .2 Particleboard: Duraflake FR by Weyerhaeuser, or other acceptable equivalents.

PART - 3 EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Install members true to line, levels and elevations.
- .2 Construct continuous members from pieces of longest practical length.
- .3 Install spanning members with "crown-edge" up.
- .4 Install materials so that grade-marks and other defacing marks are not visible or are removed by sanding.

3.2 FURRING AND BLOCKING

- .1 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, washroom accessories, equipment and other work as required.

3.3 NAILING STRIPS, GROUNDS AND ROUGH BUCKS

- .1 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

3.4 FASTENERS

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.
- .3 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.5 ELECTRICAL, DATA AND TELEPHONE EQUIPMENT BACKBOARD

- .1 Provide fire retardant treated backboards for mounting electrical equipment as indicated. Use 19 mm thick plywood on 38 mm x 89 mm furring around perimeter and at maximum 300 mm intermediate spacing.

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 E2174, Standard Practice for On-Site Inspection of Installed Fire Stops

.2 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-S104, Standard Method for Fire Tests of Door Assemblies
- .3 CAN/ULC-S105, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.
- .4 CAN/ULC-S115, Standard Method of Fire Test of Firestop Systems.

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 CAN/ULC-S104 and CAN/ULC-S105 for ratings indicated.

1.4 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 OBC.

- .6 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.
- .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 assembly shall be in accordance with ULC listed system design limitations, unless proposed assembly is approved by authorities having jurisdiction and meets Consultant's approval.
 - .1 Technical submissions that propose deviations from a listed assembly must be prepared, stamped and signed by a Professional Engineer, licensed to practice in the Province of Ontario.

1.5 **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 Provide work of this Section using competent installers experienced, trained and approved by material or system manufacturer for application of materials and systems being used. Installers shall have minimum 5 years experience in installation of firestopping materials as systems for multiple trade projects.
 - .1 Approved applicators of fireproofing materials shall select, with manufacturer's recommendations, ULC rated assembly to achieve the required fire resistance rating.
- .3 Work of this Section shall be by one Sub-Contractor responsible for firestopping materials and systems for all of the Work except as outlined above.

- .4 Pre-installation meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review procedures to be adopted, 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.
- .5 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.
- 1.6 **COORDINATION**
 - .1 Coordinate with Sections involved (and advise dates) where work will take place throughout various areas of Work.
- 1.7 **DELIVERY, STORAGE AND HANDLING**
 - .1 Deliver materials to Site in manufacturer's sealed and labelled containers. Materials shall be subject to Consultant's inspection.
 - .2 Store materials inside building for 24 hours prior to use; store in area designated by Consultant; protect from damage and environmental conditions detrimental to material.
- 1.8 **ENVIRONMENTAL CONDITIONS**
 - .1 Maintain minimum temperature of 40 deg F for minimum period of 1 week before application, during application and until application is fully cured.
 - .2 Conform to manufacturer's recommended temperatures, relative humidity and substrate moisture content for storage, mixing, application and curing of firestopping materials.
 - .3 Ventilate areas in which firestopping is being applied. Protect water-soluble material from wetting until fully cured.
- 1.9 **SUBMITTALS**
 - .1 Shop Drawings: Submit complete and detailed shop for each condition encountered on Site. Indicate following:
 - .1 ULC assembly number certification, unless proposed assembly is approved by authorities having jurisdiction and meets Consultant's approval
 - .2 Required temperature rise and flame rating
 - .3 Hose stream rating (where applicable)
 - .4 Thickness
 - .5 Proposed installation methods
 - .6 Material of firestopping and smoke seals, primers, reinforcements, damming materials, reinforcements and anchorages/fastenings
 - .7 Size of opening
 - .8 Adjacent materials
 - .9 Number of penetrations
 - .10 Location of penetrations
 - .2 Product Data: Submit up-to-date manufacturer's product data proposed for use under this Section. Include manufacture printed instructions for installation.
 - .3 Samples: If requested, submit samples of each type of firestopping systems, smoke seals and accessories. Indicate location where material/system shall be used

- .4 Certification: Submit current ULC listings and certified copies of test reports and/or smoke seals indicating that firestopping material/systems conforms to or exceeds specified requirements.
- .5 Engineering Judgments:
 - .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 an Engineering Judgment (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 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.

1.10 **WARRANTY**

- .1 Warrant work of this Section against defects and deficiencies for period of 5 years commencing at the date of Substantial Performance. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no additional cost to Owner. 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.

2.2 **MATERIALS**

- .1 Primer: As recommended by firestopping material manufacturer for specific substrate and use.
- .2 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 (1/32") thick galvanized steel sheet.
- .3 Pipe and duct insulation and wrappings: Compatible with firestopping material; as recommended by manufacturer.
- .4 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.
- .5 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.
- .6 Firestop insulation: pre-formed, semi rigid, non-combustible mineral wool.
- .7 Junction box / outlet sealing putty: intumescent putty, pre-formed in pads.
- .8 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.

PART - 3 EXECUTION

3.1 PREPARATION

- .1 Remove combustible material and loose material detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.
- .2 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.
- .3 Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.
- .4 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.
- .5 Fully protect walls, windows, floors and other surfaces around areas to be firestopped from marring or damage.
- .6 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.
- .7 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.
- .8 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.
- .9 Install damming and firestopping materials as per manufacturer's instructions.
- .10 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 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.
- .3 Remove excess compound promptly as work progresses and upon completion.
- .4 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.
- .5 Do not cover materials until full cure has taken place.

- .6 Provide firestop systems at following locations, without being limited to:
 - .1 At openings, voids and penetrations through floor slabs except openings within shafts constructed with a fire resistance rating and slabs on granular fill.
 - .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 Around mechanical and electrical assemblies penetrating fire assemblies.
 - .5 Between tops of fire rated walls and partitions and underside of floor or roof slabs.
 - .6 At all expansion joints in walls, floors and assemblies as detailed
- .7 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.
- .8 Cure materials in accordance with manufacturer's directions.

3.3 **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.
- .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 REFERENCES

.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:** Provide 1 of following:
 - .1 Multicomponent, non-sag, polyurethane joint sealant, meeting specified requirements of ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
 - .1 Dymeric 240 by Tremco (Canada),
OR
 - .2 Multicomponent, non-sag, polyurethane joint sealant, meeting specified requirements of ASTM C 920, Type M, Grade NS, Class 25, for Use NT.
 - .1 Vulkem 227 by Tremco (Canada),
 - .2 SikaFlex 2c NS by Sika Canada Inc.
 - .3 Sonolastic NP2 by BASF Construction Chemicals, LLC-Building Systems.
OR
 - .3 Non-sag type, 1 component ultra-low-modulus, pre-pigmented, neutral cure elastomeric silicone sealant conforming to ASTM C920, Type S, Grade NS, Class 100/50, Use NT, G, M, A and O. Supply in standard colours as selected.
 - .1 Dow Corning 790 by Dow Corning Corporation.
 - .2 GE SCS2700 SilPruf LM by Momentive Performance Materials Inc.
 - .3 SikaSil-C990 by Sika Canada Inc.
 - .4 Spectrem 1 by Tremco (Canada).
OR
 - .4 Non-sag type, 1 component medium-modulus, pre-pigmented, neutral cure elastomeric silicone sealant conforming to ASTM C920, Type S, Grade NS, Class 50, Use NT, G, M, A and O. Supply in standard colours as selected.
 - .1 Dow Corning 791 by Dow Corning Corporation.
 - .2 GE SCS2000 SilPruf by Momentive Performance Materials Inc.
 - .3 SikaSil-C995 by Sika Canada Inc.
 - .4 Spectrem 2 by Tremco (Canada).
 - .5 OmniSeal by BASF Construction Chemicals, LLC-Building Systems.
- .2 **Sealant Type 2:**
 - .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.
 - .3 **Sealant Type 3:** 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.
 - .4 **Sealant Type 4:** 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.
- 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 1:
 - .1 Typically used in joints between metal frames and adjacent masonry and/or concrete construction in exterior walls, exterior and interior sides; control and expansion joints in exterior and interior surfaces of poured-in-place concrete walls, precast architectural wall panels and unit masonry walls; sealing of joints between underside of pre-stressed precast concrete floor slabs and masonry; and other locations where sealant is required or noted on Drawings except in locations designated for Type 2, 3, and 4 and except where sealant is specified in other Sections.
- .4 Seal following joints with Sealant Type 2 one component modified polyurethane sealant:
 - .1 Interior gypsum board control joints.
- .5 Seal following joints with Sealant Type 3 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.
- .6 Seal following joints with Sealant Type 4 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.

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.

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 CAN/ULC S104M: Standard Method for Fire Tests of Door Assemblies
 - .2 CAN/ULC S105M: Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-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 CAN/ULC S104M and CAN/ULC 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 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 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.
- .3 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.
- .4 Interior Hollow Metal Door Frames: 1.6mm thick, cold-rolled commercial quality steel; paintable galvanneal finish; sizes as indicated on Door Schedule and Drawings.

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 galvanized 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 galvanized 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 Joint Sealer: as specified in Section 07 92 00.
- .7 Fasteners for Stops: Cadmium plated steel, counter sunk flat or oval head sheet metal Phillips screws.
- .8 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.
- .9 Resilient bumpers: Round, black rubber, stud mount.
- .10 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.

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 Pre-wire door complete with CSA approved EMT metallic conduit and fittings for Electrolynx system where indicated on Door and Frame Hardware Schedule.
- .9 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 Where electrified hardware is specified on the approved hardware schedule, steel door and frame product, shall be provided with Electrolynx system consisting of CSA approved conduit, junction boxes and wire harness complete with modular plugs for coordinated connection directly to the electrified hardware. Refer to Section 08 71 00 – Door Hardware for openings that require electrified hardware.
- .10 Reinforce door edges with channel reinforcing.
- .11 Door faces of all steel doors shall be fabricated without visible seams, free of scale, pitting, coil brakes, buckles and waves.
- .12 Longitudinal edges of doors shall be mechanically interlocked and adhesive assisted.
- .13 Tack weld and fill seam between faces and door edges of doors
- .14 Bevel stiles minimum 3mm.
- .15 Coordinate louvre openings with Mechanical Division.
- .16 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 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.
- .8 Fabricate frames to accommodate scheduled glazing. Secure glazing stops to frames with counter sunk oval head sheet metal screws.
- .9 Provide 3 bumpers on strike jamb for each single door.
- .10 Pre-wire frames complete with CSA approved EMT metallic conduit and fittings for Electrolynx system where indicated on Door and Frame Hardware Schedule.
- .11 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.
 - .4 Where electrified hardware is specified on the approved hardware schedule, steel door and frame product, shall be provided with Electrolynx system consisting of CSA approved conduit, junction boxes and wire harness complete with modular plugs for coordinated connection directly to the electrified hardware. Refer to Hardware specification for openings that require electrified hardware.
- .12 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.

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 A hardware schedule will be prepared under the direction of the Consultant at a later date. This schedule will be used for the purposes of establishing the hardware requirements and the hardware quality level.
- .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 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.
- .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.
- .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 radiused. 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 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 00



PROJECT:

HS1024-0008 (2240805)

Sunnybrook OR 3 & 4 Lead Installation
2075 Bayview Ave
Toronto, ON

ARCHITECT:

NORR

175 Bloor Street E.
North Tower, 15th Floor
Toronto, ON

Prepared By: Chad Connors

Date: February 26, 2025

Revised:

Architectural Hardware Finishes

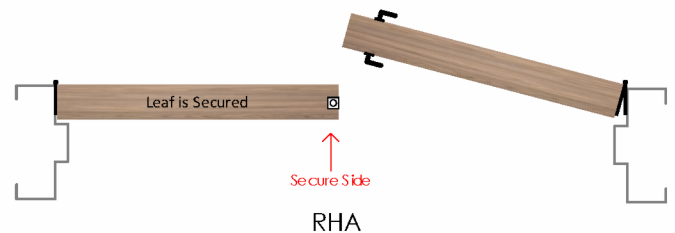
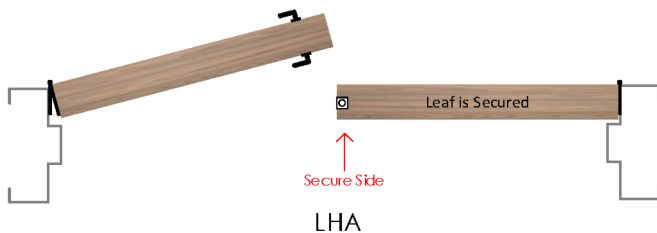
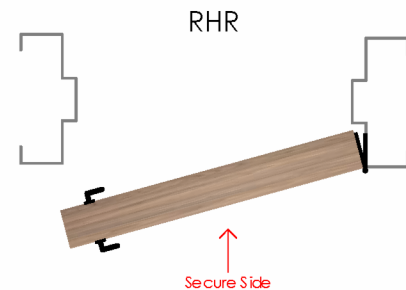
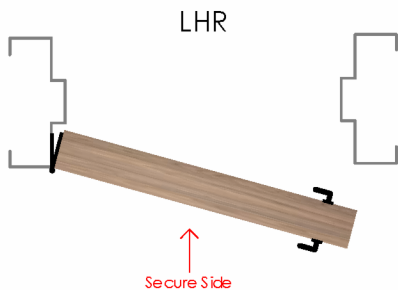
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Clear Anodized				628	689	US28
Satin Nickel	646		619	670		US15
Polished Nickel	645		618	669		US14
Satin Stainless Steel		630				US32D
Polished Stainless Steel		629				US32
Satin Chrome	652		626	702		US26D
Polished Chrome	651		625	672		US26
Satin Brass	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

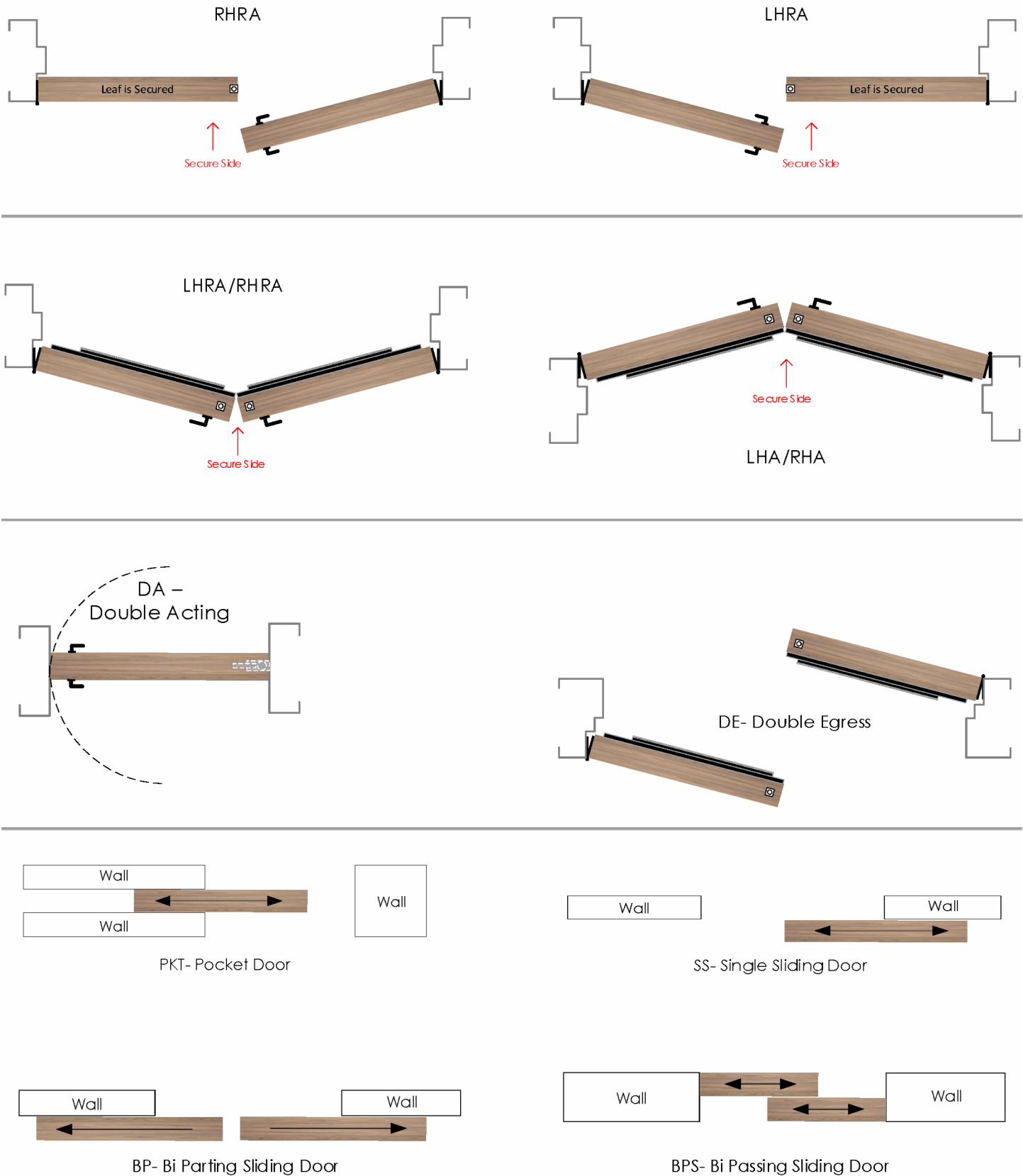
Door Handing's

Abbreviations

RH = Right Hand	RHA = Right Hand Active	SS = Single Slider
LH = Left Hand	LHA = Left Hand Active	BP = Bi-Parting Slider
RHR = Right Hand Reverse	RHA/LHA = Right & Left Hands Active	BF = Bi-Folding Slider
LHR = Left Hand Reverse	RHRA/LHRA = Right & Left Hand Reverse Active	TS = Telescopic Slider
RHRA = Right Hand Reverse Active	DA = Double Acting	PKT = Pocket Slider
LHRA = Left Hand Reverse Active	DE = Double Egress	

NOTE: The handing of a swing door is determined by placing yourself on the secured or keyed side of the door.





Products & Alternatives

NOTE: Only those products / brands listed here are acceptable and should be used to form a bid price. No unsolicited products will be considered. If acceptable alternates are listed here those too can be used to form a bid price provided, they are exactly the same as the specified item. If using an alternate product to form a price it is the bidder's responsibility to ensure that product is identical in every way to the specified item. If no alternates are listed, no alternate products are acceptable.

Product Type	Product#	Manufacturer	Alternate Manufacturer 1	Alternate Manufacturer 2
Continuous Hinge	SL24HD	Select		
Self Latch Flush Bolt	F7805/FB	Standard Metal		
Power Transfer	EPT-10	Von Duprin		
Electric Strike	1006CS	HES		
Lockset	L9000 series	Schlage		
Door Pull Plate	H413	Standard Metal		
Door Push Plate	K11A	Standard Metal		
Door Closer	4040XP	LCN		
Auto Door Operator	SW200i	Besam		
Actuator	CM-45/A2	Camden		
Coordinator	F7600	Standard Metal		
Overhead Stop	100 series	Glynn Johnson		
Kick / Armour Plate	K10	Standard Metal		
Frame Guard	K51	Standard Metal		
Door Guard	B302	Standard Metal		
Lead Lined Astragal	139SPLD	National Guard		
Smoke / Sound Seal	W-66	KN Crowder		
Door Sweep	W-24S	KN Crowder		
Door Contact	DPS	Securitron		
Door Sensor	OA-Edge1T	Optex		

Symbols



- Door has a fire rating and all associated hardware must have a fire label to suit. Must comply with local requirements.



- 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.

Abbreviations

Door:

HMD = Hollow Metal Door
IHMD = Insulated Hollow Metal Door
ALD = Aluminum Door
SSD = Stainless Steel Door
ISSD = Insulated Stainless Steel Frame
STL = Steel Door
IC-ALD = Insulated Clad Aluminum Door
SCWD = Solid Core Wood Door
HCWD = Hollow Core Wood Door
FGD = Frameless Glass Door
FRP = Fiberglass Reinforced Plastic Door
OHD = Overhead Door

Frame:

HMF = Hollow Metal Frame
ALF = Aluminum Frame
Cased Open HMF = Cased Open Hollow Metal Frame
SSF = Stainless Steel Frame
STL = Steel Frame
WDF = Wood Frame
Cased Open WDF = Cased Open Wood Frame
Cased Open Drywall = Cased Open Drywall

Fire Ratings:

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
2 HR – 120 Minute Fire Rating
3 HR – 180 Minute Fire Rating

Disclaimer

Weblinks:

Weblinks do change from time to time as manufacturers move around their websites, please inform us if you have a none functioning weblink.
















HARDWARE SCHEDULE



Heading# 1

Opening Information					
Opening Type:	Pair	Opening Size:	2 – 965 x 2134 x 44 (lead lined)	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

2	Total Openings					
1	Door#	230-A	Location:	O.R. Corridor M2920A	To	Operating Room 3
1	Door#	234-A	Location:	O.R. Corridor M2920A	To	Operating Room 4
					Handing:	LHRA/RHRA

By Hardware Supplier					
4	Continuous Hinge	SL24HD-LL x 2106 (Rivnuts)	628 / US28 / Clear Anodized	Select	
4	Door Pull Plate	H413 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
4	Push Plate	K11A-3 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Coordinator	F7676	600 / USP / Primed	Standard Metal	
4	Overhead Stop	104S	630 / US32D / Satin Stainless Steel	Glynn Johnson	
4	Kick Plate	K10A 203 x 927 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
4	Armour Plate	K10A 864 x 927 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
4	Frame Guard	K51 x 864 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
8	Guard Bar	B302 x 864	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Lead Lined Astragal	139SPLD x 2134	600 / USP / Primed	National Guard	
2	Smoke / Sound Seal	W-66 x 6198	Black	KN Crowder	
2	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	
2	Door Contact	DPS-M	Black	Securitron	
By Automatic Operator Supplier					
2	DBL Auto Door Operator	SW200i (push side mount-sequential operation)	628 / US28 / Clear Anodized	Besam	
4	Actuator	CM-45/A2	630 / US32D / Satin Stainless Steel	Camden	

8	Door Sensor	OA-Edge1T	Black	Optex	
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Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.

-----End of Heading-----



Heading#

2

Opening Information

Opening Type:	Single	Opening Size:	1200 x 2134 x 44 (lead lined)	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	3/4 HR

2	Total Openings							
1	Door#	230-B	Location:	Corridor	To	Operating Room 3	Handing:	LH
1	Door#	234-B	Location:	Corridor	To	Operating Room 4	Handing:	RH

By Hardware Supplier


2	Continuous Hinge	SL24HD-LL x 2106 (Rivnuts)	628 / US28 / Clear Anodized	Select	
2	Hospital Latch	L9010 HL6 x XL11-515	630 / US32D / Satin Stainless Steel	Schlage	
2	Overhead Stop	104S	630 / US32D / Satin Stainless Steel	Glynn Johnson	
2	Door Closer	4040XP-DA REG ST-1630	689 / US28 / Painted Aluminum	LCN	
2	Mounting Plate	4040XP-TJ	689 / US28 / Painted Aluminum	LCN	
2	Kick Plate	K10A 203 x 1162 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Armour Plate	K10F 560 x 1162 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
4	Frame Guard	K51F x 864 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Smoke / Sound Seal	W-66 x 5468	Black	KN Crowder	
2	Door Sweep	W-24S x 1200	628 / US28 / Clear Anodized	KN Crowder	

-----End of Heading-----

Heading# 3

Opening Information					
Opening Type:	Single	Opening Size:	965 x 2134 x 44 (lead lined)	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

2	Total Openings							
1	Door#	231-A	Location:	Operating Room 3	From	Ante Room M2231	Handing:	RHR
1	Door#	231-B	Location:	Operating Room 4	From	Ante Room M2231	Handing:	LHR

By Hardware Supplier					
2	Continuous Hinge	SL24HD-LL x 2106 (Rivnuts)	628 / US28 / Clear Anodized	Select	
2	Door Pull Plate	H413 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Push Plate	K11A-3 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Overhead Stop	104S	630 / US32D / Satin Stainless Steel	Glynn Johnson	
2	Door Closer	4040XP-DA PA	689 / US28 / Painted Aluminum	LCN	
2	Kick Plate	K10A 203 x 927 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Armour Plate	K10A 864 x 927 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
4	Frame Guard	K51 x 864 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Smoke / Sound Seal	W-66 x 5233	Black	KN Crowder	
2	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	





-----End of Heading-----

Heading#

4

Opening Information					
Opening Type:	Single	Opening Size:	1200 x 2134 x 44 (lead lined)	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	234-C	Location:	Corridor	To	Operating Room 4	Handing:	RH

By Hardware Supplier					
1	Continuous Hinge	SL24HD-LL x 2106 (Rivnuts)	628 / US28 / Clear Anodized	Select	
1	Hospital Privacy Latch	L9040 HL6 x XL11-515	630 / US32D / Satin Stainless Steel	Schlage	
1	Overhead Stop	104S	630 / US32D / Satin Stainless Steel	Glynn Johnson	
1	Door Closer	4040XP-DA PA	689 / US28 / Painted Aluminum	LCN	
1	Kick Plate	K10A 203 x 1162 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
1	Armour Plate	K10A 560 x 1162 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Frame Guard	K51 x 864 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
1	Smoke / Sound Seal	W-66 x 5468	Black	KN Crowder	
1	Door Sweep	W-24S x 1200	628 / US28 / Clear Anodized	KN Crowder	

-----End of Heading-----



Heading#

5

Opening Information

Opening Type:	Pair	Opening Size:	2 – 965 x 2134 x 44	STC Rating	None
Door Material:	HMD	Frame Material:	HMF	Fire Rating	None

1	Total Openings							
1	Door#	500.1	Location:	O.R. Corridor M2920A	From	Storage Room M2500.1	Handing:	LHRA

By Hardware Supplier

1	Continuous Hinge	SL24HD x 2106	628 / US28 / Clear Anodized	Select	
1	Continuous Hinge	SL24HD x 2106 x EPT	628 / US28 / Clear Anodized	Select	
1	Power Transfer	EPT-10	689 / US28 / Painted Aluminum	Von Duprin	
1	Self Latching Flush Bolt	F7805/FB	630 / US32D / Satin Stainless Steel	Standard Metal	
1	Passage Set	L9010 03B	630 / US32D / Satin Stainless Steel	Schlage	
1	Electric Strike	1006CS	630 / US32D / Satin Stainless Steel	HES	
1	Coordinator	F7676	600 / USP / Primed	Standard Metal	
2	Overhead Stop	104S	630 / US32D / Satin Stainless Steel	Glynn Johnson	
1	Door Closer	4040XP-DA PA	689 / US28 / Painted Aluminum	LCN	
2	Kick Plate	K10A 203 x 927 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Armour Plate	K10A 864 x 927 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
2	Frame Guard	K51 x 864 Tape	630 / US32D / Satin Stainless Steel	Standard Metal	
1	Smoke / Sound Seal	W-66 x 6198	Black	KN Crowder	
2	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	

By Automatic Operator Supplier

1	Auto Door Operator	SW200i (push side mount)	628 / US28 / Clear Anodized	Besam	
2	Actuator	CM-45/A2	630 / US32D / Satin Stainless Steel	Camden	
1	Door Sensor	OA-Edge1T	Black	Optex	
1	Relay	CX-33		Camden	

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Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.

-----End of Heading-----

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 Products proposed to use in the work of this Section, and include product characteristics, performance criteria, physical size, finish, limitations and additional data as may be required to demonstrate compliance with the Contract Documents.
- .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 where noted as engineered;
 - .2 Horizontal framing of ceilings and bulkheads;
- .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.

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 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.
- .4 Follow applicable requirements of ASTM C754 for installation of steel framing.
- .5 Design engineered interior metal support system members to withstand own dead load, super-imposed dead loads, to maximum allowable deflection of L/240, without permanent deformation.
- .6 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 Steel studs: ASTM C645, minimum 0.836 mm (0.0329 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.
- .3 Steel studs at door jambs and where indicated: 1.720 mm (0.0677") minimum thickness.
- .4 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.
- .5 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.
- .6 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.
- .7 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.

- .8 Fasteners for furring members: Type and size recommended by furring manufacturer for substrate and application indicated.
- .9 Channel bridging: 1.37 mm bare steel thickness, 38 mm deep with minimum 12.7 mm wide flange.
- .10 Backing plate: Galvanized steel sheet for blocking and bracing in length and width to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories, minimum base metal 1.087 mm (0.0428") thick.
 - .1 Elimination of backer plates or direct attachment of accessories or equipment to studs will not be permitted.
- .11 Attachment clips: Sized to suit acoustical ceiling grid members, complete with screws and other fastening system, Revue Clips by Revue Manufacturing Ltd.
- .12 Hangers, tie wires, inserts, anchors: Manufacturer's standard.
- .13 Insulating strip: Rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self-sticking adhesive on one face, lengths as required.
- .14 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.
- .15 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.
- .16 Sealants: as specified in Section 07 92 00.
- .17 Joint and laminating compounds: to ASTM C475, as recommended by gypsum board and tile backer board manufacturer, high bond, low shrinkage and asbestos-free.
- .18 Joint tape: 50 mm wide reinforced tape.
- .19 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.
- .20 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.
- .21 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.
- .22 Access Doors and Panels:
 - .1 Product: supplied under Mechanical and Electrical Divisions' specification.
 - .2 Installation: under this section 09 21 16.

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, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products and ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.

3.3 INSTALLATION - PARTITION AND WALL FRAMING

- .1 Comply with ASTM C754 and manufacturer's instructions. Do not bridge expansion joints.
- .2 Align partition top and bottom tracks and secure by screws at 600 mm o.c. maximum.
- .3 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.
- .4 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.
- .5 Continuously cross brace steel studs at 1500 mm on center to provide rigid installation to manufacturer's instructions.
- .6 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
- .7 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.
- .8 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.
- .9 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .10 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.
- .11 Terminate partitions at ceiling height except where indicated otherwise.
- .12 Install continuous insulating strips to isolate studs from exterior window framing.
- .13 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

- .14 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.
- .15 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.
- .16 Frame for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .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.

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 Furring indicated on the drawings us schematic. Do not regard as exact or complete. Provide all necessary framing and furring to support gypsum board in accordance with manufacturer's instructions.
- .2 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, to achieve required installation tolerances.
- .3 Locate furrings not more than 50 mm away from all openings, interior corners, intersections, frames, jambs, control joints and the like.
- .4 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.
- .5 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.
- .6 Make allowance for thermal movement. Thermally separate metal studs from exterior concrete or masonry.

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 Comply with ASTM C840, GA 216-13, GA 600-12, and manufacturer's instructions, except as otherwise indicated.

- .2 Do not apply gypsum panels until bucks, anchors, blocking, electrical and mechanical work are approved.
- .3 Remove debris and rubbish from wall and ceiling cavities, and clean with HEPA-filtered vacuum, before enclosing with board.
- .4 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.
- .5 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.
- .6 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.
- .7 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.
- .8 Attach gypsum panels to framing provided at openings and cutouts.
- .9 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 m²
 - .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 m²
 - .8 In interior ceilings with perimeter relief exceeding 15000 mm and total area between control joints exceeding 230 m²
 - .9 In exterior ceilings or soffits exceeding 9100 mm in either direction and total area between control joints exceeding 84 m²
 - .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.
- .10 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.
- .11 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.
- .12 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.
- .13 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.
- .14 Single layer fastening method: Fasten gypsum panels to supports with steel drill screws.
- .15 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.
- .16 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, in accordance with assembly listing requirements in order to obtain fire ratings indicated and as required by authorities having jurisdiction.
- .2 Vertical bulkheads in ceiling spaces over fire rated partitions shall have same fire rating as the partition over which they occur. Such bulkheads shall be of gypsum board construction unless otherwise indicated.
- .3 Where lighting fixtures, diffusers, and the like are recessed into fire rated ceilings or bulkheads, provide enclosure to maintain required fire rating. Form removable panel to give access to fixture outlet box.
- .4 Where fire hose cabinets or other fixtures or equipment are recessed in fire rated walls or partitions, provide gypsum board enclosure or backing to maintain required fire rating, unless otherwise detailed.

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 - 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. Embed 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.

3.12 **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 patched and repaired areas, 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.
- .2 Refer to Section 09 91 00 for paint Gloss Levels.

3.13 **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 Size framing systems according to manufacturer's engineered load tables, to meet maximum allowable deflection L/360 without permanent deformation.
- .3 Suspended and furred ceilings:
 - .1 Level cross furring channels to maximum tolerance of 3 mm in 3 m (1/8" in 10 ft).
- .4 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.
- .5 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").

3.14 **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.

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 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.

1.3 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.

- .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.

- .3 Design calculations: Provide complete set of design calculations showing design and seismic loads. Indicate seismic vulnerability for project location.

1.4 **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.

1.5 **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 Acoustic panels (ACT): Asbestos free, wet felted or cast mineral fibre, melamine back coating applied to the unexposed surface as a retardant to moisture absorption to prevent warp or sag, edge details as specified, size to match existing.
- .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 Install work in accordance with ASTM C636/C636M and to manufacturer's instructions except where specified otherwise.
- .2 Do not commence installation until work above ceiling has been inspected by Consultant.
- .3 Lay out system in accordance with reflected ceiling plans.
- .4 Ensure work is co-ordinated with location of related components.

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 within 6000 mm of an exterior door and an operable window.
- .5 Install adhesive bonded acoustic units to clean, dry and firm substrate.

END OF SECTION

PART - 1 GENERAL

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM D2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
 - .2 ASTM E648, Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
 - .3 ASTM E662, Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - .4 ASTM F1066, Standard Specification for Vinyl Composition Floor Tile.
 - .5 ASTM F1303, Standard Specification for Sheet Vinyl Floor Covering with Backing.
 - .6 ASTM F1344, Standard Specification for Rubber Floor Tile.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Division 01.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for flooring, adhesive, primer, sealer, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 For each colour and type selected, submit duplicate 300 x 300 mm sample pieces of sheet material, 300 mm long edge strips and base.
- .4 Low-Emitting Materials:
 - .1 Submit listing of adhesives and sealants used in building, showing compliance with VOC and chemical component limits or restriction requirements.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide extra materials of resilient sheet flooring and adhesives in accordance with Division 01.
 - .2 Provide 2% of each type and colour of material installed.
 - .3 Extra materials one piece and from same production run as installed materials.
 - .4 Identify each roll of sheet flooring and each container of adhesive.
 - .5 Deliver to Owner, upon completion of the work of this section.
 - .6 Store where directed by Owner.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Division 01.
- .2 Operation and Maintenance Data: submit operation and maintenance data for resilient flooring for incorporation into manual.

1.5 **QUALITY ASSURANCE**

- .1 Products: Provide like Products from same production run. Install Products in sequence from sequentially numbered dye lots.
- .2 Install work of this Section straight and level to variation of 1:1000.
- .3 Maintenance seminars: Provide, to the Owner, training seminars and recommendations on Product maintenance procedures.
- .4 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 of concrete floors: Maximum 3 lbs per 1000 sq.ft. per 24 hour. Test floors to ASTM F1869 using anhydrous calcium chloride method.
 - .1 Conduct a minimum three (3) tests for first 100 m² and one (1) test for each subsequent 100 m² or fraction thereof, with one within 1000 mm of an outside wall for slabs on grade.
 - .2 Alkalinity of concrete floors: Acceptable range of 5 to 9 on the pH scale. Test floors using distilled water and pH paper.
 - .1 Conduct 2 tests for every moisture vapour emission test.
 - .3 Building must be enclosed with ambient conditions equivalent to those after building occupancy.

1.6 **DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Division 01 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect resilient flooring from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 **SITE CONDITIONS**

- .1 Ensure high ventilation rate, with maximum outside air, during installation.
 - .1 Vent directly to outside.
 - .2 Do not let contaminated air recirculate through a district or whole building air distribution system.
 - .3 Maintain extra ventilation for 1 month minimum after building occupation.
- .2 Maintain air temperature and structural base temperature at flooring installation area above 20 degree C for 48 hours before, during and for 48 hours after installation

PART - 2 PRODUCTS

2.1 RESILIENT FLOORING MATERIALS

- .1 Resilient sheet flooring: CSA A146, linoleum flooring, 2.5 mm thick, manufacturer, model and colour to match existing.

2.2 ACCESSORIES

- .1 Integral flash cove base: Provide integral flash cove base by extending sheet flooring 150mm up the vertical surfaces using adhesive, welding rod, and accessories recommended and approved by the flooring manufacturer.
 - .1 Provide a fillet support strip for integral cove base with a minimum radius of 2.54cm of wood or plastic.
- .2 Primers and adhesives: of types recommended by resilient flooring manufacturer for specific material on applicable substrate, above, on or below grade.
- .3 Flooring adapters, Trims, Transition and Reducer Strips: purpose made; constructed of first grade quality raw materials, smooth and free from imperfections.
- .4 Welding rod: Compatible with resilient sheet flooring and recommended by the flooring manufacturer.
- .5 Patch and Skim Coat: Moisture resistant, fast drying, fibre reinforced cement based compound designed for preparing concrete substrates for application of finished surface.
 - .1 Product: Planiprep PSC by Mapei.
- .6 Sealer and wax: type recommended by resilient flooring material manufacturer for material type and location.
- .7 Cleanser: neutral cleanser detergent. Exact type as recommended by flooring manufacturer.

PART - 3 EXECUTION

3.1 EXAMINATION

- .1 Examine conditions, substrates and work to receive work of this Section.
- .2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
- .3 Ensure concrete floors are clean and dry by using test methods recommended by flooring manufacturer.

3.2 PREPARATION

- .1 Prepare for installation in accordance with manufacturer's written recommendations.
- .2 Prepare subfloor smooth, level, true, sound and free of cracks, holes, other defects and irregularities, in accordance with flooring manufacturers' recommendation.

- .3 Mechanically remove contamination on the substrate that may cause damage to the resilient flooring material, cause telegraphing, or prevent proper adhesion. Permanent and non-permanent markers, pens, crayons, paint, etc., shall not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material
- .4 Remove old, existing adhesives to prevent residual bleeding through to new flooring or interfering with bonding of new adhesives.
- .5 Remove sub-floor ridges and bumps and fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .6 Apply sub-floor filler to low spots and cracks to achieve floor level to a tolerance of 1:1000, allow to cure.
- .7 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler is completely cured and dry.
- .8 Sweep and vacuum clean substrates to be covered by resilient products immediately before primer application.
- .9 Prime concrete slab to resilient flooring manufacturer's written instructions.

3.3 **MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.4 **APPLICATION - FLOORING**

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.
- .2 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive that can be covered by flooring before initial set takes place.
- .3 Resilient tile flooring:
 - .1 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern.
 - .2 Border tiles: half tile width minimum.
 - .3 Install flooring to indicated pattern with joints aligned.
- .4 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.
- .5 Cut flooring neatly around fixed objects.
- .6 Continue flooring over areas which will be under built-in furniture.
- .7 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
- .8 Terminate resilient flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
- .9 Install edge strips at unprotected or exposed edges where flooring terminates.
- .10 Provide carpet/flooring adapter at interface of carpet and work of this Section, straight and true. Where carpet/resilient flooring interface occurs at doorway, locate adapter underneath door in its closed position.

3.5 APPLICATION - BASE

- .1 Lay out base to keep number of joints at minimum.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Miter internal corners. Use premoulded sections for external corners.

3.6 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
 - .1 Remove excess adhesive from floor, base and wall surfaces without damage.
 - .2 Clean, seal and wax floor and base surface to flooring manufacturer's printed instructions.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect new floors in accordance with manufacturer's printed instructions.
- .3 Repair damage to adjacent materials caused by resilient flooring 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 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, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing's.
- .2 ASTM C413, Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing's, and Polymer Concretes.
- .3 ASTM C570, Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- .4 ASTM C580, 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, Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay.
- .6 ASTM D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- .7 ASTM D696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30degC and 30degC with a Vitreous Silica Dilatometer.
- .8 ASTM D2369, Standard Test Method for Volatile Content of Coatings.
- .9 ASTM D2794, 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, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- .12 ASTM F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- .13 ASTM F2659, 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, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

- .2 Canadian Standards Association (CSA):
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.
- .3 International Concrete Repair Institute (ICRI):
 - .1 ICRI Guideline No. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays.

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.
- .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: epoxy floor coating system by Sika Canada Inc. The total system breakdown is as follows:
 - .1 Prime: Sikafloor 156
 - .2 Body: Sikafloor 9200 with Sikafloor Quartzite Trowel Aggregate
 - .3 Grout/Top Coat: Sikafloor 2002
 - .4 Finish coat: Sikafloor Duochem 942
 - .5 Integral Flash Cove base: height as indicated on Drawings.
 - .6 Colour: to match existing.

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.

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 ground down 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.
 - .1 Chemical Surface Preparation: Chemical surface preparation (acid etching) is unacceptable and will void manufacturer's warranty.
- .7 Control Joints and Cracks: Repair and treat control joints and surface cracks utilizing manufacturer's standard materials and installation details.
- .8 Protect adjacent surfaces, fixtures and equipment with drop cloths or masking as necessary to prevent damage from splatter or spillage.

3.3 **APPLICATION**

- .1 During application, comply with all manufacturer's recommendations regarding mitigation of VOCs including but not limited to sealing of doors between Site and the Hospital, use of respirators, and continuous exhausting of fumes directly to the exterior via existing windows.
- .2 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
- .3 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.
- .4 Do not apply while ambient and substrate temperatures are rising.

- .5 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.
- .6 Broadcast Aggregates into the wet Broadcast Coat resin.
- .7 Match colours and textures of Consultant accepted samples.
- .8 Where required, install cove base to dimensions indicated on Drawings with 25 mm (1") radius in accordance with manufacturer's written instructions. Install cove base with a minimum 3 mm (1/8") thickness.
- .9 Install L type white alloy or zinc base bead top strips at specified heights straight and level.
- .10 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.
- .11 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.
- .12 Follow manufacturer's written recommendations on terminations and connections to walls, drains, columns and floor-to-floor transitions.
- .13 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.
- .14 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, issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
- .4 Manufacturers and products: Listed under the Approved Product List section of the MPI Painting Manual.
- .5 Maintenance seminars: Provide, to the Owner, training seminars and recommendations on Product maintenance procedures.
- .6 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.
- .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.
- .8 All surfaces requiring painting shall be inspected by the Consultant who shall notify the Consultant and General Contractor in writing of any defects or problems, prior to commencing painting work, or after the prime coat shows defects in the substrate.
- .9 Ensure written confirmation is received from steel fabricators of the specific surface preparation procedures and primers used for steel work to ascertain appropriate and compatible finish materials.

1.3 SAMPLES AND MOCK-UPS

- .1 Samples: Provide duplicate minimum 300 mm square samples of surfaces or acceptable facsimiles requested painted with specified paint or coating in colours, gloss, sheen and textures required to MPI Painting Manual standards for review. When approved, samples become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

- .2 Sample installations: When requested by the Consultant, prepare and paint designated surface, area, room or item in each colour scheme to requirements specified, with specified paint or coating showing selected colours, gloss, sheen, textures and quality of work to MPI Painting Manual standards for review and approval. When approved, surface, area, room and items become acceptable standard of finish quality and workmanship for similar on-site work.

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 to Consultant 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 labelled 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 after facility working hours 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 Unless specifically pre-approved by the Consultant, and the product manufacturer, do not perform work when the ambient air and substrate temperatures are below 10 degree C for both interior and exterior work.
- .2 Do not perform exterior work unless environmental conditions are within MPI and manufacturer's requirements or until adequate weather protection is provided. Where required, provide suitable weatherproof covering and sufficient heating facilities to maintain minimum ambient air and substrate temperatures for 24 hours before, during and after work is completed.
- .3 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.
- .4 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.
- .5 Do not perform work when the maximum moisture content of the substrate exceeds:
 - .1 12 % for concrete and masonry.
 - .2 15% for wood.
 - .3 12 % for plaster and gypsum board.
- .6 Conduct all moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple cover patch test.
- .7 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .8 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.
- .9 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, properly labelled and identified for Owner's later use in maintenance. Store where directed.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Paint, stain and wood preservative 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 solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
 - .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 Only materials listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use on this project. Provide material from a single manufacturer for each system used.
- .2 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 and shall have low VOC content where possible.
- .4 Where required, use only materials having a minimum MPI Environmentally Friendly E2 or E3 rating based on VOC (EPA Method 24) content levels.
- .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.

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 color 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 COLORS

- .1 A Finish Schedule will be furnished after award of the Contract. The Consultant will select colours from a manufacturer's full range of colours.
- .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.
- .4 Where other applied finishes and nosing are not specified at stairs, ramps and landings providing access and exit for persons with visual impairment, provide colour contrast slip resistant finish and warning strips at treads and landings.

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 and surfaces and conditions are acceptable to the Consultant.

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 colors 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 Prime coat of stain or varnish finishes may be reduced in accordance with manufacturer's directions.
- .9 Paint finish shall continue through behind all wall-mounted items.
- .10 Unless noted otherwise, field-apply finish paint to all structural steel work, which will remain exposed and subject to normal view by pedestrians or occupants on the completed exterior or interior of the building.

3.4 **INTERIOR FINISHING SYSTEMS**

- .1 Finish interior surfaces in accordance with MPI Painting Manual requirements:
- .2 Galvanized Metal: Doors, frames, railings, misc. steel, pipes, overhead decking, ducts.
 - .1 INT 5.3M: High performance architectural latex G5 finish.
- .3 Plaster and Gypsum Board:
 - .1 INT 9.2B: High performance architectural latex G5 finish.

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 color and texture to match adjacent surfaces, in the following areas:
 - .1 Where exposed-to-view in exterior and interior areas.
 - .2 In interior high humidity interior areas.
 - .3 In boiler room, mechanical and electrical rooms.
- .2 In unfinished areas leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .3 Touch up scratches and marks on factory finished equipment with products compatible with factory finish.
- .4 Do not paint over nameplates.
- .5 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.
- .6 Paint the inside of light valances gloss white.
- .7 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .8 Paint or band all fire protection piping and sprinkler lines in accordance with mechanical specification requirements. Keep sprinkler heads free of paint.
- .9 Paint or band all natural gas piping in accordance with mechanical specification requirements.
- .10 Back prime and paint face and edges of plywood service panels for telephone and electrical equipment before installation to match adjacent wall surface. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.6 **FIELD QUALITY CONTROL AND STANDARD OF ACCEPTANCE**

- .1 Painted interior 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 natural lighting source for exterior surfaces and 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 color, sheen, texture, and hiding across full surface area.
- .3 Make good painted surfaces rejected by the 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 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 required to install radiation protection as specified in this Section including but not limited to the following:
 - .1 Lead lined gypsum board.
 - .2 Lead lined fire-rated plywood.
 - .3 Lead lined steel door frames.
 - .4 Lead lined steel doors.
 - .5 Lead 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 (GL-LD):
 - .1 Thickness: various, refer to drawings for locations.
 - .1 Lead Equivalency:

Thickness	7 mm	9 mm	14 mm	17 mm
Lead Equivalent (mmPb)	1.6	2.0	3.0	3.3

.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



**Mechanical
Specification**
FOR

**M2 OR3 AND OR4 LEAD LINING PROJECT
SUNNYBROOK HEALTH SCIENCES CENTRE**

2075 Bayview Avenue
Toronto, Ontario
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LIST OF SECTIONS - MECHANICAL

20 00 01

DIVISION 20 – COMMON WORKS FOR MECHANICAL

20 00 01	List of Sections
20 01 01	Mechanical General Requirements
20 01 02	Qualifications and Authorities - Ontario
20 01 03	Mechanical Coordination and Installation Design Services
20 01 13	Definitions and Abbreviations - Mechanical
20 05 01	Basic Materials and Methods
20 05 02	Mechanical Work in Hospital Construction
20 05 12	Common Electrical Requirements for Mechanical Services
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20 05 24	Welding and Brazing
20 05 26	Pipeline Hot-Tapping and Line Stopping
20 05 29	Common Hanger and Support Requirements for Piping
20 05 49.20	Seismic Restraint for Mechanical Services
20 05 53	Identification for Mechanical Services
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DIVISION 21 – FIRE SUPPRESSION

21 05 01	Common Work Results for Fire Suppression
21 13 13	Wet Pipe Sprinkler System
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DIVISION 22 – PLUMBING

22 60 13.70	Medical Gas Piping
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DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING

23 05 01	HVAC Piping Systems General Requirements
23 05 23.13	General-Duty Valves for HVAC Water Piping
23 05 93.14	Testing Adjusting and Balancing for Renovations
23 05 93.23	Testing Adjusting & Balancing Supplement for Healthcare
23 21 13.23	Hydronic Piping – Carbon Steel
23 31 01	Air Distribution - General
23 31 13.13	Metal Ducts
23 33 05	Duct Accessories
23 33 13.11	Manual Balancing Dampers
23 83 16	Radiant Ceiling Panels

END OF SECTION

MECHANICAL GENERAL REQUIREMENTS

20 01 01

1 GENERAL

1.1 General Contract Documents

- .1 Comply with General Conditions of the Contract, Supplementary Conditions of the Contract, and Division 01 - General Requirements.
- .2 Where content in this Specification section duplicates requirements in various Division 01 Specification sections, this section and the applicable Division 01 sections are to be read together and the most stringent requirements apply.

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.
- .2 Read drawings and specifications together as a whole and in conjunction with other such documents included under the Construction Contract.

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 Division 20 contains common work requirements that are applicable as necessary to the Work of Divisions 21 to 25 and apply as if written in full within those Divisions.

1.5 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 a 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.

1.6 Definitions and Abbreviations

- .1 Specification section 20 01 13 *Definitions and Abbreviations – Mechanical* contains general definitions and abbreviations that apply to one or more specification sections of this Division of the Work. Other specification sections of the mechanical Divisions of the Work may also include additional specific definitions and/or abbreviations that apply to that specification section.
- .2 The following general terms apply to Divisions 20 to 25 of the Work:
 - .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 Wherever the word "listed" is used in conjunction with a product and a product certification standard (including but not limited to CSA, ULC, CGSB, BNQ, UL), it shall be understood to mean that the product is "listed" by an accredited 3rd party testing laboratory as being certified to the referenced product standard.
 - .3 Wherever the words "approved", or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides, to mean that material or item referred to shall be "approved by" the Owner.
 - .4 Wherever the words "satisfactory", "as directed", "submit", "permitted", "reviewed", or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides, to mean that material or item referred to shall be "satisfactory to", "as directed by", "submitted to", "permitted by", or "reviewed by" the Consultant.
 - .5 Instructions using any form of the word:
 - (a) "install" means to place in position and activate for service or use,
 - (b) "supply" means to procure and deliver materials to the place of the Work, or to make available labour or services for the stated purpose,
 - (c) "provide" means to supply material, labour and services to install the referenced item.
 - .6 The term "building code" means the edition of the applicable building code at the time of obtaining a building permit.
 - .7 Wherever manufacturers or manufacturer's products are identified in lists under the phrase "Standard of Acceptance", these are manufacturers and/or products which meet the project standards in regard to performance, quality of material and workmanship.

1.7 Examination

- .1 Examine any existing buildings, local conditions, building site, the 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 Before commencing work under this Division, examine the work of other Divisions of the Work and report any defect or interference.

1.8 Design Services

- .1 Provide specialty design services for elements of the Work where specified in other sections of Division 20. Drawings and specifications prepared by such specialty design service providers shall be sealed by a professional engineer licensed in the jurisdiction of the Work.

1.9 Product Substitutions

- .1 In the absence of requirements concerning product substitution requests in Division 01, Contractor may propose a substitute product to that which is specified in accordance with the following.
- .2 All proposed substitutions shall be submitted using the Consultant's product substitution form and include all information stated therein.
- .3 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 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 at no additional costs to the contract,
 - .4 the Consultant shall 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 is 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 is 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.

2 SHIPPING, HANDLING AND STORAGE

2.1 Shipping

- .1 Provide adequate protection of equipment during shipping and handling so as to provide equipment at the Work site in ex-works condition when handled by commercial carrier systems.
- .2 Provide, as necessary, removable bracing of the internal components in each item of equipment so that the equipment can be moved on its side or back, without sustaining damage.
- .3 Where removeable internal bracing has been provided, the equipment to be provided with warning labels to call for the removal of the shipping bracing prior to energization.
- .4 Any component that is packaged or shipped separately is to be individually crated and tagged with unit number and the equipment number of the assembly to which it belongs.

- .5 Provide each "shipping section" with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.

2.2 Storage

- .1 Store equipment and materials at the worksite to protect them from any damage until placed into its final location. Maintain similar protection of installed equipment and materials to protect against damage until they are turned over to the Owner. Make good any damage to equipment or materials up to the time of ready for takeover.
- .2 Store equipment in accordance with the manufacturer's instructions and not less than:
 - .1 stored in a dry, clean location,
 - .2 cover with polyethylene plastic sheeting,
 - .3 include a desiccant material under the protective sheeting to absorb moisture, or provide heated ventilated air
- .3 Provide adequate ventilation and temporary heating to prevent condensation of moisture within the equipment.

2.3 Provisions for Handling and Field Erection

- .1 For equipment that will require hoisting on site, provide removable side panels, lifting angles or lifting plates to accommodate the use of slings or crane hooks, for each shipping section.
- .2 For floor mounted equipment, provide on each shipping section removable steel channel base plates to permit use of pipe rollers or dollies without damaging the equipment.

3 OWNER'S SPECIAL REQUIREMENTS FOR EXISTING SITES

- .1 The following special requirements are in addition to the requirements of Division 01 of the Work.
- .2 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.
- .3 Security passes must be visibly worn at all times by all employees.
- .4 Trades people to strictly adhere to owner's building security procedures otherwise entrance into the building will be denied.
- .5 Trades people are to enter the entrance identified by the Owner.
- .6 Park vehicles in designated areas. Do not block driveways.
- .7 Use only the freight elevator to transport tools and material. Freight elevator door must be shut immediately after exiting the cab.
- .8 Do not disable or activate any electrical or mechanical system without prior approval by the Owner's Project Manager. Also, prior to disabling or activation of any electrical or mechanical system, obtain approval from Building Operations and Building Security.
- .9 Submit prior notification to Building Security Staff before any construction activity commences which will result in heat, smoke, dust or fumes, such as welding, saw cutting, soldering, spray painting, which might affect sensitive fire detection and protection equipment.
- .10 Provide at least 48 hours prior notification to Building Operations for any fire system isolation requests.
- .11 Schedule work and meet with sub-trades daily on site, to show trades people the work areas and work to be done.

- .12 Trades-people are to supply and use their own tools. No tools, ladders or equipment, etc. will be loaned by the Owner.
- .13 Provide environmental cleaning of the job site daily during construction and upon completion. This includes above ceilings. Do not store materials or garbage on the loading dock.
- .14 Provide special care, attention and protection when transporting equipment and materials to prevent accidental damage to fire protection equipment, finishes, furnishings and fixtures.
- .15 "No Smoking" – this is a smoke-free building. Violators will be asked to leave and may be denied reentry. Smoking is not allowed on the roof.
- .16 A security escort will be required for any work being done in secured areas, e.g. raised floor, computer room and mechanical/electrical rooms.
- .17 If Building Operations deems that work on a particular system requires security escort, allow 48 hours to make appropriate arrangements.
- .18 For any open flame work, provide fire extinguishers and security fire watch.
- .19 Obtain the approval of the Building Manager for the storage of materials on site.
- .20 Perform a daily cleanup prior to leaving the site.
- .21 Secure oxygen and acetylene cylinders at all times and capped nightly.
- .22 Restore operating and redundant systems to their normal condition at the end of each work day unless otherwise approved by the Owner
- .23 At the conclusion of each work day, the Contractor's superintendent/supervisor is to advise the Building Manager on the day's activities and plans for the next day's work.

4 PROGRESS PAYMENT PROCEDURE

4.1 Schedule of Values

- .1 Provide schedule(s) of values for progress payments in accordance with this part.
- .2 Prepare and submit a schedule of values ("SOV") for the Division 20 Work.
- .3 Each SOV is to be in the sample format shown in Article "Attachments", specifically that the SOV is to include four sections for:
 - .1 Contract price work element breakdown, which includes:
 - (a) detailed breakdown by work element as agreed with the Consultant,
 - (b) line items for coordination drawings, as-built documents and operating manuals,
 - (c) a summary line item for authorized Cash Allowance disbursements (if applicable),
 - (d) line items for each Itemized Price (if applicable),
 - (e) line items for each Separate Price (if applicable and included in the Contract Price)
 - (f) a line item for the total of the original contract work element values,
 - (g) a summary line item for approved change instructions,
 - .2 Cash Allowance disbursement authorization, with separate work elements for each cash allowance,
 - .3 Approved Change Instructions, with separate work elements for each change instruction,
 - .4 Outstanding Change Instructions which are either not quoted or not yet approved.
- .4 Each work element in the SOV sections (except Outstanding Change Instructions) is to include:
 - .1 the original contract value and the percent of original contract total value (Contract Price section only),

- .2 the completed to date amount and percent of original work element contract value,
 - .3 the previously billed amount and percent of original work element contract value,
 - .4 the current billing (payment request) amount and percent of original work element contract value, and
 - .5 the balance to complete amount and percentage of original work element contract value.
- .5 The required Contract Price work element breakdown will be determined by the Consultant, with the level of breakdown appropriate to the project such as
- .1 by trade,
 - .2 by specification section or portion thereof,
 - .3 by labour vs material,
 - .4 by location in the building,
 - .5 or any combination of the above.
- .6 Submit a draft SOV for review and approval by the Consultant at least three weeks before the first request for progress payment. Do not submit requests for progress payments until the SOV has been reviewed and there are no outstanding comments from the Consultant.
- .7 Make requests for progress payments using the values on the reviewed SOV.
- .8 When a change in the Work has been approved by the Owner, include the approved changes on the SOV for the next payment application, whether or not payment is requested in full or in part for that change in that payment request period.
- .9 For each SOV, include a line item "As-Built & Operating Manuals" and includes a value that is the greater of:
- .1 the value of the work or,
 - .2 1% of the Division 20 contract price.

Payment of the indicated amount will not be made until satisfactory documents have been received by the Consultant. Where satisfactory documents are not received, a Change Directive and an associated Change Order will be issued to delete this work element and the amount from the Contract Price.

5 CONSTRUCTION CHANGES

5.1 General

- .1 The valuation method to be used for a change instruction to the Work is to be determined by the Consultant from the following methods:
- .1 by labour and material when the change instruction is by a Change Directive;
 - .2 by unit prices set out in the Contract or subsequently agreed upon for other change instructions;
 - .3 by a detailed quotation for other change instructions; or
 - .4 by a Cash Allowance Disbursement instruction.

5.2 Definitions

- .1 The following definitions apply to this section
- .1 **Allpricer** – the material pricing guide/service provided by Allpricer Limited.
 - .2 **MCAA manual** – the Mechanical Contractors Association of America publication *Labor Estimating Guide for Service* for labour units.

- .3 **Base wage rate** – the hourly rate actually paid to the trades person, determined in accordance with applicable collective bargaining agreement, or in their absence the actual gross wages paid to the worker.
- .4 **Job Site Impact Multiplier** – a multiplier expressed as a decimal number that is included in the Labour Rate to account for special job site conditions that affect labour availability, labour productivity, procurement of materials, and materials management, that are specific to the project and site conditions.
- .5 **Indirect labour** – any labour that is neither journey person labour that directly performs the work nor labour that directly supervises journey person(s).
- .6 **Labour Rate** – the actual fully burdened labour cost per hour of labour consumed by a trades person including statutory and regulatory burden, collective bargaining burden, and other project related burden. For greater clarity, the labour rate includes but is not limited to the following:
 - (a) base wage rate,
 - (b) vacation and statutory holiday pay,
 - (c) union deductions and additional union charges,
 - (d) Legislated burdens including EHT, WSIB, EI, CPP, RST on H/W
 - (e) wage-based taxes,
 - (f) job site impact multipliers,
 - (g) expendable small tools charge,
 - (h) project insurance,
 - (i) financing of payroll,
 - (j) estimating,
 - (k) rest breaks and idle time,
 - (l) safety including training, safety meetings, WHMIS, fall protection, personnel protection equipment, and safety committees,
 - (m) preparation and handling of shop drawings and other submittals,
 - (n) preparation of as-built documents, including operation and maintenance manuals,
 - (o) labour warranties,
 - (p) site facilities,
 - (q) clean-up,
 - (r) parking.
- .7 **Foreperson** – a first level supervisory position having direct control over the work performed by journeypersons.
- .8 **Journey person** – a person working in a skilled construction trade which may be prescribed by regulation, and includes apprentices.
- .9 **Labour Unit** – the number of journey person labour hours or part thereof, required to perform a specific construction task, and includes but is not limited to:
 - (a) receiving, unloading, stockpiling, distribution and handling of materials and equipment,
 - (b) rigging or erecting of materials or equipment,
 - (c) fitting and joining of materials,
 - (d) pressure testing of piping and ductwork systems,
 - (e) testing of equipment and systems.
- .10 **Line materials** – components that make up a distribution network for fluid, power, or electronic/digital information, and includes:

- (a) piping, pipe fittings, valves (of all kinds), pipe strainers and other pipe mounted equipment,
 - (b) ducting, duct fittings, duct balancing dampers and other duct mounted equipment,
 - (c) conduit, cable tray, cable, conductors, and wiring,
 - (d) supports, hangers and restraints,
 - (e) vibration isolators and seismic restraints associated with line materials,
 - (f) instrumentation including gauges and sensors/transmitters,
 - (g) electrical, pneumatic, and hydraulic actuators for valves and dampers, and
 - (h) any coatings or other protective elements applied thereto including insulation and painting.
- .11 **Overhead** – administrative expenses of the Contractor's business and the project which are not included in a Labour Rate or Labour Unit. For greater clarity, overhead includes but is not limited to the following:
- (a) company office, storage, and fabrication spaces, and associated maintenance, utilities, and expenses,
 - (b) project site office, fabrication and storage spaces, washrooms, break rooms, and associated maintenance, utilities, and expenses,
 - (c) company office equipment, furniture and supplies,
 - (d) project site office equipment, furniture and supplies,
 - (e) labour time for project managers and project assistants,
 - (f) project site security,
 - (g) project site clean-up, recycling and waste disposal,
 - (h) materials management,
 - (i) property taxes, business licenses, and auto insurance,
 - (j) dues and subscriptions,
 - (k) postage and courier,
 - (l) advertising, telephone, IT services and equipment,
 - (m) legal and accounting fees and expenses,
 - (n) sales and marketing,
 - (o) salaries and benefits for company indirect labour including company management, sales force, dispatchers, estimators, clerical staff, and at-office general (non-trades) labour.
 - (p) all other indirect labour.
- .12 **Senior Foreperson** – the second (and subsequent) level supervisory position having direct control over one or more Forepersons, where the number of Forepersons supervised is in accordance with local regulatory requirements or collective bargaining agreements. ("Superintendent" or "Supervisor" has the same meaning).

5.3 Change Directive Method

- .1 Except where otherwise determined in the Construction Contract or Division 01 specification, the valuation of changes by the Change Directive method shall comply with the following:
- .1 the form of presentation of costs and methods of measurement shall be agreed to by Consultant and Contractor before proceeding with the change,
 - .2 the adjustment in the Contract Price for a change carried out by way of Change Directive shall be determined on the basis of the cost of the Contractor's actual expenditures and savings attributed to the Change Directive. For clarity and by example, savings for deductions of similar materials,

equipment, labour or services shall be valued at the same amount as for expenditures for additions of same.

- .3 labour costs will be determined based on actual time spent and the agreed labour rate, the actual cost of installed line materials and equipment, and the agreed fee for overhead and profit,
- .4 if the change results in a net decrease in Contract cost, the contract price will be decreased by the net decrease in the cost, without adjustment for the Contractor's percentage fee for overhead and profit,
- .5 the Contractor shall keep accurate records, in an agreed upon form, of time, quantities and invoiced costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices,
- .6 this time and material method shall be used until such time as a total cost estimate of the change is agreed between the Owner and the Contractor, at which time all payments made under this time and material method will be credited against the agreed total cost for the change.

5.4 Unit Price Method

- .1 Costing of changes by the Unit Price method:
 - .1 Costs for work identified by agreed unit costs shall be charged at those rates, unless the Owner agrees to other rates.

5.5 Proposed Changes; Other Change Instructions Method

- .1 For proposed changes to the Work or other similar instructions, submit a detailed quotation for approval.
- .2 The adjustment in the Contract Price for a change carried out by way of proposed change or other similar instruction shall be determined on the basis of the cost of the Contractor's actual expenditures and savings attributed to the Proposed Change. For clarity and by example, savings for deductions of similar materials, equipment, labour or services shall be valued at the same amount as for expenditures for additions of same.
- .3 Costs are to be approved by the Owner before the proposed change to the Work proceeds. The quotation for the change to the Work is to include a summary of charges made up of three components: labour charges, material costs and fees.
- .4 Labour Charges:
 - .1 The labour unit hour estimates are to be based on the current MCAA estimating manual unless otherwise agreed by the Consultant;
 - .2 The labour cost is to be determined using the agreed labour rates.
 - .3 Labour rates for Foreperson and Senior Foreperson shall be as per agreement, or in absence of such agreement shall be 1.15 times the journeyman labour rate. The maximum allowable labour hours for supervision are not to exceed:
 - (a) for a Foreperson, a maximum of 10% of the total calculated journeyman hours on a change, and
 - (b) for a Senior Foreperson of all levels, a maximum combined amount of 3% of the total calculated journeyman hours on a change.
 - (c) no other supervisory hours will be permitted.
- .5 Material Charges:
 - .1 Material costs for line materials and installed equipment are to be net of trade discounts. The discount to be applied to list prices for items included in Allpricer manual shall not be less than:
 - (a) 20% for line materials, and
 - (b) 10% for equipment that is not line material.

.6 Fees:

- .1 The Contractor and any sub-contractor is allowed a combined overhead and profit fee of 15% for work to be performed by their own forces,
- .2 The Contractor and any sub-contractor is allowed a combined overhead and profit fee of 5% for work performed by a sub-contractor (in the case of the Contractor) or a sub-sub-contractor (in the case of work performed for a sub-contractor),
- .3 For clarity, the allowable fees on direct work and on sub-contracted work apply to a sub-sub-contractor of any tier.

5.6 Cash Allowances; Contingency Allowances

- .1 Instructions for changes to the Work to be performed under a cash allowance or contingency allowance ("Allowance") included in the contract price shall be authorized by a Cash Allowance Disbursement instruction.
- .2 Except as described below, the determination of costs for Work performed under an Allowance shall be in accordance with the procedure for proposed changes unless otherwise instructed to proceed with the work, in which case the cost of such work shall be valued in accordance with the procedures for Change Directive.
- .3 The contract price, not the Allowance, includes the overhead and profit fee for the value of the Allowance.
- .4 Except where otherwise specified in the Construction Contract, where the cost of the Work performed under a Cash Allowance Authorization;
 - .1 is less than the Allowance value, the contract price includes the overhead and profit for the contractor and any sub-contractors. A change order will be issued for a credit for the balance of the Allowance, but shall not include the associated overhead and profit fee.
 - .2 exceeds the Allowance value, a Change Order will be issued for the amount in excess of the Allowance, and the excess amount is to include the agree fee for overheat and profit.

6 SUBMITTALS

6.1 Shop Drawings and Product Data Sheets

- .1 Submit shop drawings, manufacturers product data and samples in accordance with the requirements of Division 01, this Part, and as further required in other Specification sections of Division 20.
- .2 Submit shop drawings in the same unit of measure as are used on the drawings. Both metric and U.S. customary units may be included.
- .3 Submit shop drawings by email to: shopdrawings@hhangus.com, except where a project document management web-service is used.
- .4 Include a H.H. Angus shop drawing cover sheet form prepared for this project for each shop drawing submittal (refer to part "Attachments" for an example of this form) , 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 category: architectural, structural, conveying equipment, user equipment, mechanical, electrical, telecommunications, civil or other.
 - (k) If a re-submission, the Consultant's previous submittal reference number.
- .5 Submit shop drawings in PDF format except as follows;
- .1 if the Consultant agrees to a shop drawing to be 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 and digital scanning. Allow one additional week for processing of shop drawings submitted in hardcopy format.
- .6 Manufacturer's letter sized product data sheets for standard items are acceptable in place of shop drawings provided that physical characteristics are identified and are related to specification references.
- .7 Submit with manufacturers data sheets, typed schedules listing manufacturer's and supplier's name and catalogue model number.
- .8 For plumbing fixtures and other permeant fixtures, submit fixture sheets with catalogue numbers. Identify and arrange fixture sheets in the same sequence and using the same identification number as shown in specification fixture lists.
- .9 Shop drawings and/or product data sheets to show;
- (a) dimensioned outlines of equipment and construction details,
 - (b) equipment weights and center of gravity,
 - (c) performance ratings,
 - (d) dimensioned details showing service connection points,
 - (e) elevations illustrating locations of visible equipment such as gauges, pilot lights, breakers and their trip settings, windows, meters, and access doors,
 - (f) description of operation,
 - (g) single line diagrams,
 - (h) general routing of bus ducts and connecting services,
 - (i) mounting and fixing arrangements,
 - (j) operating and maintenance clearances,
 - (k) access door swing spaces, and
 - (l) where products are required to be certified to a published standard, the mark of the testing organization who certified the product and the standard reference number to which it is certified.
- .10 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.
- .11 Shop drawing and data sheet submission is taken as certification that the products are;
- .1 from the manufacturer's current production, and
 - .2 in compliance with applicable codes, standards, and regulations.

- .12 For standard catalogued (non-custom) products, do not submit drawings showing internal construction details, component assemblies or interior piping and wiring diagrams. Such information may be necessary to understand correct functioning of equipment and are to be submitted with operating and maintenance data.
- .13 Check and stamp each shop drawing as being correct before submission. Shop drawings without such stamps will be rejected and returned.
- .14 Keep one copy of each reviewed shop drawing and product data sheet on site and have them available for reference purposes.
- .15 Where equipment is delivered without reviewed shop drawings, equipment will be condemned and is to be removed from site and replaced with new equipment after shop drawings have been submitted and reviewed.

6.2 Coordination, Fabrication, or Installation Drawings

- .1 Contractor coordination, fabrication, installation and/or sleeving drawings are to be provided in accordance with specification Section 20 01 03 *Mechanical Coordination and Installation Design Services*.
- .2 Contractor's coordination, 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 as a shop drawing.
- .3 Maintain a copy on site of such drawings for reference by the Consultant.
- .4 The Consultant reserves the right to request selected Contractor's coordination, fabrication, or installation drawings for review.

6.3 Effect of Consultants Review of Submittals

- .1 Consultant's review of shop drawings is performed on a sampling basis only, to confirm to Consultant's satisfaction that the Contractor understands the Work to be performed and is interpreting the design documents correctly, and such reviews are performed for the benefit of the Owner.
- .2 For greater certainty, the review of shop drawings by Consultant does not constitute a quality control function for the benefit of Contractor, nor does such a review relieve Contractor of their responsibility for complying with the Contract documents.

7 APPLICABLE CODES, STANDARDS AND REGULATIONS; PERMITS

7.1 Codes, Standards and Regulations

- .1 Where a published product standard or installation code is adopted by statute or regulation by an applicable AHJ, the applicable edition of the standard or code is the one that has been adopted
 - .1 at the time of obtaining a permit for the applicable portion of the Work, or
 - .2 in the absence of a requirement for a permit, the start date of construction.
- .2 Where a published product standard or installation code is not adopted by statute or regulation, then the most current edition of that standard or code at the start date of construction applies.
- .3 Install mechanical and electrical systems in accordance with the applicable requirements adopted by the AHJ in the jurisdiction of the Work.
- .4 Where requirements of the Specifications exceed those of applicable codes, standards, and regulations the requirements of the Specifications is to govern.

- .5 In the event of a conflict between codes, bulletins, 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 the most demanding requirements.

7.2 Confined Spaces

- .1 Unless otherwise prescribed by the Constructor's / Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as confined spaces in accordance with applicable health and safety legislation, 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.

7.3 Permits, Tests and Certificates

- .1 Arrange and pay for permits, tests, and Certificates of Inspection required by the AHJ applicable to the element of the Work.
- .2 Submit applications requiring Owner's signature before commencing work.
- .3 Obtain and submit applicable AHJ Inspection certificates or reports including but not limited to:
 - (a) Electrical inspection,
 - (b) Plumbing and drainage inspection,
 - (c) HVAC inspection,
 - (d) Pressure Vessel Inspection.
 - (e) Piping and Boiler Inspection.
 - (f) Fuel safety Inspection.
- .2 Renew certificates or reports so as to remain in force through the warranty period.
- .4 Co-ordinate and perform testing required by an AHJ in accordance with the Part on Testing in this Section.

8 COMMON PRODUCT REQUIREMENTS

8.1 Standard of Material and Equipment

- .1 Provide materials and equipment in accordance the requirements of Division 01 and as follows.
- .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 (certified) to applicable standards in accordance with Specification sections of the Work and as required by authorities having jurisdiction,
 - .5 registered in accordance with the requirements of the applicable provincial pressure vessels regulation and registered in accordance with CSA B51 for Canadian Registration Numbers, as applicable,
 - .6 in compliance with Standards and Regulations including but not limited 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 by the same manufacturer. ,
- .8 identical component parts of same manufacturer 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. Where manufacturers and/or products are listed under "Standard of Acceptance", select manufacturers and or products from these lists. Use of manufacturers or products other than as listed are subject to specification requirements concerning requests for substitution.
- .4 Include items of material and equipment not specifically noted on Drawings or mentioned in Specifications but which are required to make a complete and 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 fabricated control panels and component assemblies are to be listed for electrical safety requirements.
- .7 Select materials and equipment in accordance with manufacturer's recommendations and these Specifications, and install same in accordance with manufacturer's instructions and these Specifications.
- .8 Materials and equipment not satisfying these selection criteria will be condemned. Remove condemned materials from job site and provide properly selected and approved materials.

8.2 Manufacturers Nameplates

- .1 Provide manufactured equipment with metal nameplate with raised or recessed lettering, mounted on each piece of equipment. On insulated equipment, mechanically fasten plates on metal stand-off bracket arranged to clear insulation.
- .2 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.
- .3 Certified products are to clearly show the mark of the certification agency when in the final installed state.

8.3 Factory Applied Painting

- .1 Protect factory finished equipment during construction, and clean at completion of work.
- .2 Touch-up factory painted prime and/or final coats damaged during construction, with colour matching paint recommended by the equipment manufacturer.
- .3 Use heat resistant paint where conditions require.

8.4 Factory Applied Prime Painting

- .1 Factory-prime paint other equipment fabricated from iron or steel, including equipment supports and hangers, access platforms, access doors, registers, grilles, diffusers, dampers, metal radiation enclosures and fire hose cabinets where separate product specifications do not require a factory applied final coat.

8.5 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 decorative 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, provide corrosion coatings and floor sealers.
- .4 In addition, apply prime and/or final paint coats to equipment and materials where specifically detailed in other Sections of these Divisions.

8.6 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.

8.7 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.

8.8 Pre-purchased Equipment; Damage and Ownership

- .1 At time of receipt of pre-purchased or pre-tendered equipment at the job site by the installing mechanical contractor, provide the services of the manufacturer/distributor/supplier's technical representative to:
 - .1 inspect the equipment prior to unloading,
 - .2 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, and
 - .3 report any damage to the Consultant.
- .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 of the damaged equipment to the satisfaction of the Owner.

9 OFFICE AND STORAGE; TOOLS

9.1 Office and Storage

- .1 Provide temporary office, washroom 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.
- .3 Provide heat, light and telephone and Internet service

9.2 Tools, Temporary Equipment and Materials

- .1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, required to carry out the Work.

10 COORDINATION; INSTALLATION DRAWINGS

10.1 Coordination

- .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.

10.2 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 the work 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,
- .2 Circulate drawings to other trades involved in each area, and conduct coordination meetings with those trades.

11 ANCHORS AND INSERTS

- .1 Supply anchor bolts and locating templates for installation in advance of concrete pouring.

12 CUTTING, PATCHING AND REMEDIAL WORK

12.1 General

- .1 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 and pay for any resulting costs.
- .2 Neatly cut or drill holes required in existing building elements to accommodate building services including ductwork, piping, cable, raceways, bus duct or cable tray.
- .3 Arrange and pay for all cutting and patching as required for the 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, moisture-resistant elements or sight-exposed surfaces.

12.2 Structure Scanning and Cutting

- .1 Layout cutting of structural elements, such as floors slabs, walls, columns or beams and obtain approval before starting work. Conduct an initial electromagnetic scan of reinforcing rods and electrical conduit, and review with structural engineering Consultant.

Standard of Acceptance

- ° Hilti - fig. PS 300 Ferrosan

- .1 Based on the preceding results, arrange and pay for supplemental radiographic examination where necessary to improve on locating concrete reinforcement, conduits and other embedment's.
 - .1 submit radiographic results to the structural engineer and obtain comments before starting work,
 - .2 the use of radiographic imaging methods is subject to approval by the Owner on a case by case basis.
- .2 As an alternative to radiographic examination for areas where the Owner does not permit radiographic examination, based on the preceding results, provide two-dimensional ground penetrating radar scans to locate concrete reinforcement, conduits and other embedment's. Scanners to be operated by personnel trained by the measurement device manufacturer.

Standard of Acceptance

- ° Hilti PS1000 X-SCAN

- .3 Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Reroute any circuits damaged by core drilling.
- .4 Scan for all shots and anchors in floors, walls, and ceilings.

13 PROTECTION OF PERSONNEL, WORK, AND PROPERTY

13.1 Personnel Protection

- .1 Without limiting the Contractor's responsibilities regarding occupational health and safety requirements at the construction site, provide specific personnel protection as follows:
 - .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,

- .4 do not leave conduit, wires, cables, tools, equipment or materials in such a way that they constitute a hazard,
- .5 provide toe guards around openings in the roof or floor to prevent materials or debris from dropping down to a lower level,
- .6 remove loose equipment and tools from overhead areas before leaving each day,
- .7 cut off bolts at floor level to eliminate a possible tripping hazard.

13.2 Protection During Construction

- .1 Provide protection required to enable existing building and equipment to remain in continuous and normal operation.
- .2 Take the necessary precautions to protect equipment, existing building and service from damage during the Work. Accept responsibility for any damage and make good without cost to the Owner.
- .3 Protect existing surfaces and items so that they are not damaged in any way whatsoever by the work of all trades. Take precautions as necessary to prevent damage to walls, floors, ceilings, windows, doors, door frames, moldings, finishes, piping, ductwork, light fixtures, etc. Provide protection, hoarding, tarpaulins, dust sleeves etc., as required. Any damage caused because of lack of adequate protection to be made good at no cost to the Owner.
- .4 Take care when working above or around equipment that must remain in service.
- .5 Take care to eliminate dust in equipment areas.
- .6 Protect switchgear fronts from accidental breaker trips when working around or above them. Provide an extended shield constructed of 12 mm (½") fire retardant plywood a minimum of 450 mm (18") from board front to allow access to board.

13.3 Core Drilling

- .1 Wherever core drilling is required, provide temporary dust proof screens.
- .2 In areas where core drilling through a slab in an operating facility is necessary, clearly mark out the areas to be drilled on the underside of slab. Owner's representative to be notified at least 1 week prior to core drilling operation. Provide tarping of equipment supervised by the Owner.
- .3 During core drilling operations, station at least one person directly below the area of drilling with a large plastic container pressed to underside of slab to capture and hold core and water upon completion of operations.
- .4 Continuously use a wet/dry commercial quality vacuum at location of drilling operation to remove all excess water from the area.

13.4 Temporary Dust Proof Screens

- .1 Comply with Division 01 for temporary dust proof screens and infection control procedures.

13.5 Protection of Floors During Equipment Installation

- .1 Provide protection of floor finishes during installation or removal of equipment, and at any other time when moving or installing heavy equipment.

- .2 Install 19mm (¾") plywood over 6 mil plastic over finished floor areas when moving heavy equipment that could damage floor finish, or when installing equipment or line materials overhead.
- .3 Repaint or re-tile any floors or walls damaged or scratched during construction.

13.6 Housekeeping

- .1 Maintain a high level of cleanliness.
- .2 Remove scrap and refuse from the work area daily.
- .3 Whenever possible, clean up immediately following completion of work.
- .4 Deposit oily and waste solvent rags in approved containers to minimize the fire hazard.
- .5 Sweep and damp mop daily.

14 WORK IN EXISTING BUILDING

14.1 General

- .1 Comply with Division 01 for restrictions on working in existing occupied buildings and as follows.
- .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 The 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.
- .4 Perform core drilling after-hours or on weekends depending on the schedule of the impacted spaces. Coordinate with Owner for specific times.
- .5 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.
- .6 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.
- .7 Unless noted otherwise removed materials and equipment become the property of the Contractor and are to be taken from the site and disposed of appropriately.
- .8 On completion of relocations, confirm relocated equipment are in proper working order.
- .9 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.

14.2 Continuity of Services

- .1 Keep existing buildings in operation with minimum length of shutdown periods.
- .2 Make connections to existing systems at approved times.
- .3 Obtain written approval recording times when connections can be made.
- .4 Arrange work so that physical access to existing buildings is not unduly interrupted.
- .5 Be responsible for and make good any damages caused to existing systems when making connections.

- .6 Provide premium time labour to tie-in to services at night or on weekends.
- .7 For piping systems, make connections to existing piping by draining down the existing piping system. Use of hot-tapping or freezing of piping is only permitted where approved by the Owner and a specification section for such work has been included in the project specifications.
- .8 Provide temporary services to drain down existing piping systems which convey liquids or steam condensate, including provision of temporary hoses, etc., and provide services to perform the drain down of these systems, except where the Owner elects to perform such drain-downs.
- .9 For piping systems conveying liquids, after completion of new work to existing piping systems, refill the existing and new piping systems including provision of cleaning of new piping and addition of chemical treatments, as applicable, in accordance with the requirements of other sections of Division 20. Include for addition of replenishing chemical treatment for existing piping systems in accordance with the Owner's existing chemical treatment program, or in the absence of such, in accordance with the chemical water treatment requirements specified in other Sections of Division 20.

15 MOVING AND SETTING IN PLACE OF OWNER-SUPPLIED PRODUCTS

15.1 General

- .1 The requirements of this Part applies to;
 - .1 Division 20 equipment that has been directly purchased by the Owner, and
 - .2 other Owner-supplied products or equipment (i.e. process equipment) that has building services requirements.
- .2 Comply with the requirements of Division 01 and as specified herein.

15.2 Owner-Supplied Products (Supplied by Owner Equipment – “SBO”)

- .1 Items marked SBO on drawings are to be;
 - .1 purchased by the Owner,
 - .2 received, checked, and stored by the Contractor, and
 - .3 subsequently unpacked, uncrated, assembled and located in its final location by the Contractor, and installed in accordance with the manufacturer instructions,
 - .4 participate in the start-up and testing of the equipment and placing into service.
- .2 Provide mechanical and electrical services to SBO equipment in accordance with the SBO equipment manufacturer's instructions and as otherwise shown.

15.3 Existing Owners Equipment to be Relocated (E.R. or Ex. Rel.)

- .1 Applies to owners existing equipment which has mechanical and electrical services, and marked on the drawings as E.R. Ex.Rel. or otherwise so identified.
- .2 Items so marked on drawings are to be moved from their present location and reinstalled by the Contractor.
- .3 Disconnect and reconnect mechanical and electrical services to accommodate this equipment relocation.

16 TEMPORARY HEATING

16.1 During Construction

- .1 Temporary heating required while building is under construction will be provided under Division 01.

- .2 Permanent heating system may be used for temporary heating, when this equipment is installed in its permanent location and the 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, the piping system has been pressure tested, cleaned, and final chemical water treatment is in operation.
- .4 Permanent heating equipment used for temporary heating to be thoroughly cleaned and put in first class operating condition and appearance at completion of the Work, as approved by the Owner.

17 FINAL CLEANING AND ADJUSTMENTS

17.1 Final Cleaning

- .1 Conduct final cleaning in accordance with Division 01 requirements and as specified herein.
- .2 Perform final cleaning after construction activities that create dust have been completed.
- .3 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 immediately prior to handover of the building to the Owner.
- .4 HEPA vacuum the top and interiors of motor controllers, VFDs, control panels, and control cabinets followed by a thorough HEPA vacuuming of the service room 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.
- .5 Remove tools and waste materials on completion of work and leave work in clean and perfect condition.

17.2 Final Adjustments

- .1 Calibrate components and controls and check function and sequencing of systems under operating conditions.
- .2 Supply lubricating oils and greases for proper operation of equipment and systems until work has been accepted.

18 RECORD DRAWINGS

18.1 Record Drawings

- .1 Maintain record drawings in accordance with Division 01 during the course of the Work and as follows.
- .2 A set of design drawings in AutoCad, or PDF format (as determined by the Consultant) will be provided by the Consultant. Record changes in actual installation as the Work progresses by the following method:
 - .1 make sets of white prints for each phase of Work and mark-up the print drawings, or
 - .2 revise the AutoCad file directly, and identify all changes made.
- .3 Mark-up these record drawings to provide dimensioned 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.
- .4 Retain on-site the survey information from excavation and backfill of site services, and after approval, transfer this information to the record documents.
- .5 Retain these drawings and make available to Consultant for periodic review.
- .6 At 50%, 75% and 90% project completion, scan marked-up drawings to PDF format and submit copy to the Consultant, or to the project on-line document management service if one is used.

18.2 As-Built Drawings

- .1 Prior to testing, balancing and adjusting, transfer site record drawing information to a copy of the computer aided drafting/design program ("CAD") files, in the same software format used for the Consultants design drawings, to record final as-built condition.
- .2 Obtain a current set of CAD files from the Consultant. The Consultant's CAD files may not reflect all or any construction changes.
- .3 Drawings are to remain set to and follow Consultants CAD Standards - do not alter drawing scales, reference files, colours, layers or text styles,
- .4 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.
- .5 Show on mechanical as-built drawings final location of piping, ductwork, switches, starters, Motor Control Centres, thermostats, and equipment.
- .6 Show on site services as-built drawings survey information provided by an accredited land surveying service.
- .7 Identify each drawing in lower right hand corner in letters at least 12 mm (½ in) high with a note as follows:

<p style="text-align: center;">AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed (Signature of Contractor) (Date).</p>
--

- .8 The site services drawings are to include the signature and stamp of the accredited surveyor adjacent to the note.
- .9 Submit one (1) set of white prints of the draft as-built CAD files for Consultant's review.
- .10 Once "AS BUILT DRAWINGS" white prints are reviewed, transfer Consultant's comments to the CAD files. Return CAD files modified to "As Built" condition to Consultants electronically by removable mass storage device or by electronic file transfer as designed by the Consultant.
- .11 Submit three (3) sets of white prints and one (1) electronic copy of CAD files with Operating and Maintenance Manuals to the Owner.

19 OPERATING AND MAINTENANCE INSTRUCTIONS

19.1 Operating and Maintenance Manuals

- .1 Provide operating and maintenance manuals in accordance with Division 01 and as follows.
- .2 Provide operation and maintenance data bound in vinyl covered, hard back, three-ring covers, nominally 50 mm (2 in) thick, suitable for paper size of 210 mm x 300 mm (8½ in x 11 in);
 - .1 organize material in volumes, generally grouped by Trade section;
 - (a) Table of Contents,
 - (b) General Information,
 - (c) Sub-contractors (list),
 - (d) Site services,
 - (e) Fire Protection,
 - (f) Plumbing,

- (g) Heating and Cooling Plant and Distribution,
 - (h) Air Handling Equipment and Distribution,
 - (i) Building automation, Controls and Instrumentation,
 - (j) Testing Reports,
 - (k) As-Built Drawings,
 - (l) Warranties.
- .2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear;
 - (a) Project Name,
 - (b) Project Number,
 - (c) Date,
 - (d) Trade Section,
 - (e) List of Contents.
 - .3 Provide three hard-copies to Owner.
- .3 In addition, provide 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 PDF Bookmarks to create a Table of Contents for each file.
- .4 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 valve schedules and flow diagrams,
 - .7 service piping identification charts.
 - .5 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.
 - .6 Approval procedure;
 - .1 submit one set of first draft of Operating and Maintenance Manuals for approval at least one month prior to planned substantial performance date,

- .2 make corrections and resubmit for a final review,
- .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 (2) hard-copies and one (1) PDF copy on removable storage device of the Operating and Maintenance Manuals to the Owner's operating staff and obtain written confirmation of delivery. Provide a copy of the delivery record to the Consultant.

19.2 Operating and Maintenance Training

- .1 Provide operating and maintenance training in accordance with Division 01 and as follows.
- .2 Provide training 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.
- .3 Develop the proposed training plan, and submit an outline of the training program for review, adjustment and approval by the Owner.
- .4 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.
- .5 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 topic, separated by approximately one week each. Develop the proposed training plan and obtain approval from the Owner before commencing training.
- .6 All training to be scheduled and provided between the hours of 7 am to 5 pm, Monday to Friday. Where training is required to be performed outside of these hours due to availability of Owners operations personnel, if the trainers are paid for overtime outside of these hours, the overtime portion only is eligible to be paid by the Owner as an extra cost.
- .7 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.
- .8 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
- .9 Keep records of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.
- .10 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.
- .11 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 PDF format, in accordance with article on Operating and Maintenance Manuals.
- .12 Sessions may be video recorded by the Owner as an aid to ongoing training of Owners staff.

20 CARE, OPERATION AND START-UP

- .1 Provide all labour and materials as necessary to perform start-up and testing of equipment and systems.
- .2 Arrange and pay for services of manufacturer's factory service technician to supervise start-up of the installation, check, adjust, balance and calibrate components and equipment as specified in the specification sections of Division 20.
- .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.
- .4 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 the installation in complete working order. Provide a certificate indicating that the equipment is free and clear of deficiencies.

21 TESTING

21.1 General

- .1 The following describes the general requirements for testing of mechanical systems; refer to additional testing requirements in applicable sections of Division 20 of the Work.
- .2 Conduct tests during progress of Work and at its completion to verify equipment and systems meet the contract documents. 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, to the Inspection Authority and personnel witnessing tests.
- .5 The Owner reserves the right to witness any test; any such witnessing activity shall not be construed as acceptance of the system or equipment by the Owner.
- .6 Conduct tests before application of external insulation and before any portion of pipes, ducts or equipment is concealed.
- .7 Do not subject expansion joints, flexible pipe connections, meters, control valves, convertors, and fixtures, to test pressures greater than the 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.

- .8 Should section of pipe, duct, or electrical cable fail under test, replace faulty piping, duct, or cable with new fittings, pipe, duct or cable and then retest. Do not repair threaded pipe joints by caulking nor welded joints by peening. Repeat tests until results are satisfactory.
- .9 Where it is necessary to test portions of piping, ductwork or electrical cable system before system is complete, overlap successive tests so that no joint or section of duct or pipe is missed in testing.
- .10 Upon completion of work and testing of same, submit logs to demonstrate that tests have been carried out satisfactorily. Repeat any tests if requested.

21.2 Testing - Potable Water Piping

- .1 Except where otherwise specified in other sections of Division 22, test potable water systems with water or air as required by the plumbing code in effect at the location of the Work.
- .2 For water service pipes 100 mm (4") and larger, disinfect the pipe with chlorine ("hyper-chlorinate") from the street valve to the first shut-off valve inside the building. At completion of disinfection, take water samples just before the utility meter and pay for the samples to be tested by an accredited testing laboratory. Test the water samples for contaminants and to measure the residual chlorine concentration and provide test certificate confirming water contaminates are below the threshold values proscribed by applicable legislation.
- .3 Where stainless steel piping is used in the domestic water system, between the entry point in the building and the utility water meter, after taking the water sample for laboratory testing, immediately drain down the incoming service piping up to the utility meter and then flush with clean city water until a site test of the drain water shows a residual chlorine level not greater than the incoming city water supply.
- .4 Where stainless steel piping is used in potable water piping inside the building (i.e. downstream of the utility meter), do not allow any hyper-chlorinated water used for disinfection of piping to come into contact with the stainless steel piping.

21.3 Testing - Other Piping

- .1 Except where otherwise specified in other sections of Divisions 21, 22 or 23, hydraulically pressure test other water piping systems at 1½ times system design pressure (relief valve setting) or 1000 kPa (150 psi), whichever is greater, for 10 minutes then reduce the test pressure and hold 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.
 - .1 Alternatively, hold the pressure at the design pressure and testing all joints with a soap test.
- .2 Test natural gas system in accordance with CSA B149.1 *Natural Gas and Propane Piping Code*.
- .3 Test fuel oil systems in accordance with CSA B139 *Installation Code for Oil Burning Equipment*.
- .4 Test drainage, waste and vent piping for tightness and grade as required by the plumbing code in effect at the location of the Work.
- .5 Test special service piping as detailed in other sections of Divisions 21, 22 and 23.

21.4 Testing - Ventilation

- .1 Pressure test ductwork in accordance with section 23 31 13 *Ductwork*, or other applicable sections of Division 23.

21.5 Testing - Electrical

- .1 Make tests of equipment and wiring. Test wiring systems in accordance with section 20 05 12 *Wiring Requirements for Mechanical*.
- .2 Replace defective equipment and wiring with new material.

22 TEMPORARY AND TRIAL USAGE

- .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 warranty.

23 SPECIAL TOOLS AND SPARE PARTS

23.1 Spare Parts

- .1 Prior to application for Substantial Performance, furnish spare parts as follows;
 - .1 one set of mechanical seals for one pump of each model size,
 - .2 one pump casing joint gasket for each model size,
 - .3 one head gasket for each shell-and-tube heat exchanger with removable heads,
 - .4 one glass for each gauge glass,
 - .5 one set of V-belts for each drive of the same model size,
 - .6 one set of filter cartridges for each filter or filter bank installed.
- .2 Maintain an inventory record and delivery receipt record of spare parts delivered to the Owner, and include them in the Operating and Maintenance manuals.

24 CONSULTANT REVIEWS

24.1 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 as required by the local authority have jurisdiction. It is the Contractor's responsibility to ensure that the Work is complete and constructed in accordance with the design documents.

24.2 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, readily noticeable deficiencies may be recorded by the Consultant where the deficient 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, specifically in identification and rectification of deficiencies or incomplete 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.

24.3 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 by the Consultant 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.

24.4 Partial Occupancy Reviews

- .1 Where the Work is planned to include occupancy by the Owner of a part of the Work but not the entire Work ("partial occupancy"), the procedures specified for Substantial Performance Review will apply to the portion of the Work being considered for partial occupancy.

24.5 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.

24.6 Final Review

- .1 At project completion submit written request for final review of mechanical and electrical systems. 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 equipment/line material 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.

25 CONTRACTOR INSPECTIONS

25.1 General

- .1 The Division 20 contractor shall assign one person responsible for ensuring that Work from all mechanical trades is complete prior to;
 - .1 closing in wall, ceilings or burying of services,
 - .2 partial-occupancy reviews, and
 - .3 substantial performance reviews.
- .2 In conjunction with the Contractor's Mechanical and Electrical sub-contractors, the Contractor shall walk the site and thoroughly inspect that the work is complete, in good workmanship and installed according to the contract documents and derived documents therefrom. The Contractor shall then submit a report attesting to the completed state of the Work (the "Statement of Completion" report, as detailed later in this part).
- .3 In the case of Contractor inspections for partial-occupancy or substantial performance, submit the Statement of Completion report at least 24 hours prior to the scheduled review by the Consultant.

25.2 Contractor Inspections for Partial Occupancy and Substantial Performance

- .1 In preparation for the Consultants general review for partial-occupancy and/or substantial performance of the Work, the Contractor shall perform a comprehensive inspection of the Work to ensure that their contractual obligations are met before requesting a Consultant's review of the Work. In performing this inspection, the Contractor shall create a Statement of Completion report which is to include;
 - .1 date and time of the Contractor's inspection, signed by the person who conducted the inspection,
 - .2 names of the mechanical contractor's personnel who participated in the inspection,
 - .3 confirmation that previously noted deficiencies have been completed,
 - .4 confirmation that the work is 100% complete, tested, balanced and free of deficiencies, or include a list of outstanding deficiencies and incomplete Work with;
 - (a) a reason why the Work has not been completed (i.e. another trade has to complete their work)
 - (b) a plan of action to complete the Work, and
 - (c) a commitment date for completion of the Work including rectification of all deficiencies.
- .2 The format of the Statement of Completion shall be approved by the Consultant.
- .3 The Consultant shall review and sign-off the Statement of Completion Report and return a copy to the Contractor. The Contractor shall retain on-site a log of all signed off Statement of Completion reports.
- .4 If a required Statement of Completion report is not received, the Consultant reserves the right to withhold conducting a review for partial-occupancy or substantial performance.
- .5 After receipt of the Contractor's Statement of Completion report, if upon entering an area of the work covered by the Statement of Completion report the Consultant determines, in its sole opinion, that the applicable Work is not ready for review, the Consultant may elect to cancel the review of the Work or the affected portion of the Work, and shall assume no responsibility for any damages or losses as a result of cancellation of the review. The Contractor shall remedy the incomplete work and request another review with 72 hours prior written notice, and shall resubmit the revised Statement of Completion at least 24 hours prior to the new review.

26 CORRECTION AFTER COMPLETION

- .1 At completion, submit a written warranty undertaking to remedy defects in work for a period of one year from date of substantial performance of the Work. This warranty is not to supplant other warranties of longer period called for on certain equipment or materials.
- .2 Warranties are to encompass replacement of defective parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation of the corrected Work.
- .3 Submit similar warranties for one year from date of acceptance for any part of work accepted by Owner, before completion of the whole Work.

27 ATTACHMENTS

27.1 Schedule of Values Form

- .1 Attached sample of the Schedule of Values form layout.

27.2 Shop Drawing Submittal Form

- .1 Attached sample of shop drawings submittal form.

SCHEDULE OF VALUES

Project Name: <<name of project>>
Owner Name: <<owner name>>
Contractor Name: <<name of trade contractor: mechanical, electrical, etc>>
Division(s) of the Work: <<i.e. 20, 21, 22...>>
For the billing period ending: dd-mmm-yyy

This sheet is an example of a required schedule of values to be developed by the Contractor, to be submitted with each progress payment request.
Specific level of detail for each work element to be approved by the Consultant.

Item	Base Contract Element	Contract Value		Complete to Date		Previously Billed		This Billing		Balance to Complete	
		\$	%	\$	%	\$	%	\$	%	\$	%
1.1	<<work element>>	1,000,000.00	65.9%	400,000.00	40.0%	225,000.00	22.5%	175,000.00	17.5%	600,000.00	60.0%
1.2	<<work element>>	250,000.00	16.5%	30,000.00	12.0%	5,000.00	2.0%	25,000.00	10.0%	220,000.00	88.0%
1.3	<<work element>>	125,000.00	8.2%	50,000.00	40.0%	22,000.00	17.6%	28,000.00	22.4%	75,000.00	60.0%
X.X	Itemized Price No. 1	25,000.00	1.6%	0.00	0.0%	0.00	0.0%	0.00	0.0%	25,000.00	100.0%
X.X	Separate Price No. 1	12,500.00	0.8%	5,000.00	40.0%	0.00	0.0%	5,000.00	40.0%	7,500.00	60.0%
CCA.1	Cash Allowance Disbursements Summary	75,000.00	4.9%	34,000.00	0.0%	8,000.00	0.0%	26,000.00	0.0%	41,000.00	0.0%
X.X	Coordination drawings	15,000.00	1.0%								
X.X	As-built documents and operating manuals	15,000.00	1.0%								
	Original Contract Values	1,517,500.00	100.0%	519,000.00	34.2%	260,000.00	17.1%	259,000.00	17.1%	968,500.00	63.8%
CO.1	Approved Changes Summary	13,400.00		5,200.00	38.8%	2,000.00	14.9%	3,200.00	23.9%	8,200.00	61.2%
	Total Current Contract Values	1,530,900.00		524,200.00	34.2%	262,000.00	17.1%	262,200.00	17.1%	976,700.00	63.8%

Reference	Cash Allowance Disbursement	CA Value		Complete to Date		Previously Billed		This Billing		Balance to Complete	
		\$	%	\$	%	\$	%	\$	%	\$	%
CAA_1	<<description of cash allowance>>	20,000.00		20,000.00	100.0%	8,000.00	40.0%	12,000.00	60.0%	0.00	0.0%
CAA_2	<<description of cash allowance>>	55,000.00		14,000.00	25.5%	-	0.0%	14,000.00	25.5%	41,000.00	74.5%
	Total	75,000.00		34,000.00	45.3%	8,000.00	10.7%	26,000.00	34.7%	41,000.00	54.7%

Reference	Approved Changes	Change Value		Complete to Date		Previously Billed		This Billing		Balance to Complete	
		\$	%	\$	%	\$	%	\$	%	\$	%
CO_01	<<description of change of work>>	5,800.00		-	0.0%	-	0.0%	0.00	0.0%	5,800.00	100.0%
CD-01	<<description of change of work>>	7,600.00		5,200.00	68.4%	2,000.00	26.3%	3,200.00	42.1%	2,400.00	31.6%
	Total	13,400.00		5,200.00	38.8%	2,000.00	14.9%	3,200.00	23.9%	8,200.00	61.2%

Reference	Unquoted/Unapproved Changes	Status	Quotation	
			\$	%
CCN-01	<<description of change of work>>	Waiting for approval	12,000.00	
CCN-02	<<description of change of work>>	Unquoted		
	Total		12,000.00	



Toronto Montreal Vancouver Dallas Chicago

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: Click or tap here to enter text.

Project Name: Click or tap here to enter text.

HHA Project No: Click or tap here to enter text.

Contractor to complete the following for each submission.

Date: _____

Contractor Name: _____ Ref. No: _____

Manufacturer Name: _____

Product Type/Description: _____

Specification section number: _____

Contractor Trade Category:

- | | | | |
|--|-------------------------------------|--|---|
| <input type="checkbox"/> Architectural | <input type="checkbox"/> Structural | <input type="checkbox"/> Conveying Equipment | <input type="checkbox"/> User Equipment |
| <input type="checkbox"/> Mechanical | <input type="checkbox"/> Electrical | <input type="checkbox"/> Telecommunications | <input type="checkbox"/> Civil |
| <input type="checkbox"/> Other | | | |

If this is a resubmission, check here: ☐

Previous submission HHA reference no.: _____

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END OF SECTION

QUALIFICATIONS AND AUTHORITIES - ONTARIO

20 01 02

1 GENERAL

1.1 Scope

- .1 This 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 a certificate of qualification or be an apprentice in accordance with the *Building Opportunities in the Skilled Trade Act, 2021*, S.O. 2021, c. 28, including but not limited to the following prescribed trades in accordance with the *Prescribed Trades and Related Matters* regulation O.Reg. 876/21:
 - .1 Construction Millwright,
 - .2 Electrician – construction and maintenance,
 - .3 Fuel and electrical systems technician,
 - .4 Heat and frost insulator,
 - .5 Information technology – hardware technician,
 - .6 Information technology – network technician,
 - .7 Network cabling specialist,
 - .8 Instrumentation and control technician,
 - .9 Plumber,
 - .10 Refrigeration and air-conditioning systems mechanic,
 - .11 Sheet metal worker,
 - .12 Sprinkler and fire protection installer,
 - .13 Steamfitter,

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)	Technical Standards and Safety Authority	TSSA
Heating Oil and Diesel Fuel	Technical Standards and Safety Authority	TSSA
Propane	Technical Standards and Safety Authority	TSSA
Pressure Piping	Technical Standards and Safety Authority	TSSA
Refrigeration	Technical Standards and Safety Authority	TSSA
Licensed Plant Operators	Technical Standards and Safety Authority	TSSA
Electrical	Electrical Safety Authority	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 permits, 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 construction contract. In the absence of any requirements in the project construction contract, 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.
- .2 The use of Consultant's drawings directly for construction, without preparation of Contractor detailed coordination, fabrication, and installation design drawings, is at the Contractors risk.

1.4 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 may be returned by Consultant for re-submission to include proposed resolution.

2 WORK RESTRICTIONS

- .1 The following commentary describes work restrictions that may affect the Contractors construction schedule and/or means and methods of construction, and are to be taken into consideration by the Contractor when estimating the cost and duration of 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 availability of existing documentation

3 INTERFERENCE COORDINATION

3.1 General

- .1 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.
- .2 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions. Provide necessary offsets in ducts, piping etc. to change elevation and direction as required to coordinate services in the ceiling space.
- .3 Location of equipment and associated service connections are diagrammatic and based on manufacturer information available at the time of design. Include suitable allowances for and make adjustments to installation of actual equipment, including but not limited to size of housekeeping pads, methods of support, routing of pipe, duct, conduit and other services around and to the equipment, and location of services connection points to the equipment, at no change to the Construction Price.
- .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.
- .7 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.

3.2 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.

3.3 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 Maintain these interconnection drawings through the course of the Work and include a final updated version with the Operating and Maintenance instructions.

3.4 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.
- .3 Submit interface drawings as a shop drawing for Consultants review.

- .4 Maintain these interconnection drawings through the course of the Work and include a final updated version with the Operating and Maintenance instructions.

4 OWNERS EQUIPMENT AND RELOCATED EQUIPMENT

- .1 The service provisions shown for Owner's supplied equipment and/or relocated equipment is based on the 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.

5 FABRICATION AND INSTALLATION DRAWINGS

- .1 On an as-needed basis, prepare fabrication, spooling, and/or installation drawings based on the completed interference coordination drawings. Such drawings are to be 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

Authority 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%.

Building Automation System ("BAS"): the building control systems as specified in Division 25.

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 required 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

AMCA	Air Movement and Control Association International
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
MCAA	Mechanical Contractors Association of America
MCAC	Mechanical Contractors Association of Canada
MSS	Manufacturers Standardization Society
NECA	National Electrical Contractors Association
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, and applicable to each Section of Division 20 to 25.

2 ACCESSIBILITY FOR BUILDING CONTROL DEVICES

- .1 Mount control devices, intended to be adjusted or to otherwise be operated 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 lbf).
- .2 The above requirements do not apply to control devices that are solely located and used by the building operations staff.

3 ACCESS PANELS / DOORS

3.1 General

- .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.

Standard of Acceptance

- Williams Brothers – fig. GP
- Elmdor/Acorn - fig. DW
- Mifab - fig. UA

3.2 Applicable Product Standards

- .1 CAN/ULC-S104 Standard Method for Fire Testing of Door Assemblies

3.3 Construction:

- .1 Standard access door:
 - .1 1.6 mm (16 ga) carbon steel door and door-frame with white satin coat prime coat finish, with door edges turned back to frame for rigidity,
 - .2 flush mounted with 180° opening door, round safety corners, concealed hinges, plaster lock and anchor straps,
 - .3 latch: screw driver operated,
 - .4 access doors in ceilings, where acoustic tile is applied to plaster or gypsum board, to be dish type designed to receive tile insert.
 - .5 size:
 - (a) 600 mm x 600 mm (24 in x 24 in) for personnel entry,
 - (b) 300 mm x 450 mm (12 in x 18 in) for hand entry,

.2 Variations:

- .1 stainless steel variant:
 - (a) Type 304 stainless steel with No. 4 brush satin finish.
- .2 waterproof variant:
 - (a) Type 304 stainless steel with No. 4 brush satin finish, with neoprene gasketed door.
- .3 security access variant:
 - (a) keyed cylinder, with all cylinders keyed alike,
- .4 fire rated variant:
 - (a) where access door is located in a horizontal or vertical fire separation that has a fire resistance rating of 2 hours or less,
 - (b) insulated door with 50 mm (2 in) fire retardant mineral wool insulation, and 0.95 mm (20 ga.) back liner,
 - (c) heavy duty spring for self-closing door action,
 - (d) rated for installation in masonry walls and fire rated shaft wall construction, or fire rated ceiling construction as applicable to the installation,
 - (e) listed to CAN/ULC-S104 for minimum 1.5 hour closure ratings.
- .5 Submit shop drawings showing access door size, type and location.

3.4 Installation:

- .1 Access doors are 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.
- .2 Supply access doors and make arrangements and pay for installation by Division in whose work they occur.
- .3 Supply access doors with the required variations in accordance with the following table:

Space Type	Wall or Ceiling Finish	Variants		
		Stainless Steel	Water-proof	Key lock
Service rooms, Service corridors,	Drywall	---	---	---

Space Type	Wall or Ceiling Finish	Variants		
		Stainless Steel	Water-proof	Key lock
Public spaces and corridors - more than 2.4 m (8 ft) above the floor, Private spaces, washrooms	Tile or other hard finished surfaces	Yes	---	---
Public spaces and corridors - 2.4 m (8 ft) or less above the floor, Mental health patient areas, Public washrooms	Drywall	---	---	Yes
	Tile or other Hard Surfaces	Yes	---	Yes
Shower rooms, bathtub rooms, Pools, saunas, Kitchens, laundries, Other damp, washdown or high humidity spaces	All	Yes	Yes	Yes

- .4 Provide fire rated variant in addition to the above table variants, as applicable to the wall or ceiling construction.
- .5 Size and locate access doors in applied tile, block or in glazed or unglazed structural tile to suit joint patterns.
- .6 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.
- .7 At time of instruction of owners operating staff, hand-over and obtain signed receipt for 4 sets of each type of key used for access doors with key-lock cylinders.

4 DIELECTRIC FITTINGS

4.1 General

- .1 Provide dielectric fittings for connection between carbon/galvanized steel piping and either copper tube or stainless steel tube/piping in the following pipe systems:
 - .1 Non-Potable Water (NPW) piping systems which do not have any chemical treatment,
 - .2 Domestic hot water systems where galvanized steel pipe is used, including at connections to hot water heating equipment.

4.2 Products

- .1 Dielectric unions – NPS 2 and under:
 - .1 body and union nut material selected to suit connecting piping materials, including carbon steel/copper, carbon steel/stainless steel, and copper/stainless steel,
 - .2 flat-face union design,
 - .3 tail-piece with NFPT ends with thermobaked epoxy coating, and Teflon shoulder gasket,
 - .4 head-piece with integral O-ring, with threaded or sweat pipe ends.

- .5 union nut,
- .6 pressure rating: Class 3000.
- .7 dielectric coating resistance rating: minimum 500 V/mil thickness.

Standard of Acceptance

- Hart Industrial Unions - fig. D-3136 series

.2 Dielectric nipples – NPS 3 and smaller:

- .1 for connecting copper to carbon steel piping,
- .2 fitting body: Zinc-plated carbon steel tube to ASTM A513,
- .3 liner: polypropylene covering entire inner surface of fitting body,
- .4 fitting ends: threaded to ASME B1.20.1.
- .5 design pressure: 2000 kPa (300 psi) at design temperature,
- .6 design temperature: -40 to +110°C (-40 to +230°F)

Standard of Acceptance

- ASC - fig. 7090

.3 Dielectric insulating flanges – NPS 2-1/2 to NPS 4;

- .1 For connecting copper to carbon steel piping.
- .2 Ductile iron flanges, Class 125 to ANSI B16.42.
- .3 Copper tailpiece for soldered joint,
- .4 NFPT thread to AMSE B1.20.1 x copper solder joint,
- .5 BUNA-N gasket,
- .6 lead free materials to NSF 61+G.
- .7 maximum design pressure: 1200 kPa (175 psi)
- .8 maximum operating temperature: 82°C (180°F)

Standard of Acceptance

- Watts No. LF3100

.4 Dielectric insulated flange – single face with copper tube tailpiece – NPS 2-1/2 to NPS 4;

- .1 For connecting copper to carbon steel piping.
- .2 Van Stone style carbon steel flange with copper tailpiece with flared flaired end,
- .3 carbon steel flange, Class 150 to ANSI B16.5, with powder coated finish.
- .4 copper tailpiece with rolled flange face-end, and EPDM insulating gasket isolating the copper tube from the steel flange.

Standard of Acceptance

- CTS Flange Canada - fig. CTS Copper Flange Adaptor

.5 Dielectric Insulating gaskets for flanges NPS 6 and over:

- .1 for use with ASME Class 150 and 300 dimensional flanges.
- .2 suitable for connecting dissimilar piping materials, including carbon steel/copper, carbon steel/stainless steel, and copper/stainless steel,
- .3 compatible with pressure and temperature service,
- .4 BUNA-N or EPDM gasket seals compatible with potable water
- .5 flange bolts run in insulating sleeves with insulating washers under nuts.

Standard of Acceptance

- Advance Products and Systems

4.3 Installation

- .1 Provide dielectric isolation on specified piping systems between pipes of dissimilar metals with suitable insulating dielectric unions, dielectric nipples, 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.

5 DRAIN VALVES

- .1 Provide drain points with drain valves at low points of piping systems and at section isolating valves.
- .2 Drain valves:
 - .1 NPS ¾ drain and valve for service pipes NPS 2-1/2 and smaller, complete with hose end male thread, cap and chain,
 - .2 NPS 2 drain and valve for services pipes NPS 3 and larger, complete with female Camlock coupling and dustcap.
- .3 Where mechanical-compression fittings are used in the piping system, use only threaded fittings for the construction of the drain piping.

6 SLEEVES

6.1 General

- .1 Provided sleeves for pipes, ducts and conduits passing through walls, floors and roofs.
- .2 Maintain fire-resistance integrity where pipes and ducts pass through walls, floors and partitions which are or form part of a fire separation.
- .3 Manufactured sleeves and integral sleeves with firestopping may be used provided they meet the same performance requirements as specified for fabricated sleeves.

Standard of Acceptance

- Hilti
- 3M
- Marfab Metal Products

6.2 Floor and Wall Sleeves – Dry Locations (“Standard Sleeves”)

- .1 Sleeve dimensions in floor and wall fire separations having a fire-resistance rating:
 - .1 For piping, insulated piping, and conduit:
 - (a) opening sized to suit fire stopping methods employed but in no case having an inside dimension more than 50 mm (2 in.) larger than the outside dimension of the service.

- (b) sleeves may be permanent or only provided as formwork in concrete and masonry construction,
- .2 For ductwork:
 - (a) opening sized to suit duct fire damper and/or smoke damper with clearance required for thermal expansion between the wall/floor opening and the fire/smoke damper sleeve in accordance with the fire/smoke damper manufacturer installation instructions.
 - (b) opening sleeves may be permanent or only provided as formwork in concrete and masonry construction,
 - (c) in gypsum-board construction provide permanent opening sleeves or ensure that steel-stud framing is provided to line the opening in the construction.
- .3 Sleeve length – permanent type:
 - (a) piping: extend 25 mm (1 in.) past each face of fire separation.
 - (b) ductwork fire damper sleeve: as required to allow for installation of retaining angles and installation of required access door.
- .2 Sleeve dimensions for all other wall and floor types (except waterproof floors):
 - .1 For all services:
 - (a) opening sized to suit the outside dimension of the service, but in no case having an inside dimension of not less than 12 mm (1/2 in.) and not more than 50 mm (2 in.) larger than the outside dimension of the service.
 - (b) for clarity, for insulated pipes and insulated ducts the outside dimension of the service includes the insulation thickness.
 - .2 Sleeve length:
 - (a) flush to wall/floor construction or not to extend more than 25 mm (1 in.) past each face of wall or floor construction.
- .3 Sleeve construction for pipes and conduits:
 - .1 for all types of floor and wall construction:
 - (a) minimum schedule 10 steel pipe,
 - (b) fabricated carbon steel sheet of same thickness as schedule 10 pipe, rolled to dimension, lapped and spot welded, or
 - (c) as required by specific firestop system listing requirements.
- .4 Sleeve construction for ducts smaller than 0.4 m² (4 sq ft) cross sectional area including insulation:
 - .1 for wall construction other than as fire separations having a fire-resistance rating:
 - (a) 1 mm (20 ga) minimum sheet metal, lapped and spot welded with 20 mm (3/4 in) lip flange at one, or
 - (b) sleeves are not required where wall openings are coordinated wall construction trades which includes any duct insulation.
 - .2 for floors and walls that are fire separations with required fire-resistance rating:
 - (a) as required by fire and/or smoke damper listing.
- .5 Sleeve construction for ducts of 0.4 m² (4 sq ft) and larger cross sectional area including insulation through walls and floors:
 - .1 for wall construction other than fire separations having a fire-resistance rating:
 - (a) 1.6 mm (16 ga) minimum sheet metal, lapped and spot welded with 20 mm (3/4 in) lip flange at one end.

- .2 for floors and walls that are fire separations with required fire-resistance rating:
 - (a) as required by fire and/or smoke damper listing.
- .6 Manufactured floor sleeves with integral fire stopping:
 - .1 floor sleeve with integrated firestopping, for insulated and non-insulated metal pipes, and plastic pipes,
 - .2 for installation in concrete floors and metal deck/concrete floors,
 - .3 adaptors for support or pipe riser clamps,
 - .4 listed to CAN/ULC-S115.

Standard of Acceptance

- ° Hilti - fig. CP 680 series

6.3 Slot Sleeves

- .1 Application:
 - .1 where multiple pipes or conduits are grouped together in a linear arrangement to pass through a concrete floor or wall, or masonry wall, a common slot sleeve may be used,
 - .2 where slot openings are not shown on structural drawings, Contractor may propose location and sizes of slot openings for approval by the structural engineer. Where such approval is denied, use individual sleeves for each pipe or conduit.
- .2 Formwork:
 - .1 provide removable formwork or instruct the contractor under Division 03 of the Work to set formwork for the required slot dimensions prior to pouring concrete or setting of masonry units.
- .3 Slot dimensions:
 - .1 slot sleeve dimensions, pipe and conduit sizes, and location of services within the slot are subject to firestopping listing requirements.

6.4 Installation

- .1 Provide sleeves for the passage of services through walls, floors and roofs in accordance with the following table:

Construction Element	Fire Resistance Rating	Element Construction	Mechanical Service	Opening Sleeve Required
Roof	Any or none	All	All	Yes
Walls	>0 hrs	Concrete, Masonry Units	Pipe and Conduit	As required for formwork
			Ductwork	As required for formwork
		Gypsum Board	Pipe and Conduit	Yes
			Ductwork	As required by fire or smoke damper listing
Wall (smoke barrier)	0 hrs	All	All	Yes, or wall tightly finished to sides of service

Acoustic Isolation Walls	None [1]	All	All	Yes
All other walls	None [1]	All	All	None unless otherwise shown
Floors	>0 hrs	Concrete	Pipe and Conduit	As required for formwork
			Ductwork	As required by fire or smoke damper listing
Waterproof Floors	Any or none	Concrete	Pipe and Conduit	Yes
			Ductwork	Yes or Curb

Notes:

[1] Walls are not fire separations of any type.

- .2 Place and secure sleeves in concrete form work for floors, walls and roofs.
- .3 Supply sleeves to be set in masonry walls with installation detail drawings setting out locations of sleeves.
- .4 Standard sleeves:
 - .1 terminate flush with surfaces of concrete and masonry walls.
 - .2 standard sleeves may be omitted where the services pass through walls which are not fire-separations and are concealed above opaque ceilings.
- .5 Waterproof sleeves in existing concrete buildings:
 - .1 install sleeves in neatly cut or drilled holes in existing construction,
 - .2 carry out cutting and drilling of structural elements, such as floors, slabs, and walls in accordance with procedure set out in Article "Cutting and Patching".
 - .3 provide 150 wide x 150 high mm (6 x 6 in.) housekeeping curb for each penetration.
 - .4 extend sleeves 50 mm (2 in.) above top of housekeeping curbs, with water bar mechanically fastened to curb,
- .6 Seal the void between sleeve and service:
 - .1 except for sleeves for fire dampers and smoke dampers, fill void between sleeve and pipe, conduit or duct in accordance with Article "Fire Stopping and Smoke Seals" in this Section for sleeves located in fire separations,
 - (a) for waterproof sleeves, use firestopping material which is also suitable for exposure to water under normal operating conditions.
 - .2 at other locations, pack the void between sleeve and pipe, conduit or duct for full depth of sleeve, with mineral wool insulation and seal both ends with silicone-free caulking compound.

7 FIRE STOPPING AND SMOKE SEALS

7.1 General

- .1 Provide fire stopping and smoke seals where ducts, pipes or conduits penetrate fire separations.
- .2 Fire stop materials to be impervious to water when installed in a horizontal separation, including waterproof service sleeves.

- .3 Firestop material manufacturer or their designated service representative to provide the following services:
 - .1 selection of listed fire stopping assemblies for each applicable service penetration and fire separation assembly/rating,
 - .2 provide training of contractor's staff for proper installation of fire stopping assembly; create and maintain a log of those personnel who obtain training,
 - .3 inspect the completed installation of all penetrations and submit a written report to the Consultant, including photo record of randomly selected instances of each fire stopping method. Where deficiencies are discovered, note the deficiencies in the report and provide remedial instructions to the contractor to correct the deficiency. After deficiencies are corrected, re-inspect the deficiencies to conform their correction, update and resubmit the report to the Consultant.
- .4 Submit a complete fire stopping and smoke seal shop drawing schedule to the Consultant for review. Include details, cut sheets, system description and location for each proposed fire stopping and smoke sealing application.

7.2 Products

- .1 Materials to form ULC listed or cUL listed/classified assemblies.

Standard of Acceptance

- Hilti Firestop Systems
 - 3M
 - Nelson Firestop Products
 - Eastern Wire + Conduit (Royal Quickstop)
- .2 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.

7.3 Installation

- .1 Install firestopping and smoke seals in accordance with the manufacturer's recommendations and in accordance with its listing.
- .2 Firestopping and smoke seals to be installed only by personnel trained by the manufacturer on the installation of such systems.
- .3 Seal space between penetrating service and sleeve or opening in in fire rated floors and walls with a firestop and smoke sealing system.
- .4 Select thickness and arrangement of back-up materials to suit size of service, length of sleeve and anticipated movement.
- .5 At time of application of materials, surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials.
- .6 Select firestopping system to allow insulation and vapour barrier to pass un-broken through assembly.
- .7 Do not apply fire stopping materials to fire or smoke dampers.

8 WALL AND FLOOR PLATES

8.1 General

- .1 Provide finishing plates fitted to ducts, pipes, and electrical services provided under Division 20 of the Work which pass through walls, floors and ceilings in finished areas.

8.2 Products

- .1 Escutcheons for small diameter piping and small diameter electrical conduit:
 - .1 manufactured chrome plated two-piece split type with hinge and set-screw.
- .2 Finishing plates for ducts, larger pipes, larger electrical conduits and electrical cables:
 - .1 finishing plate (ring) fabricated from minimum 0.9 mm (20 ga) thick T304 stainless steel with No. 4 brushed finish, with minimum 25 mm (1 in) high collar ring,
 - .2 mounting holes drilled at not less than three (3) symmetrically location positions around the ring to allow mechanical fastening,
 - .3 plate diameter to be sufficiently sized to overlap the wall, floor or ceiling opening by not less than 25 mm (1 in) all around the opening.

8.3 Installation

- .1 Escutcheons;
 - .1 secure escutcheons to pipe and electrical conduit with mechanical fastener.
- .2 Finishing plates:
 - .1 set finishing plates flat against the finished surfaces, and secure to the surface with stainless steel pan-head mechanical fasteners. Provide insert anchor plugs in the finished surface as necessary to secure the fasteners.

END OF SECTION

MECHANICAL WORK IN HOSPITAL CONSTRUCTION 20 05 02

1 GENERAL

1.1 Scope

- .1 Contractor is responsible to review all documents for all divisions to coordinate phasing and services required at end of each phase.
- .2 Work in existing areas where new construction connects to existing will be heavily phased. Rework of services will impact on the existing hospital. 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.
 - .1 Note a portion of the renovation requires re-routing of existing piping. ***All new piping is to be in place prior to removal/disconnection of existing*** to minimize downtime.
- .3 Except as identified, shut downs of existing services will be restricted from 11PM to 5AM and on weekends.
- .4 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 Owner's IPAC procedures.

1.2 General

- .1 When directed by the Engineer, where specific sizes are listed in sections below, components or services may be provided in sizes equal to or smaller than the sizes listed.

1.3 Access Doors

- .1 Provide in contract, supply and installation of: 6 @ 24" x 24 access doors. These spare access doors are for unexpected situations and in addition to access doors required in contract to provide access to installed devices in hard ceilings.

1.4 Medical Gas Connections

- .1 Make connections to the existing medical gas systems, on a gas by gas basis, within one overnight 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 of the connections to the existing hospital to be made immediately after the completion of the work.

1.5 Sleeving, Core Drilling and Scanning

- .1 All services penetrating concrete walls and floors to be sleeved prior to pouring. Submit sleeving drawings indicating service size and sleeve size, superimposed over structural drawings and submit for approval. Relocate sleeves as directed by Engineer.
- .2 Include in contract for additional cores and scanning for the following for missed sleeves and/or changes.

- .1 4@ 4" cores

1.6 Spare Components

- .1 Provide the following components in addition to those required in contract.
- .2 Provide spare valves including installation on existing or new piping, modifications to insulation as required:
 - .1 Domestic Water service – 4@ 1/2", 4@ 2"
 - .2 Heating and Cooling service – 4@ 2"
 - .3 Medical Gas service – 4@ 1", 2@ 1 1/2"
- .3 Provide the following spare fire dampers c/w duct access door and installation in new or existing ductwork
 - .1 2@ 24" x 24"
- .4 Provide **2 spare BAS control points** complete with device, wiring and conduit (assume 200 ft per point), programming, etc in contract to be used by discretion of Engineer.

1.7 Freezing of Live Water Services

- .1 Include in contract an allowance for the following connections where existing valves do not hold or do not exist:
 - .1 Freezing of four (4) 4" water lines

1.8 Phasing

- .1 Carefully examine the phasing plan from 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 relevant reports at each phase of construction.

1.9 Air and Water Balancing

- .1 Air and water balancing is to be carried by the mechanical contractor. Refer to relevant sections in Divisions 22 and 23.

- .2 Provide air/water balancing at the end of each phase.

1.10 Work in Occupied Areas

- .1 Work in Owner occupied areas to be scheduled with the Owner.
- .2 Access to these areas will be at the discretion of the Owner and strictly after hours unless otherwise noted on the drawings.

1.11 Phased Occupancy, Equipment Maintenance, Equipment Operation and Warrantee.

- .1 This 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.
- .2 The Mechanical Contractor to ensure all mechanical equipment is complete and functioning before testing and commissioning is done.
- .3 The mechanical contractor will be responsible to maintain and operate 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 Owner.
- .4 The mechanical contractor shall operate the systems to the Owners benefit to ensure that the occupied phases are fully serviced to the Owners schedule. The mechanical contractor to provide a list of emergency contacts so they can respond 24/7 to issues with their system. Repairs to be made quickly to minimize disruption to the users and Owner.
- .5 Training of Owner's maintenance personnel to be done at end of project prior to formal turnover to Owner. 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.
- .6 Equipment and system warranties to start after substantial performance even though equipment may be installed and operating early in the construction. 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.

END OF SECTION

COMMON ELECTRICAL 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, at voltages of 600V and less and to the extent specified herein.
- .2 Pre-installation survey of SCCR values for equipment supplied under Divisions 20 to 25 which requires power wiring supply, to verify nameplate SCCR is equal to or greater than the minimum specified SCCR values.

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.

1.3 Definitions and Abbreviations

- .1 The following definitions apply to this section and referenced sections:
 - .1 **Control panels** – an electrical device that controls or monitors mechanical equipment, or that interfaces with instrumentation devices.
 - .2 **Control wiring** - wiring for the purpose of communication or control of equipment and instrumentation.
 - .3 **Electrical safety code** - the edition with amendments of CSA C22.1 as adopted by applicable legislation at the location of the Work.
 - .4 **Mechanical breaker panel (MBP)** means a 120/208 V mechanical power panel with overcurrent protection circuit breakers provided as part of an MCC.
 - .5 **Mechanical service panel (MSP)** - panelboard with branch circuit overcurrent protection devices provided by Division 26, and dedicated to supply power for equipment provided by mechanical trades work.
 - .6 **Mechanical trades work** - equipment and systems provided under Divisions 20 to 25.
 - .7 **Motor controllers** - constant speed motor controllers of the manual, magnetic or solid-state type in accordance with specification section 20 05 14.13.
 - .8 **Motor Control Center** – has the meaning as specified in section 20 05 14.13.
 - .9 **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.)
 - .10 **Power Panel (PP)**: 208 up to 600 V, 3 phase, panelboard 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.
 - .11 **Power wiring** means wiring that provides electrical power to equipment including to control panels, including BAS panels, that are not integral to the controlled equipment.
 - .12 **Receptacle panel (RP)** - a 120/208 V panelboard with branch circuit breakers, provided by Division 26.

- .13 **SCCR**: the RMS symmetrical short-circuit current rating of the equipment or motor controller, measured at the input to the motor or controlled equipment (short-circuit withstand rating has the same meaning).
- .14 **VFD**: variable frequency drives in accordance with specification section 20 05 14.16.
- .15 **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 inclusive.

1.4 Applicable Codes and Standards

- .1 Legislation:
 - .1 Electrical safety legislation in the jurisdiction of the Work.
 - .2 For clarity, on Federal Government projects, comply with the provincial or territorial legislation at the place of the Work which adopts the applicable edition of CSA 22.1 with any amendments
- .2 Installation standards and codes:
 - .1 CSA C22.1 Canadian Electrical Code Part 1, as amended and adopted by the AHJ for electrical safety in the province or territory at the place of the Work.
- .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.94.1 Enclosures for Electrical Equipment, Non-Environmental Considerations
 - .5 CSA C22.2 No. 106 HRC – Miscellaneous Fuses
 - .6 CSA C22.2 No. 124 Mineral Insulated Cable
 - .7 CSA C22.2 No. 131 Type TECK 90 Cable
 - .8 CSA C22.2 No. 208 Fire Alarm and Signal Cable
 - .9 CSA C22.2 No. 230 Tray Cable
 - .10 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 Short Circuit Current Ratings (SCCR) and Markings

- .1 Except where another Specification section requires a SCCR of a different value, equipment provided under Division 20 to 25 which is supplied electrical power in accordance with CSA C22.1 shall have a short circuit capacity rating (SCCR) of not less than 10kAIC RMS symmetrical.
- .2 The SCCR value is to be marked on all equipment provide with power wiring in accordance with CSA C22.1. Where the SCCR nameplate rating references an instruction manual, provide a separate label that states the SCCR value.

1.7 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.

1.8 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.

1.9 Submittals

- .1 Submit manufacturer catalogue cut-sheets for the following materials;
 - .1 VFD Inverter Duty cable,
 - .2 service lights.

1.10 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 (e.g.: exhaust from propane fueled 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 controlled by constant speed motor controllers;
 - (a) do not use for motors controlled by variable frequency drives,
 - .2 control wiring including control valves 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 Extra-Low Voltage Power Wiring – 24 VAC, 24 VDC

- .1 Application: power wiring to 24 VAC or 24 VDC electrically commutated motors.
- .2 Type: ACIC,
- .3 Cable:
 - .1 insulated solid or stranded copper conductors,
 - .2 insulation: XLPE, colour coded or numbered wires,
 - .3 minimum wire size: 16 AWG,
 - .4 voltage rating: 600 V.
- .4 Armour:
 - .1 aluminium interlocked armour.
- .5 Jacket:
 - .1 FT4 flame retardant,
 - .2 FT6 when installed in raised floors, or 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.

2.3 Instrumentation Cabling

- .1 Application: instrumentation and control wire suitable for analogue 4-20 mA and 0-10 VDC signaling.
- .2 Cable:
 - .1 insulated solid-copper twisted-multipair conductors, shielded cables with individually shielded pairs, 100% coverage overall shield, drain wires and overall rated jacket,
 - .2 insulation: XLPE, colour coded or numbered wires,
 - .3 minimum wire size: as specified by equipment manufacturer or controls vendor, but not less than 18 AWG,
- .3 Armour:
 - .1 corrugated steel, or
 - .2 none required if installed in conduit or approved wireway.
- .4 Jacket:
 - .1 FT4 flame retardant,
 - .2 FT6 when installed in open style cable trays in ceiling spaces that are used as return air plenums.
- .5 Listed to CSA C22.2 No. 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 Conduit and Equipment Supports

- .1 General:
 - .1 supports for conduit may conform to Specification section 20 05 29 except/and as specified herein.
 - .2 Materials: carbon steel supports, hot dipped galvanized after fabrication.
 - .3 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.

- .2 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

- .3 Upper attachment – existing concrete:
 - .1 conform to Specification section 20 05 29.
- .4 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

- .5 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

.6 Hanger rods:

- .1 continuous threaded rod, carbon steel, USS national course thread,
- .2 minimum rod size: Ø6 mm (1/4 in. dia.),
- .3 tension load ratings to MSS SP-58,

Standard of Acceptance

- Anvil - fig. 146
- Myatt - fig. 434

.7 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

.8 Support channels:

- .1 U shape, minimum size 41 mm x 41 mm x 2.5 mm (1-1/2" x 1-1/2" x 1/10") thick, surface mounted, suspended or set in poured concrete walls and ceilings.
- .2 channel size selected for total supported loads,
- .3 conduit attachments: one-piece or two piece conduit clamps suitable for suspended loads and bottom supported conduit loads.

.9 J Hooks:

- .1 galvanized steel open-style J hooks with rolled edges for fastening direct to building structure or hanger rods.

2.7 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 Pre-Installation Survey for Short Circuit Current Ratings

- .1 Prior to installation of power wiring to mechanical equipment provided under Division 20 to 25, conduct a survey of such mechanical equipment's' SCCR values. Verify that the equipment nameplate SCCR rating is equal to or greater than:
 - .1 the general value specified in this section, or
 - .2 the specific value specified in the relevant Specification section for the equipment.
- .2 Where the nameplate SCCR is less than the specified minimum SCCR required value, provide a fused disconnect switch as specified herein ahead of the equipment, even if the equipment already has an integral disconnect switch. The cost for the provision of such disconnect switches shall be borne by the trade contractor supplying the mechanical equipment, at no cost to the Owner.
- .3 For clarity, this survey also applies to existing mechanical equipment where the Work includes replacement of the power wiring supplying the equipment.

3.2 General Installation Requirements

- .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 In other than service rooms, run conduit and cable concealed within walls or above ceilings.
 - .1 for open-cell concrete block walls, install conduit during wall construction with openings for outlet boxes,
 - .2 for solid concrete walls, rough-in conduit and outlet boxes supported from structural reinforcing bars prior to pouring of concrete,
 - .3 where walls or ceiling structures are exposed, such as steel or finished concrete, arrange conduit neatly on the supporting surface, avoid the use of elbows to the greatest extent possible, and locate conduit as close as possible to the building structure.
- .3 In service rooms, run conduit and cables exposed.

3.3 Conduit Support and Hanger Installation

- .1 As an alternative to the materials specified herein, specification section 20 05 29 may also be used for support of conduits.
- .2 Support conduit from building structure in accordance with specification section 20 05 29.
- .3 Support conduit directly from or on structural building elements. Do not support conduit directly from other services.
- .4 Provide all miscellaneous materials including nuts, washers, and backing plates to make a complete support installation.
- .5 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.
- .6 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,

- .7 Support horizontal conduit at intervals not exceeding 3 m (6 ft).
- .8 Support vertical conduit at intervals not exceeding 3 m (6 ft).
- .9 Where trapeze hangers are used, secure conduit to trapeze with U-bolts or conduit clamps.
- .10 Mechanically fasten supplementary steel to structural steel.

3.4 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 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 Use conduit type as follows:
 - .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. Except for motor temperature transducer wiring, do not install control wiring in the same conduit as power wiring.
 - .1 exception: motor temperature transducer wiring between motor and associated motor controller may be run in the same conduit as the associated motor feeder provided the conduit is sized for the additional wire pair.

3.5 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.

3.6 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, star-washers, 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 except that the smallest 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.
- .7 For VFDs, bond both ends of the VFD inverter duty cable as previously specified herein.

3.7 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 blank cover plates for boxes without wiring devices.

3.8 Seismic Restraint

- .1 Provide seismic restraints for electrical conduit in accordance with specification section 20 05 49.

3.9 Coordination and Division of Responsibility – Division 20 and Division 26

- .1 Schedule A at the end of this Specification section specifies the division of responsibility between Division 20 and Division 26 for provision of electrical work for mechanical equipment, including termination of conductors.
- .2 For clarity;
 - .1 the Division 20 electrical Work may be performed by the Division 26 contractor, but the work is managed and paid for by the Division 20 contractor.
 - .2 related work performed under Division 26 is listed in Schedule A for reference.
- .3 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 and 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,
- .4 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.

3.10 Wiring Diagrams

- .1 The following wiring diagrams are included at the end of this section:
 - .1 20 05 12 - 001 Mechanical – Electrical Coordination (Sheet 1 of 3)
 - .2 20 05 12 - 002 Mechanical – Electrical Coordination (Sheet 2 of 3)
 - .3 20 05 12 - 003 Mechanical – Electrical Coordination (Sheet 3 of 3)

Schedule A – Coordination of Division 20 and 26 Scope of Work			
Reference	Work Element	Div. 20	Div. 26
All	Motor Control Centers, motor controller racks, motor controllers, VFDs, Mechanical Breaker Panels (MBP), and disconnect switches	●	
Mechanical Equipment at voltage > 600 VAC	Power wiring from Division 26 switchgear to: <ul style="list-style-type: none"> - motor controller, - between motor controller and the mechanical equipment (where motor controller is free-standing separate from the mechanical equipment) - field-installed disconnect switches, and wiring between the disconnect switch and the mechanical equipment 		●
	Field-installed disconnect switches.		●
General Mechanical Equipment fed from Dedicated Power Panels for Mechanical Equipment (Note 1)	Mechanical Service Panels (MSP), including branch overcurrent protection devices.		●
	Power wiring from MSPs and/or MCCs to: <ul style="list-style-type: none"> - 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 RP and/or MBP to: <ul style="list-style-type: none"> - 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.) 	●	
General Mechanical Equipment fed from Non-dedicated Power Panels (Note 2)	Non-dedicated Power Panels (PP) and receptacle panels (RP), including branch overcurrent protection devices.		●
	Distribution splitters		●
	Power wiring from PPs and/or distribution splitters to: <ul style="list-style-type: none"> - 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 RP to: <ul style="list-style-type: none"> - motor controller or disconnect switch, - disconnect switch for package equipment, - packaged equipment (with integral disconnect switch), - equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc.) 		●

Schedule A – Coordination of Division 20 and 26 Scope of Work			
Reference	Work Element	Div. 20	Div. 26
	Power wiring from: <ul style="list-style-type: none"> - disconnect switch to a VFD, - motor controller or VFD to the motor, - disconnect switch to packaged equipment 	●	
Terminal Units BAS Controllers	Power wiring for controllers at 120 V, single phase terminating at each terminal box controller		●
	Power wiring for controllers at 120 or 24 VAC, from junction box provided by Division 26 to each terminal unit controller.	●	
	Power wiring for controllers at 24 VAC/DC, from building automation system control panels to terminal unit box controller.	●	
	3 phase, 208 V and higher voltage wiring direct to terminal unit box.		●
BAS Controls and OEM Controls	In service rooms: provision of 120/208 VAC mechanical service panels (MSP) 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: wiring from MSP or BP to the BAS and OEM control equipment.	●	
	Other than service rooms: Dedicated 120V 15A normal and emergency branch circuit breakers as indicated on the receptacle panel schedules.		●
	Power wiring for controls other than in service rooms: wiring from dedicated circuits in receptacle panels to control equipment.	●	
	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 with sufficient wiring to terminate at plumbing fixtures requiring control power		●
	Conduit from adjacent junction box or pull box to plumbing fixtures requiring control power, pulling of wiring to the plumbing fixture and termination of wiring to the fixture or primary side of control transformer.	●	
	Control transformers and extra-low voltage wiring	●	

Schedule A – Coordination of Division 20 and 26 Scope of Work			
Reference	Work Element	Div. 20	Div. 26
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 the equipment service light.		●
	120 VAC, 15A power circuits for equipment convenience receptacles, terminated in the receptacle.		●
	Power wiring from adjacent junction boxes to light switches/service convenience receptacles and fixtures	●	
	Equipment service lights, switches and convenience receptacles.	●	
Fire and Smoke Dampers	Power wiring to damper interlock control panels for smoke dampers, motorized fire dampers, and combination smoke/fire dampers.		●
	Wiring between damper interlock control panels (for smoke dampers, motorized fire dampers, and combination smoke/fire dampers), to their associated dampers.	●	
Life Safety Interface	[Fire Alarm System ("FAS") control and monitoring modules located at BAS control interface panel.][Fire Alarm System ("FAS") control and monitoring modules located at/near fan starter or damper actuator, and wiring between control module and damper motor and fan starter.]		●
	FAS control and monitoring modules located at/near sprinkler and standpipe supervised valves and flow switches including wiring between each module and the respective valve/flow switch.		●
	Wiring between FAS control and monitoring modules, and smoke control and smoke venting fans and dampers.		●
	Termination of FAS control and monitoring wiring in BAS panels	●	

Notes:

[1] MPP and MBP will be located in mechanical services rooms.

[2] PP and RP are not dedicated for mechanical equipment and may be located in any type of service room or space.

LEGEND

CONSTANT SPEED MOTOR
CONTROLLER

SCOPE OF WORK:
DIVISION "A" / DIVISION "B"
BOUNDARY

VARIABLE FREQUENCY DRIVE

UNFUSED SERVICE DISCONNECT
SWITCH

FUSED SERVICE DISCONNECT
SWITCH

TRANSFORMER

120 VAC/ XX VDC POWER SUPPLY,
CLASS AS SHOWN

120/208 VAC MECHANICAL BREAKER
PANEL

MECHANICAL SERVICE PANEL (DIV 26)

POWER PANEL (DIV 26)

JUNCTION BOX

MOTOR

ELECTRIC HEAT TRACING

PACKAGED EQUIPEMENT WITH
MOTORS AND INTEGRAL MOTOR
CONTROLLERS

CONTROL PANELS, TERMINAL UNIT
CONTROLLERS, AND OTHER NON-
MOTORIZED EQUIPMENT

FUSE

LIGHT SWITCH (FOR SERVICE LIGHTS)
- FLOOR PLAN


POWER SWITCH (SINGLE-LINE)

SERVICE LIGHT

ALARM BEACON

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.

 **HHA Angus**

Sheet Title
**MECHANICAL – ELECTRICAL
COORDINATION BLOCK DIAGRAM
(SHEET 1 OF 3)**

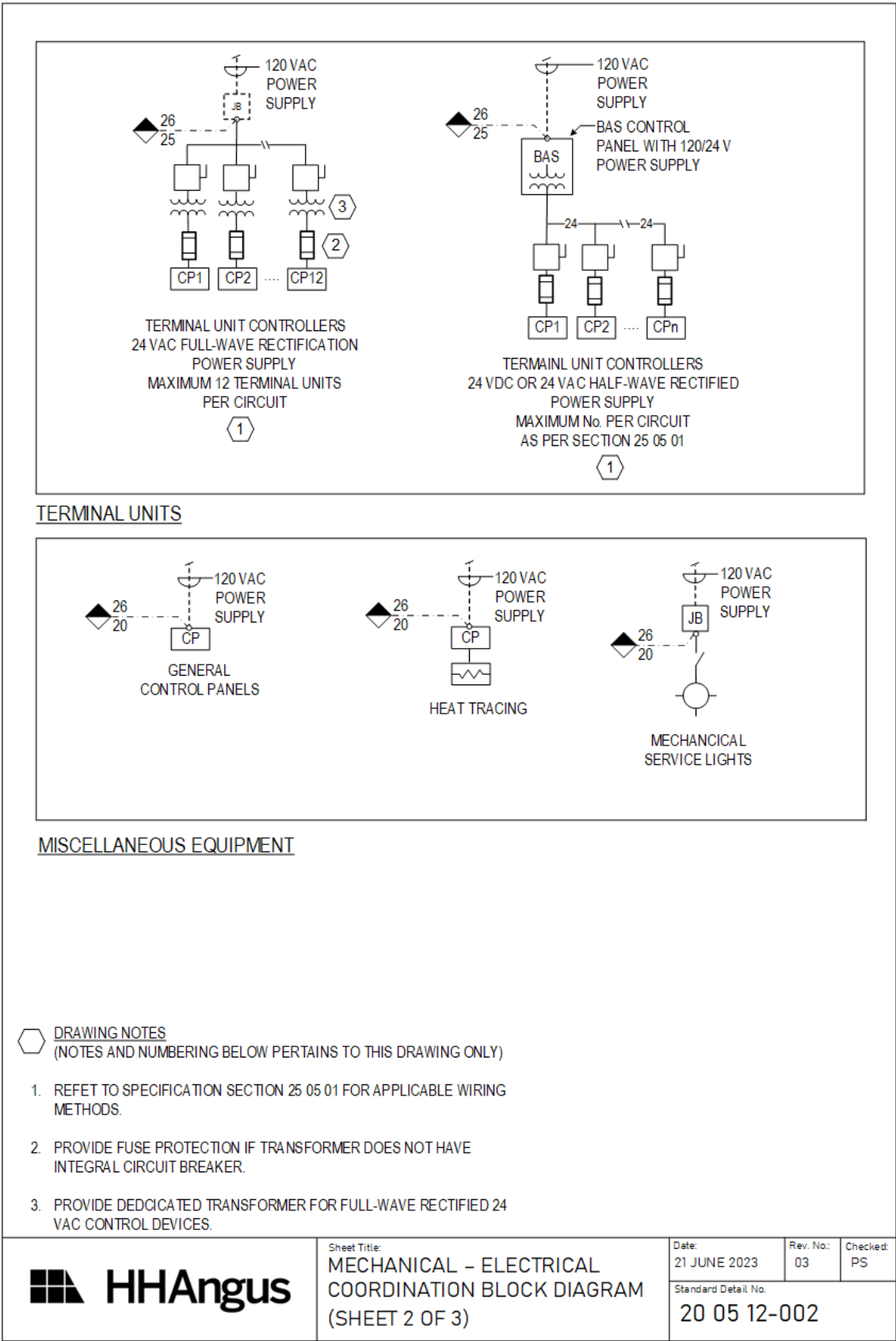
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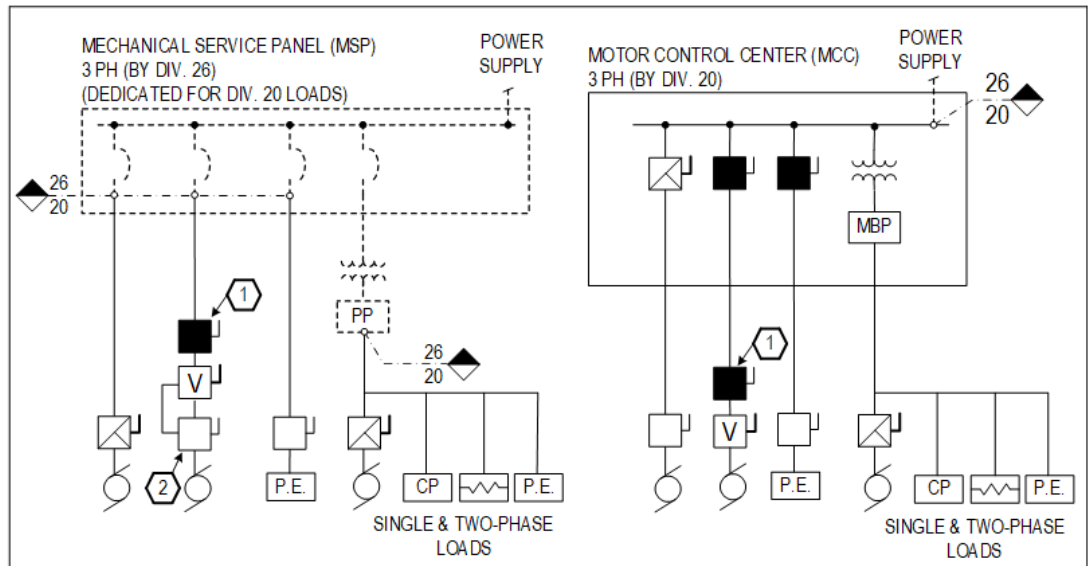
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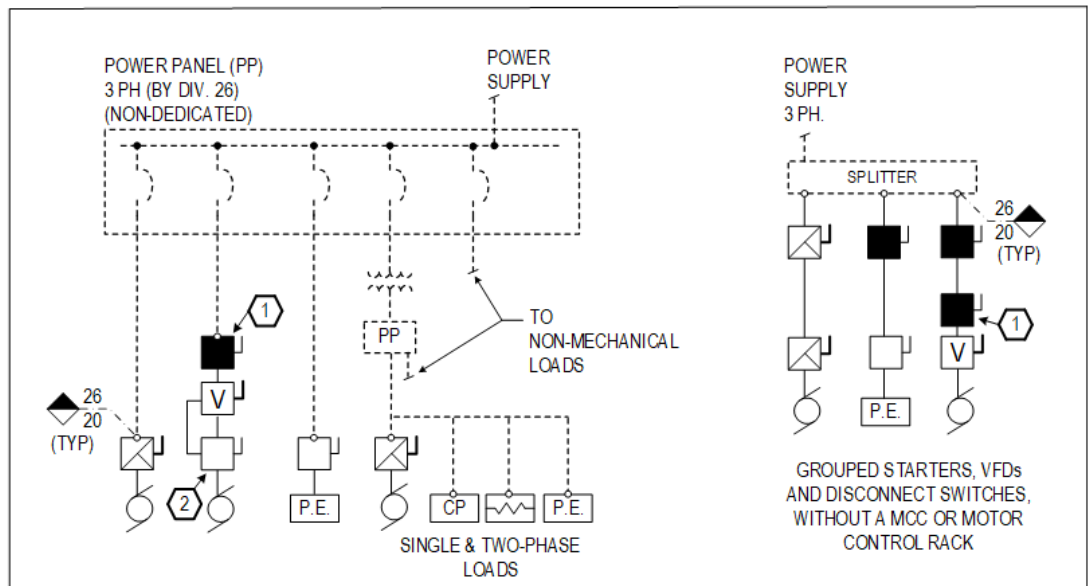
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20 05 12 - 001





DEDICATED POWER DISTRIBUTION EQUIPMENT



NON-DEDICATED POWER DISTRIBUTED EQUIPMENT

DRAWING NOTES
(NOTES AND NUMBERING BELOW PERTAINS TO THIS DRAWING ONLY)

1. SEPARATE FUSED DISCONNECT WHEN REQUIRED TO MEET SPECIFIED SCCR VALUES. (TYP).
2. SEPARATE UNFUSED DISCONNECT WHERE V.F.D. IS REMOTE FROM THE MOTOR. PROVIDE DISCONNECT SWITCH POSITION INDICATOR WITH INTERLOCK WIRING 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.



Sheet Title
**MECHANICAL – ELECTRICAL
COORDINATION BLOCK DIAGRAM
(SHEET 3 OF 3)**

Date: 21 JUNE 2023	Rev. No.: 04	Checked: PS
Standard Detail No. 20 05 12 – 003		

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.
 - 23 05 23.13 General-Duty Valves for HVAC Water 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

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	•					
Preso			•			
S.A. Armstrong	•		•			
Shurjoint				•		•
Sure Seal				•		
Tour & Anderson			•			

Manufacturer	Gate, Globe, Angle, Check	Silent Check	DRV	Butterfly	Plug	Ball
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 only (excluding pumps)				•		•
Pump Balancing		• [1] [3]		•		•

Notes:

[1] Gear operator with position limit memory stops.

[2] Not used.

[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 mains 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.

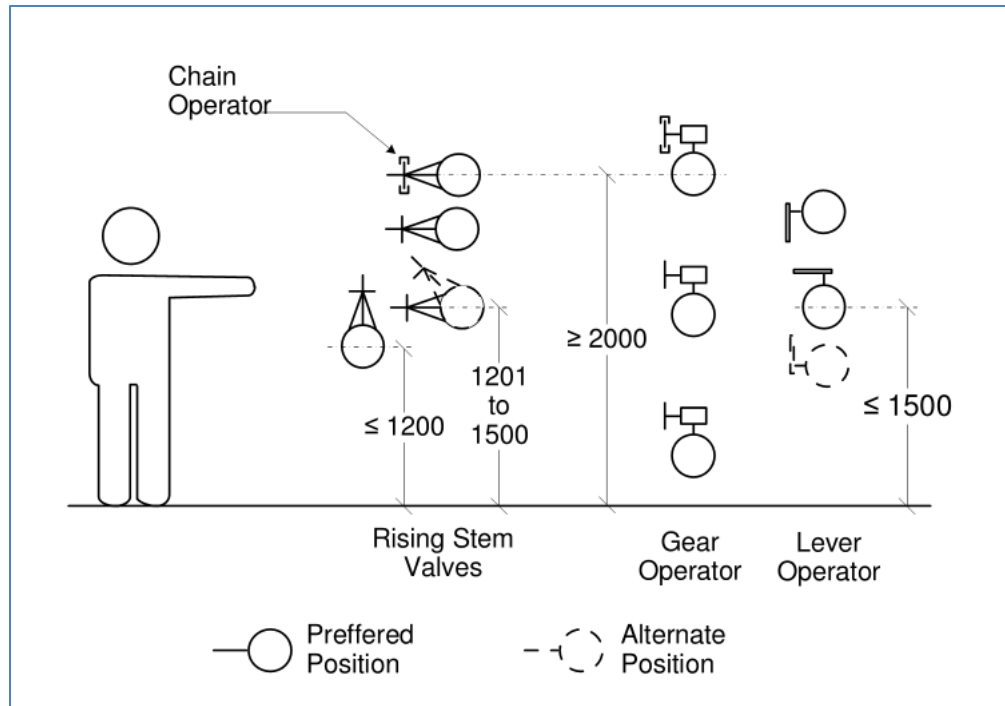


Figure 1: Valve Spindle Arrangement

- .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.

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” unless the context otherwise dictates one or the other.

1.3 Applicable Codes and Standards

- .1 Installation codes and standards:

- .1 ASME B31.1 Pressure Piping
- .2 ASME B31.3 Process Piping
- .3 ASME B31.9 Building Services Piping
- .4 ASME BPVC Section V Nondestructive Examination
- .5 ASME BPVC Section IX Welding and Brazing Qualifications
- .6 CSA B51. Boiler, Pressure Vessel, and Pressure Piping Code

1.4 Quality Control

- .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.
- .2 Welding procedures shall be registered with the AHJ (BPV), in accordance with CSA B51 and as qualified in accordance with ASME BPVC Section IX.
- .3 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.
- .4 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.

2 PRODUCTS

2.1 Not used

3 EXECUTION

3.1 Welding Method and Quality

- .1 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.
- .2 Welds to be solid homogeneous part of metals joined and free from pits, slag-inclusions, and scale.
- .3 Weld surfaces to be smooth and regular and weld metal deposition to achieve full penetration groove weld fused to the base metal throughout joint thickness. Fillet welds, where permitted or required by applicable piping codes, shall achieve adequate depth of fusion of the base metal as required by those codes.
- .4 Brazed joints to use brazing filler and fluxes as specified for each applicable piping system. For socket joints, the tube and joint are to overlapped not less than four times the thickness of the thinner base material, with filter material penetrating to this full depth and finished with well-developed fillet.

3.2 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 butt weld guided-bend 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.

3.3 Welding Examination

- .1 For piping systems which are specified to be constructed to ASME B31.1 or ASME B31.3, examination of pipe welds, 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 pipe welds in accordance with that piping code shall be performed by the Contractor using personnel who are suitably experienced for such examinations.
- .3 Acceptance criteria for weld examination shall be in accordance with the specified ASME piping code applicable to each piping system and as may be specified in other Specification sections of Division 21 to 23.

- .1 for clarity, where ASME B31.9 code applies to a piping system, the weld examinations and weld defect acceptance criteria are summarized in the following table.
- (a) Notwithstanding the listed weld defect criteria, the overall quality of the weld shall also be able to meet the requirements for incomplete weld penetration and weld root concavity. However, examination of the interior surface of the weld is not required.

Table 1: Weld Defect Acceptance Criteria – ASME B31.9		
Type of Weld	Weld Defect	Acceptance Criteria
Girth (butt) weld, Groove weld, Fillet weld, Socket weld, Seal weld	Cracks	None
	Lack of fusion	Length of unfused areas \leq 20% of pipe circumference or total length of weld, and not more than 25% in any 150 mm (6 in.) of weld
	Undercut	Not exceed the lessor of 1 mm (1/32 in.) or 12.5% of wall thickness.
	Weld surface	Weld reinforcement not to exceed 4.8 mm (3/16 in.)

3.4 Welding Inspection

- .1 Arrange and pay for any required inspection of welds by the AHJ (BPV).
- .2 Welders certificates and welding procedures used for the Work to be made available for inspection by the AHJ (BPV) on demand. Provide traceability of welders work by either stamping each weld with the welder's identifying number, or maintain a record log to record and identify each welders work.

END OF SECTION

PIPELINE HOT-TAPPING AND LINE STOPPING

20 05 26

1 GENERAL

1.1 Scope

- .1 Make branch connections to existing piping systems by means of hot-tapping while maintaining main pipeline in service.
- .2 Temporarily isolate portions of existing piping systems by means of pipe line-stopping.

1.2 Limitations on Use

- .1 Hot-tapping and/or line-stopping are not to be used where isolation and/or draining of the pipeline is permitted by the Owner.
- .2 Hot-tapping and/or line-stopping are only to be used where;
 - .1 permitted by the Owner,
 - .2 specified for particular branch connections and for temperature thermowells,
 - .3 the existing piping design pressure at the location of a welded-on hot-tap does not exceed 2100 kPa (300 psig),
 - .4 the existing piping design pressure at the location of a mechanical-bolted tapping-saddle does not exceed 1050 kPa (150 psig); and
 - .5 permitted by the AHJ responsible for boiler and pressure vessel safety.
- .3 The application of this specification is limited to the following piping systems:
 - .1 potable water systems,
 - .2 liquids no more hazardous than water, including building heating and cooling piping systems which contain industry-standard corrosion inhibitors and other related chemical treatment additives, including anti-freeze additives,
 - .3 saturated steam at design pressures not exceeding 1100 kPa (160 psig), or
 - .4 steam-condensate systems not exceeding a design temperature of 185°C (365°F),

1.3 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 05 23.13 General-Duty Valves for HVAC Water Piping
 - .4 23 21 13.23 Hydronic Piping – Carbon Steel

1.4 Definitions and Abbreviations

- .1 The following definitions apply to this section.
 - .1 **Hot-tapping** – the method by which a new branch connection is made to an existing mains pipe while the mains pipe is under pressure and continues operating.

- .2 **Line-Stopping** – the method for temporarily blocking flow in an existing pipe by use of line-plugging or line-freezing.
- .3 **Line-Freezing** – line-stopping by freezing the mains pipe fluid by application of cryogenic fluids to the exterior of the pipe.
- .4 **Line-plugging** – line-stopping by insertion of a plug through a branch connection, and which may require the use of hot-tapping to make suitable branch connections.

1.5 Applicable Codes and Standards

- .1 Legislation;
 - .1 TSSA SB-05-02(R2) Safety Information Bulletin: Hot Tap and Line Stopping for Pressure Equipment.
- .2 Installation codes and standards (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 Section IX Boiler and Pressure Vessel Code: Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators – Welding, Brazing and Fusing Qualifications.
 - .5 ASME PCC-2 Repair of Pressure Equipment and Piping

1.6 Qualified Tradesperson

- .1 Work to be performed by qualified, licensed and recognized firm with an established reputation in this field, using tradesperson holding applicable certificates of competency (license) issued by the AHJ responsible for pressure piping system safety. The license shall include an endorsement for performance of hot-tapping operations, when required by the AHJ.

1.7 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 as applicable to the piping system being modified. Include specific information required for hot-tapping and/or line stopping.
- .2 At the start of the Work, obtain existing pressure piping system registration numbers, if available, from the Owner and/or the AHJ.

1.8 Design Criteria

- .1 Specialist hot-tapping contractor to prepare hot-tapping procedures in accordance with, at a minimum, the requirements of the applicable piping code, ASME Section IX and ASME PCC-2.
 - .1 for hot-tapping by welding to steel pipe, develop welding procedures to provide for a resulting maximum allowable working pressure of the new branch fitting attachment that is not less than 2.0 times the piping system design pressure listed in the schedule at the end of this section, assuming the following wall thickness deductions:
 - (a) 12.5% mill tolerance of new nominal wall thickness,
 - (b) 0.75 mm (0.030) corrosion allowance,
 - .2 allowable pressure to be based on the measured actual wall thickness of the existing mains pipe.
- .2 Piping design and installation code:

- .1 Refer to the applicable specification section for the piping system.
- .3 System design criteria.
 - .1 Refer to the applicable specification section for the piping system.

1.9 Submittals

- .1 Shop drawings:
 - .1 submit product data sheets for materials specified herein.
 - .2 submit shop drawings for fabricated components and equipment.
- .2 Submit written procedures for hot-tapping and/or line-plugging as applicable to the method used.
- .3 Submit calculations sealed by a professional engineer licensed in the province of the project, for the resulting maximum allowable working pressure of the resulting branch-to-main pipe fitting at the design temperature of the applicable piping system.

1.10 Quality Control

- .1 Welding of piping to conform to specification section 20 05 24 and as specified herein.
- .2 Produce and implement hot-tapping procedures, which includes but is not limited to:
 - .1 pre-installation inspections, preparation, welding, pressure testing, weld examination, and safety precautions,
 - .2 specific welding procedure specifications (WPS) suitable for hot tapping, which include
 - (a) requirements for groove welds for direct attachment of integrally reinforced welding branch fittings, with requirements (if any) for supplemental reinforcing pads,
 - (b) the use of fillet-weld attachments for split-tee welding fittings.
- .3 Hot-tap welding procedures are to be registered with the AHJ responsible for pressure piping safety, and as a minimum shall conform to ASME Section IX and ASME PCC-2.
- .4 Hot-tap branch fitting or fabricated split-tee assembly to have current Canadian Registration Number (CRN) in accordance with CSA B51.

2 PRODUCTS

2.1 Hot-Tapping – Steel Piping

- .1 Reinforced outlet fittings: as specified in the applicable piping specification section,
- .2 Flanges and gaskets: as specified in the applicable piping specification section.
- .3 Manufactured split-tees:
 - .1 fabricated split-tees with integral reinforced outlets branch fitting and branch end fitting,
 - .2 inside surface of split tee to be equal to the outside diameter of the mains pipe,
 - .3 designed for fillet welds of the split-tee to the mains pipe, and with flange-edge weld joint of mating flanges,
- .4 Branch pipe run end fitting:
 - .1 branch size NPS 2 and smaller: threaded.
 - .2 branch size NPS 2-1/2 and larger: flanged.
 - .3 for thermowells: threaded.

2.2 Hot-Tapping - Copper Tube

- .1 For potable water applications only.
- .2 Two-piece mechanical tapping saddle:
 - .1 body: two-piece body, T304 stainless steel to ASTM A240, providing 360° coverage of mains pipe,
 - .2 hardware: fastening hardware including threaded studs, washer bar to be T304 stainless steel to ASTM A240, and welded to the body.
 - .3 branch outlet fitting: T304 stainless steel to ASTM A240, with MNPT threaded end fitting to ASME AB1.20.1.
 - .4 gasket: gridded, multiple O-ring, NBR gasket providing complete coverage of mains pipe, bonded to the body,
 - .5 listed for low lead and contamination to NSF 61 and NSF 61+G
- .3 Pipe sizes:
 - .1 mains pipe size: NPS 2 to 8
 - .2 branch pipe size: at least one NPS size smaller than the mains pipe.
- .4 Performance:
 - .1 working pressure rating: 1000 kPa (148 psi),
 - .2 test pressure: 1.5 times working pressure.
 - .3 working temperature rating: -40 to 120°C (-40 to 248°F)

Standard of Acceptance

- PowerSeal Corp. - fig. 3425 PowerStop
- Pacific Flow Control Inc.

2.3 Valves

- .1 As specified in the applicable piping specification valve sections,
 - .1 branch size NPS 2 and under: full ported ball valve,
 - .2 branch size NPS 2-1/2 and larger: gate valves.

3 EXECUTION

3.1 Site Safety

- .1 At all times manage the site safety protocols described in the hot-tapping or line-stopping procedure(s). Exclude all personnel not necessary for the actual hot-tap or line-stopping operation from the work area.

3.2 Site Investigation

- .1 Prior to performing any hot-tapping operation for weld-on branch connections, verify existing pipe wall thickness at the location of the hot-tap with an ultrasonic thickness gauge. Actual wall thickness to be used in verifying suitability of welding procedures and to determine if reinforcing pads are required.

3.3 Hot-Tapping

- .1 Pre-installation inspection and cleaning;

- .1 Prior to hot-tapping the pipe, check mains pipe or tube that the work surface area is clear of pitting, damage or excessive surface corrosion.
- .2 For steel piping, select a location which will be free of existing main pipe butt welds. For split-tee welding fittings, if the existing main pipe has a longitudinal manufacturer seam weld, grind any excess weld smooth to the main pipe surface as required to permit full contact between the split-tee welding fitting and the mains pipe.
- .3 Clean the pipe surface at the area of the work, removing all dirt, oil, grease and debris from the external surface of the main pipe or tube. For copper tubing, clean the exterior surface of the copper tube with emery cloth.
- .2 Hot tapping machine;
 - .1 Select tapping machine and cutters as required to suit the product operating pressure and temperature, and mains pipe material.
 - .2 Bore cutter to be the maximum size possible to pass through the isolation valve. Check that the coupon retention system is not damaged prior to use.
 - .3 Support the tapping machine so as not to impose an overhung load on the isolation valve.
- .3 Weld-on branch connection installation on steel pipe:
 - .1 Use an integrally reinforced outlet fitting directly welded to the pipe, or a split-tee fitting welded to the main pipe.
 - .2 Where an integrally reinforced outlet fitting is directly welded to the main pipe, provide additional reinforcing pads where the welding procedure requires such additional reinforcement to attain the required maximum allowable working pressure.
- .4 Mechanical fitting installation on copper tube;
 - .1 Confirm existing mains tube OD is within the acceptable range of the mechanical fitting manufacturers installation instructions.
 - .2 Install the mechanical saddle fitting, including cleaning of the gasket and application of any required lubricant, in accordance with the fitting manufacturer's installation instructions.
 - .3 Tighten fitting bolts to the required torque specified by the manufacturer, and check that the gasket has compressed to the required thickness.
 - .4 Retighten the fitting bolts at other times as required by the manufacturer instructions.
 - .5 Where the operating fluid temperature is greater than 20°C, retighten the fitting bolts 48 hours after the completion of the hot tap. If there are small leaks observed at this time, retighten the fitting bolts following another 48 hour period. At all times, do not exceed the maximum torque value specified by the fitting manufacturer.
 - .6 If leaks continue to occur after two x 48 hour retightening periods, arrange with the Owner to shut-down the system, and replace the mechanical saddle fitting with new pipe-tee fitting.
 - .7 Record the torque values (required and measured) for the initial tightening and all subsequent retightening of the bolts, and measured compressed gasket thickness.

3.4 Hot-Tap Pressure Testing

- .1 Initial pressure testing:
 - .1 conduct an initial pressure test of the branch fitting after the branch connection fitting and isolation valve has been attached to the mains pipe/tube, but prior to drilling the branch opening,
 - .2 where the test pressure is 820 kPa (120 psig) or less, a pneumatic pressure test using CO2 or nitrogen may be used with a soap leak test.

- .3 where the test pressure is greater than 820 kPa (120 psig), use a hydrostatic pressure test.
- .2 Secondary pressure test:
 - .1 Conduct a secondary pressure test after the hot tap machine has been installed but prior to drilling. Conduct the pressure test with the same method as described for the initial pressure test.
- .3 Final pressure test:
 - .1 After completion of the hot tap and removal of the hot-tapping machine, conduct an in-service soap pressure test to check for any final leaks. If leaks are discovered, modify the installation to make it leak-tight.

3.5 Line-Plugging

- .1 Do not use.

3.6 Line-Freezing

- .1 Temporarily freeze the piping by use of freezing assembly jackets with cryogenic fluids (preferably liquid nitrogen). Freeze a sufficient length of pipe to achieve an ice plug which would have a nominal compression strength of at least 17 MPa (2500 psig). Allow greater ice plug length where welding on the pipe mains is required.
- .2 Once the line-stopping is achieved, in addition to the work required on the mains pipe that necessitated the line-stopping, add a drain connection consisting of:
 - .1 a branch pipe of not less than NPS 1 in size, of the same material as the mains pipe,
 - .2 a ball valve as specified for the applicable piping section, and
 - .3 a 100 mm long nipple with a hose-end fitting with cap.
- .3 After completion of the work on the main pipeline, partially open the new drain valve and leave open during melting of the plug. Provide temporary hoses to discharge fluid to a safe location until such time as both plugs are partially melted and operating fluid discharges from the drain.

3.7 Inspections

- .1 Coordinate with the AHJ inspector to allow them to witness the hot-tapping work.

3.8 Cleaning

- .1 After completion of the hot tap and removal of the hot tap machine, flush the branch assembly to remove any residual metal filings:
 - .1 for water systems, provide a temporary hose to drain water to a safe location.
 - .2 for steam systems, provide temporary piping to allow free-blowing of steam to a safe location.

3.9 Test and installation records

- .1 Submit a test record recording all pressure test results, including test method and test pressures, and in the case of a mechanical fitting include all bolt torque values and manufacturer torque requirements. Include time and date of each measurement and the name of the person conducting the test.
- .2 Submit a copy of the above test to the Owner and the Consultant.
- .3 Submit a copy of any AHJ inspection reports to the Owner and the Consultant.

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, including insulation protection devices.
- .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 Common Work Results for Fire Suppression
 - .2 22 60 13.70 Medical Gas Piping
 - .3 Applicable sections of Division 22 sections for plumbing and drainage piping,
- .3 Provide engineering services associated with the design, analysis, and selection of custom piping supports, including pipe riser supports.

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 49 Seismic Restraints for Mechanical Services

1.3 Definitions and Abbreviations

- .1 The following definitions apply to this section:
 - .1 **Ambient piping:** piping with a fluid temperature greater than 16°C (61°F) and up to and including 40°C (104°F).
 - .2 **Cold piping:** piping with a fluid temperature greater than 4°C (39°C) and up to and including 16°C (61°F).
 - .3 **Dual temperature piping:** piping which operates non-simultaneously as both cold piping and hot piping depending on the season.
 - .4 **Hot piping:** piping with a fluid temperature greater than 60°C (140°F).
 - .5 **Low temperature piping:** piping with a fluid temperature greater than 40°C (104°F) and up to and including 60°C (140°F)

1.4 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 CAN/UL 203 Standard for Pipe Hanger Equipment for Fire Protection Service
- .2 Refer to each applicable piping specification section for supplemental requirements for pipe supports.

1.5 Analysis, Design, and Inspection Services

- .1 Where custom fabricated pipe and equipment supports are proposed to be used, provide the services of a professional engineer, licensed in the province or territory of the Work and who specializes in the design of piping and equipment supports (the "Specialty Engineer"), for the design of piping and equipment support systems and to provide inspection services of the completed installation.

- .2 Provide services of a Specialty Engineer for the design and selection of constant-load and variable-load hanger supports. Where a manufacturer of such equipment provides this design service, this is deemed to meet this requirement.
- .3 Specialty Engineer design services to include;
 - .1 provide the design of the piping support system, including anchors, guides, expansion joints, and shall include seismic restraints where applicable,
 - .2 analysis of dead loads, thermal expansion loads, wind load, static seismic loads (where applicable) and capacity of materials utilized for connections to equipment and structure.
 - .3 provide design drawings showing locations of supports, restraints and details of construction and attachment of supports and restraints,
 - .4 seismic design to conform to Specification section 20 05 49 where applicable.
- .4 Specialty Engineer inspection services to include:
 - .1 at periods during installation and at completion of the installation of the piping supports and anchor devices, the Specialty Engineer shall inspect the installation, identify and report deficiencies (if any) which are observed, and re-inspect the installation after deficiencies have been corrected,
 - .2 Specialty Engineer to submit periodic inspection reports and a final inspection report after all work is completed and deficiencies have been corrected, confirming the installation conforms to the design requirements. Prepare and submit any required declarations or similar document to this effect where required by local legislation. Include in the final report site photographs of the complete installation prior to covering with insulation, with specific photos at pipe anchors, guides, and expansion joints.
- .5 Provide shop drawings of custom supports, which shall be sealed by the Specialty Engineer.
- .6 Provide signed declarations for commitment for general review and final review letters of conformity as required by applicable legislation at the place of the Work.

1.6 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 published tension load rating data in accordance with Table 2 of MSS SP-58.
 - .2 design of custom trapeze hangers shall meet the design criteria as specified in Part 2 of this section.

1.7 Submittals

- .1 Submit manufacturer product data sheets for 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.

2 PRODUCTS

2.1 General

- .1 Fabricate pipe hangers, supports, sway braces and associated components from stock or production parts, manufactured and fabricated in conformance with MSS SP-58, and the requirements of the piping code specified for each piping system.
- .2 Pipe hangers and supports for fire protection systems to be listed to CAN/UL 203, except where such listing requirement is excluded under applicable NFPA standards.
- .3 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.
- .4 Where specified products define the applicable pipe size NPS range (notwithstanding that the product may be available for larger pipe sizes), the maximum specified pipe size is limited to not exceed the load rating of the specified product under maximum allowable pipe spans as defined in MSS SP-58 for insulated pipe filled with water.
- .5 Product finishes (unless otherwise specified for each product):
 - .1 plain carbon steel or zinc-plated steel.
- .6 Select pipe support products from manufacturers standard product line.

Standard of Acceptance

- Anvil
- Unistrut
- Taylor
- Acrow Richmond
- Portable Pipe Hangers
- Hilti
- nVent Caddy
- Pipe Shields
- Buckaroos

2.2 Upper Attachments – Anchors for Existing Concrete

- .1 General:
 - .1 upper hanger attachment for anchoring into existing concrete decks, for piping or equipment supports,
 - .2 designed to receive USS coarse thread hanger rods.
- .2 Drop-in anchors:
 - .1 zinc-plated carbon steel drop-in friction anchor design, with matched drill bit and setting tool,
 - .2 not to be used for seismic restraints or hanger rods at pipe hangers having seismic restraint,
 - .3 rated for uncracked concrete,
 - .4 listed to CAN/UL 203 for fire protection piping, for pipe NPS ¾ through NPS 8,
 - .5 capacity rating with 4:1 safety factor to ultimate load,
 - .6 minimum load rating in tension based on connected rod size:

Rod Nominal Size	Tension Load kN (lbf)	Single Pipe Size Limit NPS
Ø3/8	2.82 (635)	2
Ø1/2	4.2 (945)	3
Ø5/8	8.34 (1875)	4
Ø3/4	11.1 (2500)	8

Standard of Acceptance

- Hilti - fig. HDI, HDI+, HDI-L+

.3 Wedge anchors:

- .1 anchor-end wedging action on concrete, and not relying on friction between side of bolt and concrete hole wall,
- .2 zinc-plated carbon steel wedge anchor design with load washer and nut,
- .3 wedge anchor capacity as specified herein to be rated for cracked concrete having not less than 20 MPa (2900 psi) strength.
- .4 rated for cracked and uncracked concrete,
- .5 listed for seismic tension and shear loads in accordance with ACI 355.2 and ICC-ES AC193.
- .6 listed to CAN/UL 203 for fire protection piping, for pipe NPS ¾ through NPS 8,
- .7 extra-long bolt length to allow attachment of hanger rod coupling with full thread engagement in the coupling, while providing required load engagement length,
- .8 standard rating: minimum load rating in tension based on connected rod size:

Rod Nominal Size	Tension Load kN (lbf)	Single Pipe Size Limit NPS
Ø3/8	4.85 (1090)	2
Ø1/2	7.52 (1690)	3
Ø5/8	12.1 (2715)	4
Ø3/4	15.5 (3495)	8

Standard of Acceptance

- Hilti - fig. Kwick Bolt series

- .9 high-capacity rating: minimum load rating in tension based on connected rod size:

Rod Nominal Size	Tension Load kN (lbf)
Ø3/8	14.0 (3150)
Ø1/2	20.8 (4675)
Ø5/8	29.1 (6535)

Rod Nominal Size	Tension Load kN (lbf)
Ø3/4	40.6 (9135)
Ø7/8	53.4 (12,000)

Standard of Acceptance

- Hilti - fig. HSL-3 series

2.3 Upper Attachment – Mounting Plates

- .1 Surface mounting plates to underside of concrete decks:
 - .1 for installation post concrete pour with either concrete inserts or drilled anchors,
 - .2 surface mount carbon steel plate, with either clevis hanger with pin (for use with hanging rod-eye) or for attachment of hanger rod and load nut,
 - .3 mounting holes in four corners of plate, sized for fastening bolts to achieve rated capacity,
 - .4 minimum load rating in tension based on connected rod size:

Rod Nominal Size	Tension Load kN (lbf)	Single Pipe Size Limit NPS
Ø3/8	3.25 (730)	2
Ø1/2	6.0 (1350)	3
Ø5/8	9.6 (2160)	4
Ø3/4	14.4 (3230)	8
Ø7/8	19.9 (4480)	12
Ø1	26.2 (5900)	18
Ø1-1/4	42.3 (9500)	20
Ø1-1/2	61.4 (13,800)	30

Standard of Acceptance

- Anvil - fig. 49 clevis plate,
- Anvil - fig. 52 load nut,
- Taylor - fig. 166 clevis plate,

2.4 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),
 - .4 minimum load rating:
 - (a) medium duty: 6.7 kN (1500 lbs).

- (b) heavy duty: 13.4 kN (3000 lbs).

Standard of Acceptance

- Anvil - fig. 195 and 199
- Taylor - fig. 801 and 802.

.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,
- .5 minimum load rating: 3.35 kN (750 lbs).

Standard of Acceptance

- Anvil - fig. 194

2.5 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
- Taylor - fig. 63

.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
- Taylor – fig. 64

2.6 Hanger Rod

.1 Continuous threaded rod:

- .1 carbon steel, USS course thread,
- .2 tension load ratings to meet or exceed MSS SP-58.

Standard of Acceptance

- Anvil - fig. 146
- Taylor – fig. 54

.2 Welded eye rod:

- .1 carbon steel, USS course thread,
- .2 tension load ratings to MSS SP-58,
- .3 tension load ratings to meet or exceed MSS SP-58 for hanger rod.

Standard of Acceptance

- Anvil - fig. 278
- Taylor - fig. 53

.3 Rod connectors:

- .1 carbon steel, USS course thread,
- .2 with mid-point site hole,
- .3 tension load ratings to meet or exceed MSS SP-58.

Standard of Acceptance

- Anvil - fig. 135i
- Taylor - fig. 62S

2.7 Horizontal Pipe Support - Clevis

.1 Clevis support:

- .1 applicable piping materials:
 - (a) carbon steel and stainless steel pipe, schedule 10 to 80,
 - (b) cast iron DWV piping,
- .2 carbon steel, adjustable clevis, with clevis bolt reinforcing tube, to MSS SP-58 Type 1,
- .3 adjustable hanger height while under load,
- .4 listed to CAN/UL 203 for fire protection piping,
- .5 applicable pipe size:
 - (a) steel pipe: NPS ½ to NPS 16
 - (b) ductile or cast iron drainage pipe: NPS 3 to 24

Standard of Acceptance

- Anvil - fig. 260
- Anvil - fig. 590 (for ductile or cast iron drainage pipe)
- Taylor – fig. 24
- Taylor – fig. 27AC (for ductile or cast iron pipe)

.2 Clevis support with extended yoke for where yoke is located inside of pipe insulation:

- .1 applicable piping materials:
 - (a) carbon steel and stainless steel pipe, schedule 10 to 80,
 - (b) cast iron DWV piping,

- .2 carbon steel, adjustable clevis, with clevis bolt reinforcing tube, to MSS SP-58 Type 1,
- .3 adjustable hanger height while under load,
- .4 yoke sized for outside dimension of pipe only, with extended yoke to clear pipe insulation,
- .5 applicable pipe size:
 - (a) steel pipe: NPS $\frac{3}{4}$ to NPS 12

Standard of Acceptance

- Anvil - fig. 300
- Taylor – fig. 24L

.3 Clevis support with integral non-metallic insulation saddle:

- .1 alternate to using standard clevis hanger specified above with separate high density insulation inserts or pipe insulation saddles,
- .2 applicable piping materials:
 - (a) insulated carbon steel and stainless steel pipe, schedule 10 to 80,
 - (b) insulated cast iron drainage piping.
- .3 carbon steel, adjustable clevis, with clevis bolt reinforcing tube, to MSS SP-58 Type 1,
- .4 adjustable hanger height while under load,
- .5 listed to CAN/UL 203 for fire protection piping,
- .6 with glass-reinforced polypropylene saddle, sized to allow up to 50 mm (2 in.) insulation thickness,
- .7 yoke and clevis sized for outside dimension of pipe and insulation,
- .8 applicable pipe size:
 - (a) steel pipe: NPS $\frac{1}{2}$ to NPS 8,
 - (b) copper tube: NPS $\frac{1}{2}$ to NPS 8.
- .9 piping system design temperature limits: 4.4 to 100°C (40 to 212°F).

Standard of Acceptance

- Anvil - fig. 260 ISS

.4 Clevis support for copper pipe and tube:

- .1 for copper tube, NPS $\frac{1}{2}$ to 4,
- .2 zinc-plated carbon steel yoke and clevis, adjustable clevis to MSS SP-58, type 1, copper plated or felt lined finish,
- .3 applicable tube size: NPS $\frac{1}{2}$ to NPS 4,
- .4 sized for outside dimension of pipe/tube, or outside diameter of pipe and insulation as applicable.

Standard of Acceptance

- Anvil - fig. CT-65 or 260F
- Taylor – fig. 52

2.8 Horizontal Pipe Support – Clevis for Fire Protection

- .1 Pipe size range: NPS 2 to NPS 8.

- .2 Light-duty, side-opening clevis support:
 - .1 for fire protection service only,
 - .2 pipe size range: NPS 2 to 8,
 - .3 galvanized carbon steel, adjustable clevis with fixed yoke,
 - .4 listed to ULC/ORD-C203 or UL 203 for fire protection piping,
 - .5 sized for outside dimension of pipe (and insulation if applicable).
 - .6 sized for outside dimension of pipe (and insulation where applicable),
 - .7 nominal pipe size: NPS 2 to NPS 8.

Standard of Acceptance

- Hilti - fig. MH-SLC Speed Lock

2.9 Horizontal Pipe Support – Swivel Ring Hanger

- .1 For non-insulated drain-waste-vent piping, gas piping, and chemical piping.
- .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
- Taylor – fig. 41, 43

2.10 Pipe Straps

- .1 General:
 - .1 for non-insulated drain-waste-vent piping, gas piping, and chemical piping.
 - .2 pipe size: NPS 4 and smaller.
- .2 Zinc plated carbon steel U-loop straps for mechanical fastening to structure.

Standard of Acceptance

- Anvil - fig. 262

- .3 Hot-dipped galvanized carbon steel U-loop with clip-in or bolt-on attachment to modular channel supports.

Standard of Acceptance

- Unistrut

2.11 Horizontal Pipe Support – Pipe Roller (Type 41, 43, 44)

- .1 Suspended support pipe roller – trapeze hanger style:
 - .1 adjustable height, pipe roller support for overhead support, to MSS SP-58 type 41,
 - .2 dual-hanger rod trapeze style,

- .3 pipe size range: NPS ½ to NPS 16, with or without insulation.

Standard of Acceptance

- Anvil - fig. 171
- Taylor – fig. 95

- .2 Suspended support pipe roller – clevis hanger style:

- .1 adjustable height, pipe roller support for overhead support, to MSS SP-58 type 43,
- .2 single rod clevis style,
- .3 pipe size range: NPS ½ to NPS 8, with or without insulation.

Standard of Acceptance

- Anvil - fig. 181
- Taylor – fig. 93

- .3 Bottom support pipe roller:

- .1 adjustable height, pipe roller with bottom support rods, to MSS SP-58 type 41,
- .2 for bottom support of piping,
- .3 with mounting rods and upper/lower retention nuts at both ends,
- .4 pipe size range: NPS ½ to NPS 16, with or without insulation.

Standard of Acceptance

- Anvil - fig. 177
- Taylor – fig. 95S

- .4 Bottom support pipe roller with stand:

- .1 pipe roller with cast iron support stand, to MSS SP-58 type 44,
- .2 for bottom support of piping,
- .3 fixed height and adjustable height variants,
- .4 base drilled for fastening to supporting element,
- .5 pipe size range: NPS ½ to NPS 18, with or without insulation.

Standard of Acceptance

- Anvil - fig. 271 (fixed), fig. 274 (adjustable)
- Taylor – fig. 279S (fixed), fig. 280S (adjustable)

2.12 Horizontal Pipe Support – Slides

- .1 Structural slide bases – 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 operating temperature range: -28 to 200°C (-20 to 400°F),
- .4 pipe insulation thickness clearance: up to 75 mm (3 in.),
- .5 pipe size and load rating in accordance with the following table:

Slide Base Type	Vertical Support Load Rating kN (lbf)	Lateral Restraint Load Rating kN (lbf)	Uplift Restraint Load Rating kN (lbf)	Pipe Size Range NPS	
				Water	Steam, Gas
T	35.0 (8000)	9.0 (2000)	3.6 (800)	½ to 18	½ to 30
H	53.0 (12,000)	13.0 (3000)	5.3 (1200)	6 to 8	½ to 30
	53.0 (12,000)	18.8 (4000)	7.1 (1600)	10 to 20	
	107 (24,000)	26.0 (6000)	10.7 (2400)	24 to 30	

Standard of Acceptance

- Anvil - figs. 257A, 436A, 439A
- Taylor – figs. 257A

.2 Structural slide base assemblies with PTFE pads – welded attachment:

- .1 for piping with design temperatures greater than 121°C (250°F), including steam at pressures greater than 103 kPa (15 psig),
 - (a) may also be used for lower temperatures,
- .2 as specified above for slide bases and as follows,
- .3 PTFE bonded to underside of slide,
- .4 matching lower steel plates with bonded PTFE element (for fastening to structural support beam),

Standard of Acceptance

- Anvil - figs. 257, 436, 439
- Taylor – figs. 257

.3 Restraint variants for slides:

- .1 lug restraints to limit lateral movement due to thermal expansion of between 6 mm to 25 mm (1/4 to 1 in.),
- .2 where seismic restraint is required, lug restraints designed to limit lateral and vertical uplift movement to not more than 6 mm (1/4 in.),
 - (a) exception: if lateral movement of greater than 6 mm (1/4 in.) is shown, then the seismic design load is to be two (2) times the seismic load as shown in Specification section 20 05 49.

.4 Clamp for T and H slides supporting cold piping:

- .1 galvanized steel clamp for insulated cold piping, sized for outside dimension of insulated pipe,
- .2 rolled from structural plate steel with bolting flanges,
- .3 continuous single clamp for length of slide, or two (2) individual clamps at each end of the slide,
- .4 bottom half of clamp welded to T or H slides,
- .5 top half of clamp mechanically fastened to bottom half.

Standard of Acceptance

- Anvil - fig. 212 (2 clamp) 432 (continuous clamp)

2.13 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
- Taylor – fig. 170

2.14 Horizontal Pipe Support – Drainage MJ

- .1 For support of horizontal cast iron drainage piping, as an alternative to clevis hangers.
- .2 Designed to support each end of the pipe on both sides of a drainage MJ joint, and at intermediate supports, elbows and tees.
- .3 Carbon steel, plain finish.
- .4 Pipe size: NPS 2 to NPS 6

Standard of Acceptance

- Anvil - fig. 250
- Taylor – fig. 25

2.15 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

2.16 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
- Taylor – fig. 82

.6 suspended pipe riser clamps, 4 or 6 bolt patterns, to ANSI/MSS SP-58, type 42,

Standard of Acceptance

- Anvil - fig. 40, 40SS
- Taylor – fig. 82HCopper pipe and tube:

.7 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
- Taylor – fig. 85

2.17 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

- Taylor – fig. 35

2.18 Insulation Shields

.1 Insulation shields:

- .1 galvanized steel protection shield, thickness and length as applicable to pipe size, to MSS SP-58 type 40
- .2 designed to meet MSS SP-58 maximum support spans with insulation inserts having a compressive strength of 620 kPa (90 psi).
- .3 pipe size: NPS ½ to 24,
- .4 insulation thickness: 12 mm to 50 mm (1/2 in. to 2 in.).
- .5 gauge: minimum 18 ga.
- .6 sleeve width: minimum 180 degree arc of insulation exterior surface
- .7 minimum sleeve length:
 - (a) pipe NPS ½ to 4: 300 mm (12 in.)
 - (b) pipe NPS 6: 450 mm (18 in.)
 - (c) pipe NPS 8 to 24: 600 mm (24 in.)

Standard of Acceptance

- Anvil - fig. 167 (up to NPS 24)
- Anvil - fig. 168 (up to NPS 8)

- Taylor – fig. 69H

- .8 sleeve length exemption: sleeve lengths may be reduced where shield is supplied as an integrated part of a high density insulation insert system. – refer to Specification section 20 07 19.

2.19 Insulation 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.
- .2 For pipe sizes NPS ¾ to 36.
- .3 Insulation thickness range: 25 to 140 mm (1 to 5.5 in.)

Standard of Acceptance

- Anvil - fig. 160 to 166
- Taylor – fig. 70 to 77

3 EXECUTION

3.1 General

- .1 Where the specific requirements for pipe supports are specified in other sections of Division 20 to 23, the requirements of those sections take precedence over the requirements of this specification section.

3.2 Coordination with Concrete Work

- .1 Do not use explosive drive pins in any section of the Work without obtaining prior approval from the Consultant.

3.3 Support and Hanger Installation – General Requirements

- .1 Support piping directly on or from structural building elements. Do not support pipe directly from other services. Multiple piping services may be supported on a common trapeze support.
- .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. Select hangers to include an electrical insulating material between the hanger and the pipe, or provide electrical insulating material.
- .5 Coordinate location of pipe supports with pipe flexible connectors, pipe guides and pipe anchors.
- .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 lengths,
 - .2 size supporting steel to limit horizontal span deflection to 1/250 (0.4%) between connecting points to the structure,
 - .3 mechanically fasten supplementary steel to structural steel to prevent axial and transverse displacement, and rotation.

- .7 It is permissible to offset hangers and displace the hanging rod so that in the final operating position, the hanging rods are within 4° of vertical.
- .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 load nuts on the underside of attachment to the pipe support, including clevis hangers, roll supports, roll yoke hangers, and trapeze hangers.

3.4 Horizontal Pipe Support Spacing and Hanger Rod Size

- .1 Provide horizontal pipe supports at the spacing as detailed in the Schedule "A" included at the end of this Specification section, unless specified otherwise in other sections of Division 20 to 23.
 - .1 Schedule "A" includes alternate hanger rod size and support spans for reduced rod sizes.
- .2 Use threaded rod of the size based on pipe type and horizontal pipe hanger spacing as stated in the Schedule "A" for single rod hangers. Where the pipe hanger type requires two rods, the rod size may be reduced by one trade size but shall not be less than Ø3/8 in.
- .3 For piping using flexible roll-groove joints, there shall be not less than one hanger between pairs of joints.
- .4 Support plastic and other special piping, including anchors and guides, in accordance with the pipe manufacturer's requirements.

3.5 Horizontal Pipe Hanger and Support Selection

- .1 Select horizontal pipe hanger and support type based on pipe size and fluid service temperature in accordance with Schedules "B(1)" and "B(2)" at the end of this section.
- .2 For fire protection piping;
 - .1 use clevis hangers for all pipe sizes,
 - .2 swivel ring pipe hangers may be used for fire protection piping NPS 4 and smaller.
- .3 Swivel ring pipe hangers may only be used for;
 - .1 drain waste and vent (DWV) piping and tubing, NPS 4 and smaller,
 - .2 medical gas piping, NPS 4 and smaller.
- .4 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.
- .5 For other piping, select pipe support types in accordance with Schedule B at the end of this section.

The use of a half-section of a suspended pipe clamp to support a horizontal pipe using two threaded rods is prohibited unless the manufacturer has written installation instructions permitting such use. The use of a pipe riser clamp for this purpose is prohibited.

3.6 Clevis Hangers

- .1 Where clevis hangers are used for cold piping, select clevis to fit the outside dimension of pipe and associated insulation.

- .2 Where clevis hangers are used for heating piping;
 - .1 select clevis to fit the pipe diameter only (clevis located inside of insulation) for small diameter piping in accordance with Schedule "C" at the end of this section,
 - .2 for larger diameter piping, select clevis to fit the outside dimensions of pipe and insulation – refer to Schedule "C" at the end of this section,
 - .3 where the distance from the building support element to the clevis pin is less than the value shown in the standard details at the end of this section, use an alternative method of support;
 - (a) exception: where the pipe is installed tight to the structure, the exposed length between the structural attachment and the top of the clevis shall not exceed 25 mm (1 in.).
- .3 Where clevis hangers are used for stainless steel pipe or tube and for copper tube;
 - .1 use copper or epoxy finished carbon steel 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 select hanger size for outside of the pipe and insulation.
- .4 Adjust clevis hangers to provide the required drainage slope and direction for each pipe.
- .5 Where the project requires seismic bracing of piping systems, add a Schedule 40 pipe over the clevis bolt, sized to provide at least 6 mm (1/4 in.) inside diameter clearance to the clevis bolt. This applies only where a transverse or longitudinal brace is attached to the clevis hanger.

3.7 Roll Hangers and Supports

- .1 For roll hangers, provide load and lock nuts to allow final adjustment of roll hanger to allow pipe drainage.
- .2 For roll supports supported above the structure element, the length of exposed threaded pipe between the roll support and the structural element shall not exceed 10 times the outside diameter of the rod.

3.8 Slide Supports

- .1 For hot piping, weld the T or H slide directly to the pipe.
- .2 For cold piping, weld the T or H slide to the bottom half of a carbon steel clamp assembly.
- .3 Use slides with integral lateral movement limit lugs at pipe supports required to function as a guide. Movement clearance to be between 6 mm and 25 mm (1/4 to 1 in.).
- .4 Where seismic restraint is required, use slides with integral lateral and vertical-up movement limit lugs so that the maximum allowable movement does not exceed 6 mm (1/4 in.).
- .5 For fluid service temperatures of 121°C (250°F) and less, apply grease with a service temperature of not less than 200°C (392°F) over the entire bottom of the T or H slide.
- .6 For fluid service temperatures greater than 121°C (250°F) use a PTFE slide pad bonded to the underside of the slide and a matching PTFE slide pad bonded to the top of the structural steel support.

3.9 Vertical Pipe Supports

- .1 Pipe riser clamps:
 - .1 provide pipe riser clamps for non-insulated pipes NPS 4 and smaller 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 vertical cold piping and hot piping for riser heights that are 25 m (82 ft) or less in height as follows:
 - .1 provide a pipe anchor at the base of the riser or the mid-height of the riser.

3.10 Pipe Saddles and Shields

- .1 Provide pipe saddles and shields for insulated piping in accordance with Schedule "C" at the end of this section.
- .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 of the designation type as shown in Schedule "C" and as specified 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.

3.11 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.

3.12 Schedules

- .1 The following appended schedules form part of this Specification section.
 - .1 Schedule A1(a) Horizontal Pipe Support Loads and Support Spans – Schedule 20 to 80 Pipe
 - .2 Schedule A1(b) Alternate Hanging Rod Sizes and Support Spans for Schedule 20 to 80 Pipe
 - .3 Schedule A2(a) Horizontal Pipe Support Loads and Spans – Schedule 10/10S Stainless Steel Pipe
 - .4 Schedule A2(b) Alternate Hanging Rod Sizes and Support Spans for Schedule 10/10S Stainless-steel Pipe
 - .5 Schedule A3 Horizontal Pipe Support Loads and Spans – Copper and Stainless Steel Tube
 - .6 Schedule B Pipe Support Type Selection Requirements
 - .7 Schedule C Insulation Protection Requirements

3.13 Standard Details

- .1 The following standard details are appended to the end of this Specification section.
 - .1 20 05 29-010 Cold Piping and Dual-Temperature Piping – Clevis Hanger Detail

- .2 20 05 29-011 Cold Piping and Dual-Temperature Piping – Roll Hanger Detail
- .3 20 05 29-012 Cold Piping and Dual-Temperature Piping – Trapeze Hanger Detail
- .4 20 05 29-013 Cold Piping and Dual-Temperature Piping – Slide Support Detail
- .5 20 05 29-020 Hot Piping – Clevis Hanger Detail
- .6 20 05 29-021 Hot Piping $\leq 100^{\circ}\text{C}$, Small Size Piping – Clevis Hanger Details
- .7 20 05 29-022 Hot Piping – Roll and Trapeze Hanger Detail
- .8 20 05 29-023 Hot Piping – Slide Support Detail
- .9 20 05 29-030 Slide Supports – Guides and Seismic Restraint

Schedule A1(a)

**Horizontal Pipe Support Spacing
for
Carbon Steel, Galvanized Steel, Stainless-steel Piping
Schedule 20 to 80 Inclusive**

Notes for Schedule A1(a) and A1(b):

[1] Hanging rod size for single support. Where two supports are used, the rod size may be reduced by one size but not less than Ø3/8 in..

[2] Subject to load capacity of hanger components other than the hanging rod.

[3] Where piping is hydrostatically tested with water, temporary pipe supports are required to limit pipe span to the "liquids" values.

[4] For trapeze hangers only.

Pipe Size NPS	Rod Diameter Single Support [Note 1] Inches	Maximum Support Spacing, Liquids [Note 2] m (ft)	Maximum Support Spacing Steam, Gases [Note 2, 3] m (ft)
½	Ø 3/8	1.8 (6)	1.8 (6)
¾ to 1¼	Ø 3/8	2.1 (7)	2.1 (7)
1½	Ø 3/8	2.7 (9)	2.7 (9)
2	Ø 3/8	3.0 (10)	4.0 (13)
2½	Ø ½	3.3 (11)	4.3 (14)
3	Ø ½	3.3 (12)	4.6 (15)
4	Ø 5/8	4.2 (14)	5.2 (17)
6	Ø ¾	5.1 (17)	6.4 (21)
8	Ø ¾	5.7 (19)	7.3 (24)
10	Ø 7/8	6.7 (22)	7.9 (26)
12	Ø 7/8	7.0 (23)	9.1 (30)
14	Ø 1	7.5 (25)	9.8 (32)
16	Ø 1	8.0 (27)	10.7 (35)
18	Ø 1 [Note 4]	8.4 (28)	11.3 (37)
20	Ø 1-1/4 [Note 4]	9.0 (30)	11.9 (39.0)
24	Ø 1-1/2 [Note 4]	9.6 (32)	12.8 (42.0)
30	Ø 1-1/2 [Note 4]	10.0 (33)	13.4 (44.0)

Schedule A1(b)

**Alternate Rod Sizes and Pipe Spans
For Pipe Sizes NPS 10 to 16
Carbon Steel, Galvanized Steel, Stainless-steel Piping
Schedule 20 to 80 Inclusive**

The following table provides alternate combinations of rod hanger size and associated support spacing for select pipe sizes.

Pipe Size NPS	Rod Diameter Single Support [Note 1] Inches	Maximum Support Spacing, Liquids [Note 2] m (ft)	Maximum Support Spacing Steam, Gases [Note 2, 3] m (ft)
10	Ø 3/4	4.0 (13)	6.7 (22)
12	Ø 3/4	3.0 (10)	5.8 (19)
14	Ø 3/4	2.7 (9)	5.2 (17)
	Ø 7/8	5.8 (19)	9.1 (30)
16	Ø 3/4	2.1 (7)	4.6 (15)
	Ø 7/8	4.9 (16)	7.9 (26)

Schedule A2(a)

**Horizontal Pipe Support Spacing
For
Stainless-steel Pipe
Schedule 10/10S**

Notes for Schedule A2(a) and A2(b):

[1] Rod size for single support. Where two supports are used, the rod size may be reduced by one size but not less than Ø3/8 in..

[2] Subject to load capacity of hanger components other than the hanging rod.

[3] Where piping is hydrostatically tested with water, temporary pipe supports are required to limit pipe span to the "liquids" values.

[4] For trapeze hangers only.

Pipe Size NPS	Rod Diameter Single Support [Note 1]	Maximum Spacing, Liquids [Note 2] m (ft)	Maximum Spacing Steam, Gases [Note 2, 3] m (ft)
½	Ø 3/8	1.83 (6)	2.45 (8)
¾	Ø 3/8	2.1 (7)	2.75 (9)
1	Ø 3/8	2.45 (8)	2.75 (9)
1¼	Ø 3/8	2.75 (9)	2.75(9)
1½	Ø 3/8	2.75 (9)	3.65 (12)
2	Ø 3/8	3.10 (10)	4.0 (13)
2½	Ø 1/2	3.35 (11)	4.3 (14)
3	Ø 1/2	3.65 (12)	4.6 (15)
4	Ø 5/8	4.25 (14)	5.2 (17)
6	Ø 3/4	4.9 (16)	6.4 (21)
8	Ø 3/4	5.5 (18)	7.3 (24)
10	Ø 7/8	5.8 (19)	7.9 (26)
12	Ø 7/8	6.1 (20)	9.2 (30)
14	Ø 1	7.0 (23)	9.7 (32)
16	Ø 1	7.3 (24)	10.7 (35)
18	Ø 1 [Note 4]	7.3 (24)	11.3 (37)
20	Ø 1-1/4 [Note 4]	7.6 (25)	11.9 (39)
24	Ø 1-1/2 [Note 4]	7.3 (25)	11.9 (42)
30	Ø 1-1/2 [Note 4]	8.5 (28)	12.8 (44)

Schedule A2(b)

**Alternate Rod Sizes and Pipe Spans
For Pipe Sizes NPS 10 to 16
Stainless-steel Pipe
Schedule 10/10S**

The following table provides alternate combinations of rod hanger size and associated support spacing for select pipe sizes.

Pipe Size NPS	Rod Diameter Single Support [Note 1] Inches	Maximum Spacing, Liquids [Note 2] m (ft)	Maximum Spacing Steam, Gases [Note 2, 3] m (ft)
10	Ø 3/4	4.9 (16)	4.9 (16)
12	Ø 3/4	3.7 (12)	3.7 (12)
14	Ø 3/4	2.7 (9)	2.7 (9)
	Ø 7/8	5.2 (17)	6.1 (20)
16	Ø 3/4	2.4 (8)	2.4 (8)
	Ø 7/8	4.3 (14)	5.2 (17)

Schedule A3

**Horizontal Pipe Support Spacing
For
Copper Tube and Stainless-steel Tube**

Notes for Schedule A3:

[1] Rod size for single support. Where two supports are used, the rod size may be reduced by one size but not less than M10 (3/8 in.).

[2] Subject to load capacity of hanger components other than the hanging rod.

Pipe Size NPS	Rod Diameter Single Support [Note 1] Inches	Maximum Spacing, Liquids and Gases [Note 2] m (ft)
½	Ø 3/8	1.5 m (5 ft)
¾ to 1¼	Ø 3/8	1.8 m (6 ft)
1½	Ø 3/8	2.4 m (8 ft)
2	Ø 3/8	2.4 m (8 ft)
2½	Ø 1/2	3.0 m (10 ft)
3	Ø 1/2	3.0 m (10 ft)
4	Ø 5/8	3.0 m (10 ft)
6	Ø ¾	4.3 (14)
8	Ø ¾	4.9 (16)

Schedule B

Pipe Support Type Selection Requirements

The following tables B(1) and B(2) lists hanger types which are to be used based on pipe size and service temperature. Refer to Schedule C for additional requirements concerning insulation protection.

Pipe Support Type Legend

CL	Clevis hanger
CL(EY)	Clevis hanger with extended yoke for installation under pipe insulation
CL(IS)	Clevis hanger with integral insulation saddle
CL(LD)	Clevis hanger, light duty
SW	Swivel hanger
RS	Roll support
RH	Roll hanger with clevis
RB	Roll support with integral base
TS	T slide
HS	H slide
TZ	Trapeze

Application Legend

A	Acceptable
---	Not permitted

Table B(1):
Pipe Support Type Selection Requirements
For Fluid Service Temperatures up to 100°C (212°F) or Less

Pipe/Tube Size NPS	CL	CL (EY)	CL (IS)	CL (LD)	SW [Note 1]	RS	RH	RB	TS	HS	TZ
½ - ¾	A	A	A	A	A	---	---	---	---	---	A
1 - 4	A	A	A	A	A	A	A	A	A	---	A
6	A	A	A	---	---	A	A	A	A	A	A
8	A	A	A	---	---	---	A	A	A	A	A
10	A	A	---	---	---	---	A	A	A	A	A
12	A	A	---	---	---	---	A	A	A	A	A
14	A	---	---	---	---	---	A	A	A	A	A
16	A	---	---	---	---	---	---	A	A	A	A
18	---	---	---	---	---	---	---	A	A	A	A
20	---	---	---	---	---	---	---	---	A	A	A
24	---	---	---	---	---	---	---	---	---	A	A
30	---	---	---	---	---	---	---	---	---	A	A

Notes:

[1] For uninsulated ambient piping/tubing only.

Table B(2):

**Pipe Support Type Selection Requirements
Fluid Service Temperatures greater than 100°C (212°F)
Including Steam at All Pressures**

Pipe/Tube Size NPS	CL	CL (EY)	CL (IS)	CL (LD)	SW	RS	RH	RB	TS	HS	TZ
½ - ¾	A	---	---	A	---	---	---	---	---	---	A
1 - 4	A	---	---	A	---	A	A	A	A	---	A
6	A	---	---	---	---	A	A	A	A	A	A
8	A	---	---	---	---	---	A	A	A	A	A
10	---	---	---	---	---	---	A	A	A	A	A
12	---	---	---	---	---	---	A	A	A	A	A
14	---	---	---	---	---	---	A	A	A	A	A
16	---	---	---	---	---	---	---	A	A	A	A
18	---	---	---	---	---	---	---	A	A	A	A
20	---	---	---	---	---	---	---	---	A	A	A
24	---	---	---	---	---	---	---	---	---	A	A
30	---	---	---	---	---	---	---	---	---	A	A

Schedule C

Insulation Protection Requirements For Pipe Hanger/Support

Notes for Schedule C:

[1] For the column Hanger Support Position, "Insulation" means hanger or support element is outside of the pipe and insulation. "Pipe" means hanger or support element is in direct contact with the pipe and is encased in the pipe insulation.

[2] "Pipe" position only applies to clevis hangers. For all other pipe supports, use the "Insulation" hanger/support position.

[3] Include heavy-duty support plate welded to shield.

[4] Restrictions apply to minimum length of hanger rod for heating piping at this temperature range. Refer to standard details.

[5] Refer to specification section 20 07 19 Piping Insulation for type P-21, P-22 and P-23 high-density insert specifications.

[6] Where ambient piping is required to be insulated under section 20 07 19, insulation is to be protected in accordance with the requirements for Low Temperature Piping.

[7] Insulation for Dual Temperature Piping is to be protected in accordance with the requirements for Cold Piping.

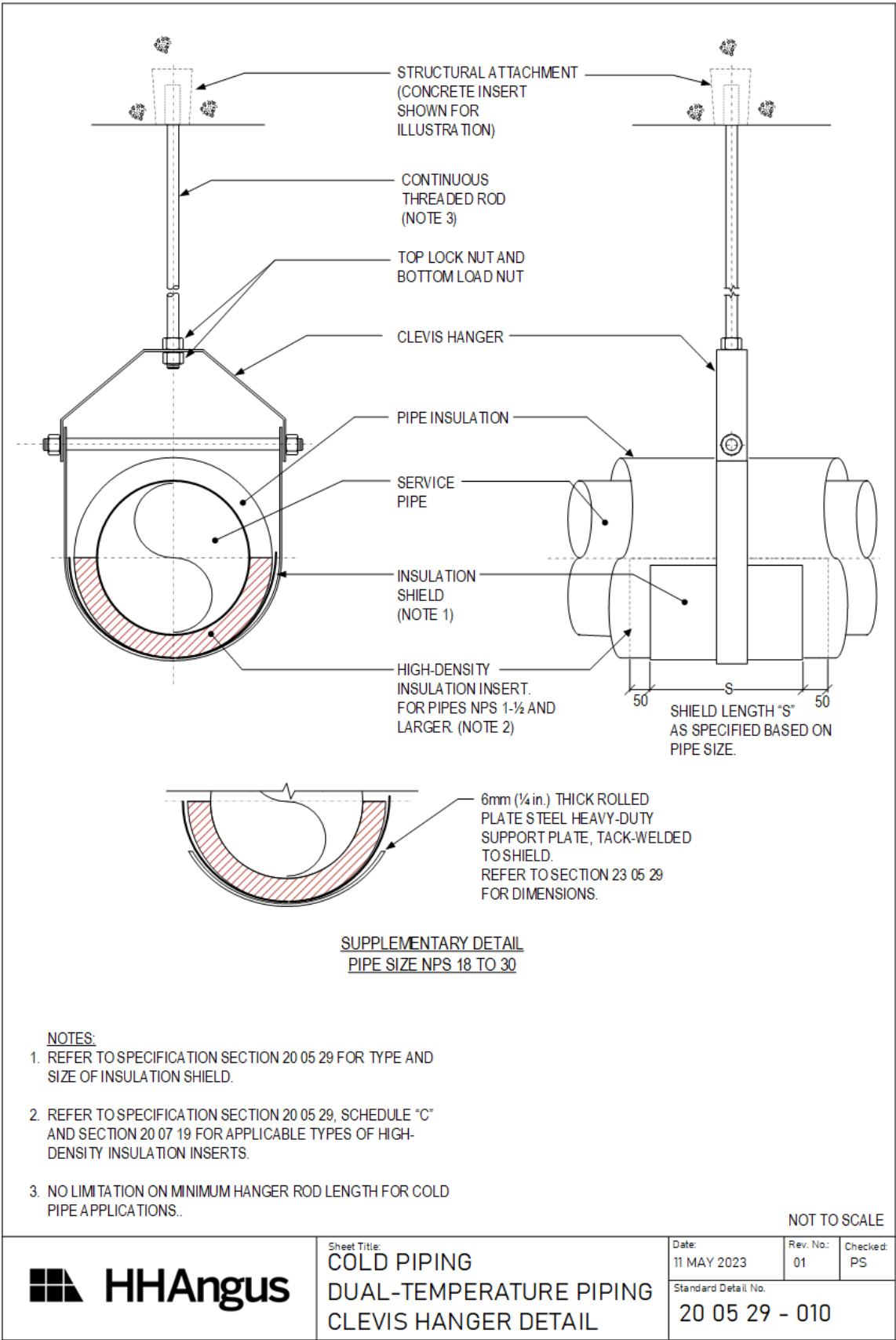
Application Legend for Insulation Saddle and Shields

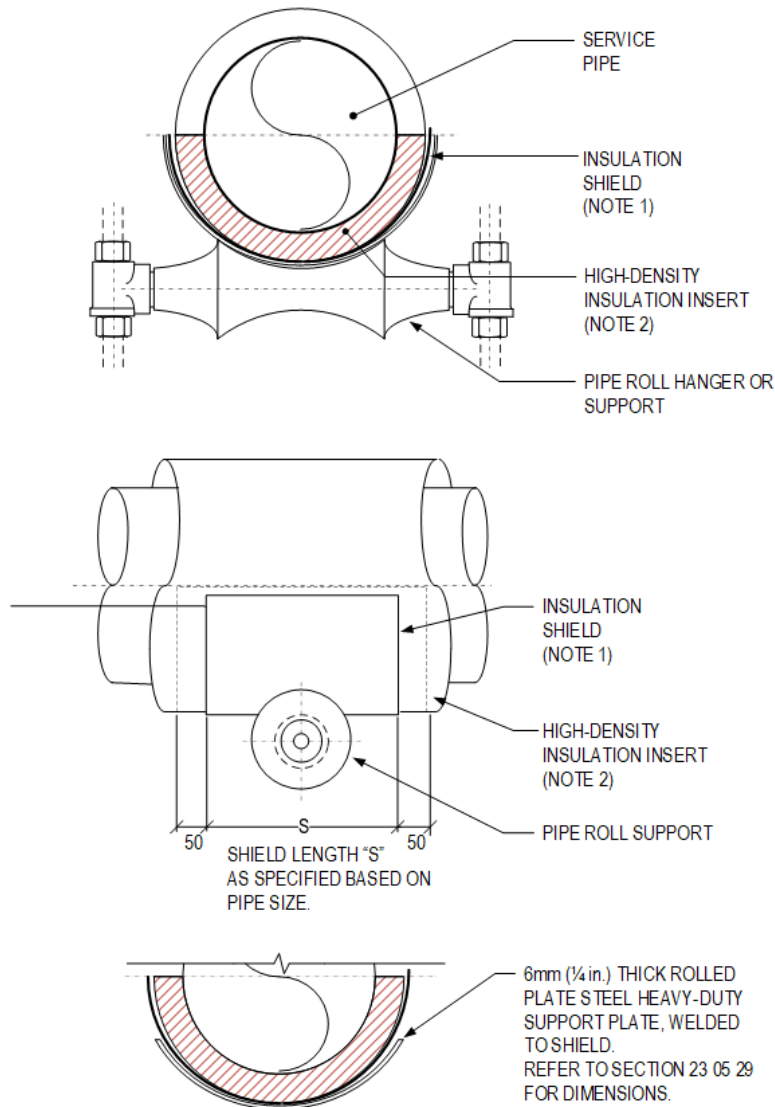
REQ	Required
ALT	Acceptable Alternate
	Not Applicable

Service Temperature °C (F)	Pipe Size NPS	Hanger/ Support Position [Note 1, 2]	Pipe Saddle	Insulation Shield	
				Shield	High-Density Insert Type [Note 5]
Hot Piping > 121 to ≤ 205 (> 250 to ≤ 400) Including steam >103 kPa (15 psi)	≥ 6	Insulation	REQ		
	>1-1/4 and ≤ 4	Insulation	ALT		
				ALT	P-23
	≤ 1-1/4	Insulation		REQ	
Hot Piping > 100 to ≤ 121 (> 212 to ≤ 250) Including steam ≤ 103 kPa (15 psi)	≥ 6	Insulation	REQ		
	>1-1/4 and ≤ 4	Insulation	ALT		
				ALT	P-21, P-22, or P-23
	≤ 1-1/4	Insulation		REQ	

Schedule C (Con't)

Service Temperature °C (F)	Pipe Size NPS	Hanger/ Support Position [Note 1, 2]	Pipe Saddle	Insulation Shield	High- Density Insert Type
Hot Piping 61 to 100 (141 to 212)	≥10 and ≤ 30	Insulation	REQ		
	≥ 6 and ≤ 16	Insulation	ALT		
				REQ	P-21, P-22, or P-23
	≥ 1-1/2 and ≤ 4	Insulation		ALT	P-21, P-22, or P-23
		Pipe [Note 4]	ALT		
	≤ 1-1/4	Insulation		ALT	
		Pipe [Note 4]	ALT		
Low Temperature Water 40 to 60 (104 to 140) [Note 6]	≥18 and ≤ 30	Insulation		REQ [Note 3]	P-21, P-22, or P-23
	≥ 6 and ≤ 16	Insulation		REQ	P-21, P-22, or P-23
	≥ 1-1/2 and ≤ 4	Insulation		ALT	P-21, P-22, or P-23
		Pipe	ALT		
	≤ 1-1/4	Insulation		ALT	
		Pipe	ALT		
Cold Piping 4 to 16 (39 to 61) [Note 7]	≥18 and ≤ 30	Insulation		REQ [Note 3]	P-21 or P-22
	≥ 1-1/2 and ≤ 16	Insulation		REQ	P-21 or P-22
	≤ 1-1/4	Insulation		REQ	
Fire protection piping	≥ 1-1/2	Pipe			
	≤ 1-1/4	Pipe			
MRI Quench Piping	All	Insulation		REQ	P-22






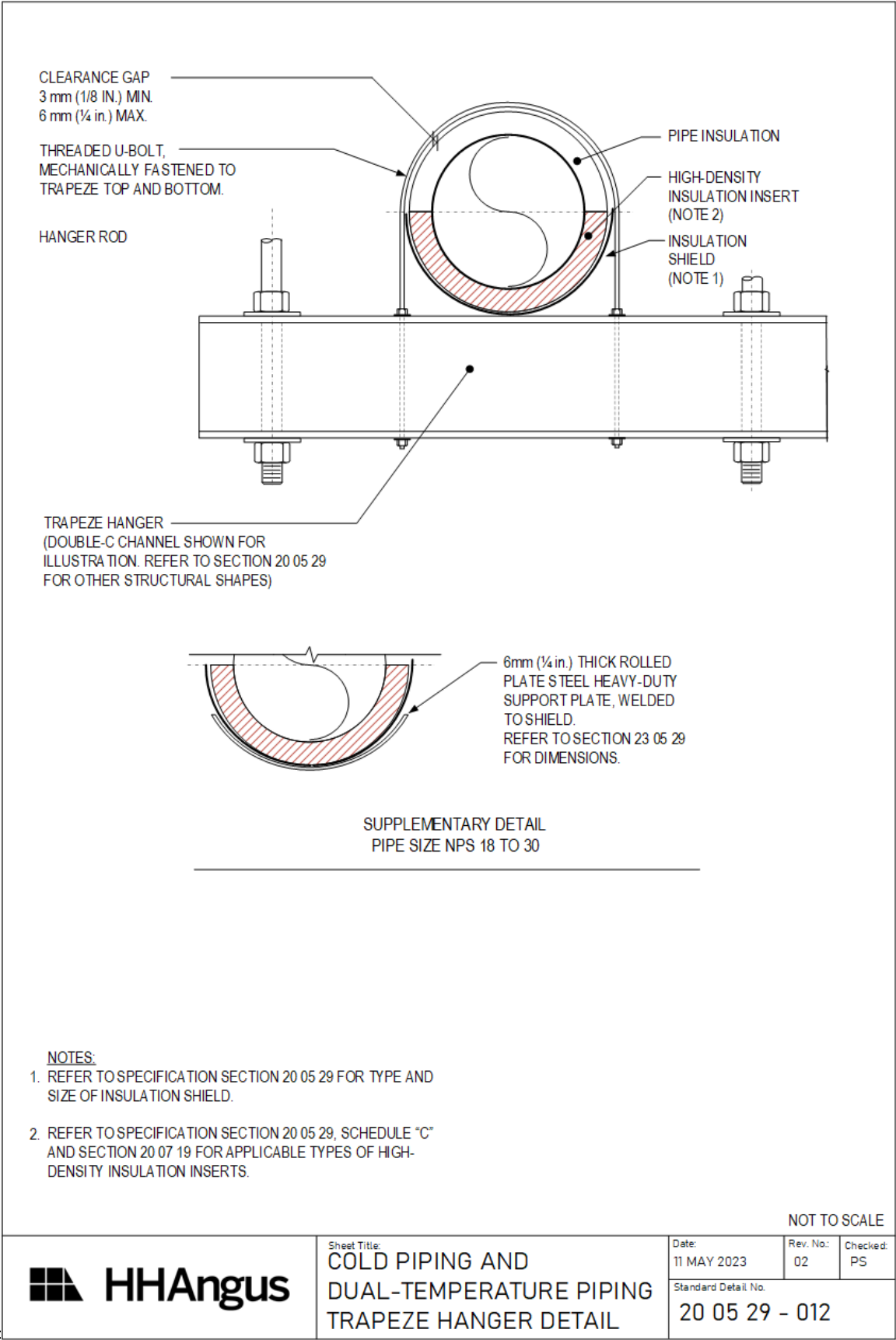
SUPPLEMENTARY DETAIL
PIPE SIZE NPS 18 TO 30

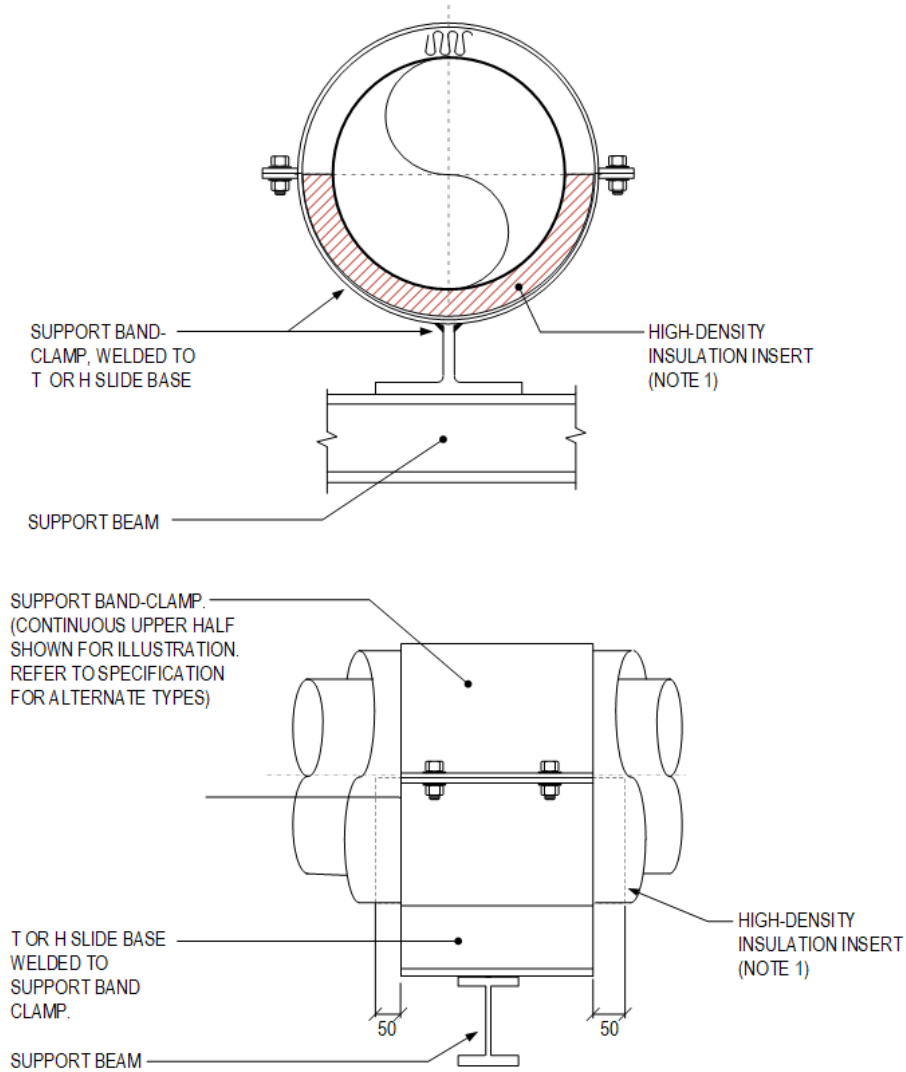
NOTES:

1. REFER TO SPECIFICATION SECTION 20 05 29 FOR TYPE AND SIZE OF INSULATION SHIELD.
2. REFER TO SPECIFICATION SECTION 20 05 29, SCHEDULE "C" AND SECTION 20 07 19 FOR APPLICABLE TYPES OF HIGH-DENSITY INSULATION INSERTS.
3. NO LIMITATION ON MINIMUM HANGER ROD LENGTH.

NOT TO SCALE

	Sheet Title: COLD PIPING AND DUAL-TEMPERATURE PIPING ROLL HANGER DETAIL	Date: 11 MAY 2023	Rev. No.: 02	Checked: PS
		Standard Detail No. 20 05 29 - 011		





NOTES:

1. REFER TO SPECIFICATION SECTION 20 05 29, SCHEDULE "C" AND SECTION 20 07 19 FOR APPLICABLE TYPES OF HIGH-DENSITY INSULATION INSERTS.

NOT TO SCALE



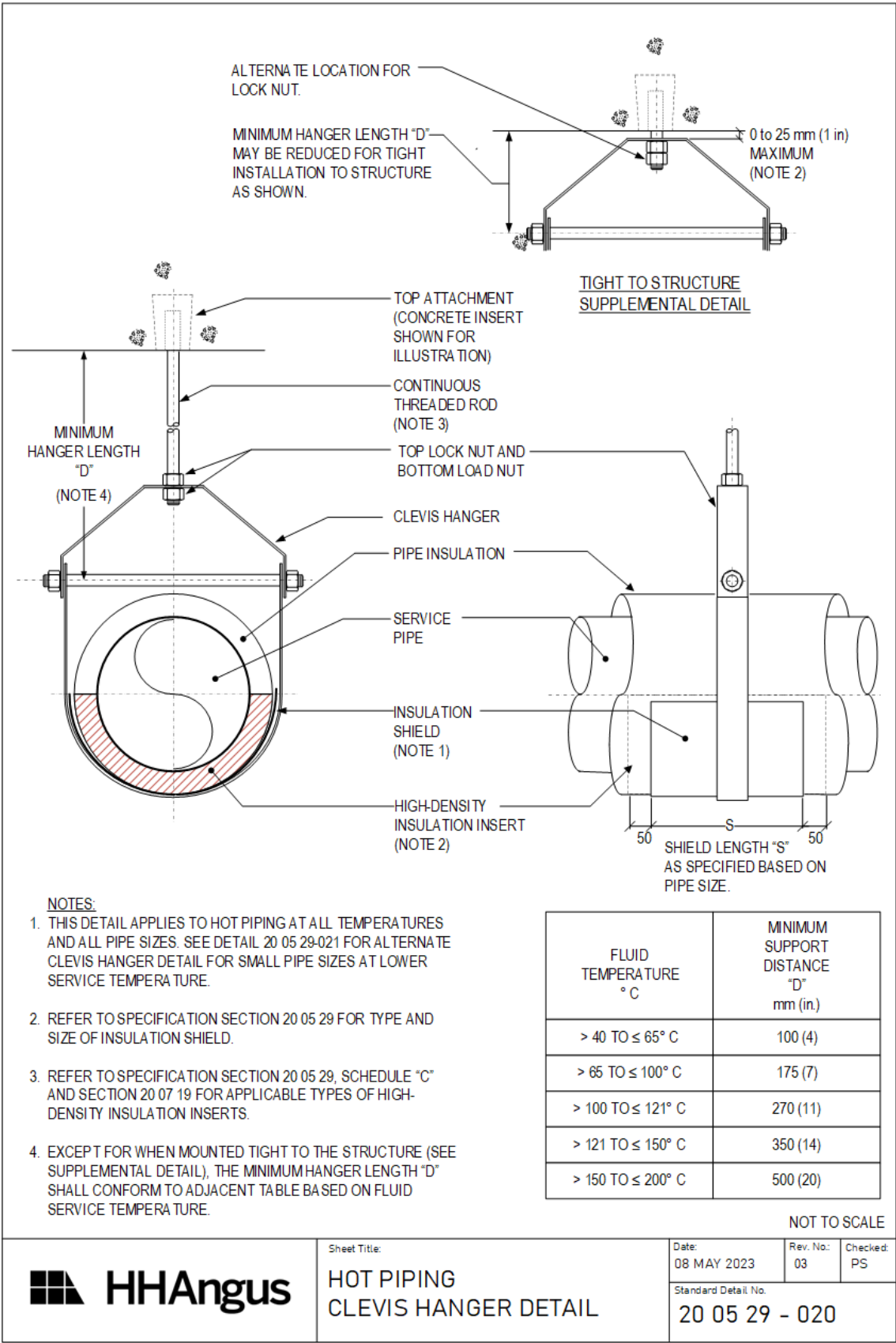
Sheet Title:
**COLD PIPING AND
DUAL-TEMPERATURE PIPING
SLIDE SUPPORT DETAIL**

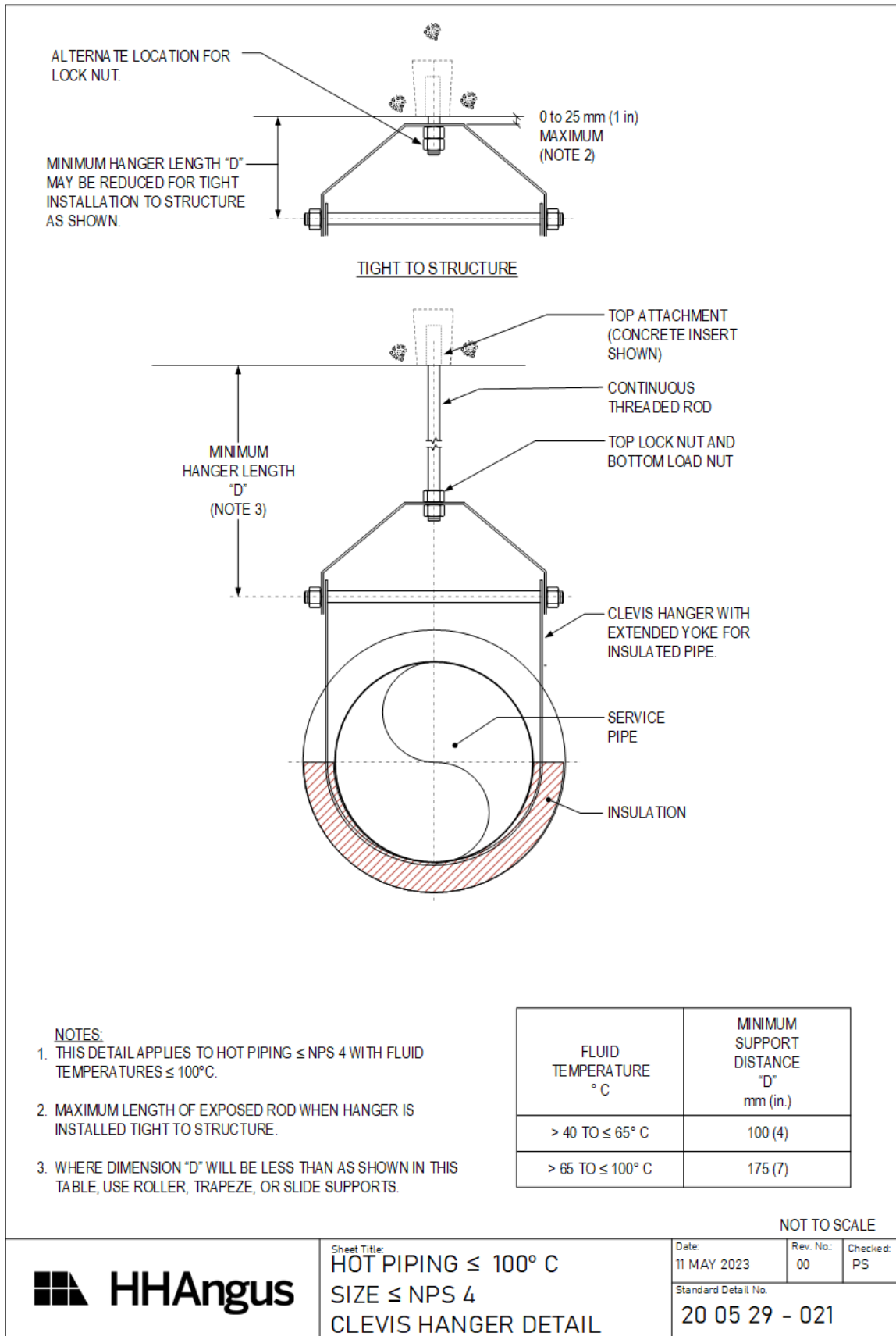
Date:
11 MAY 2023

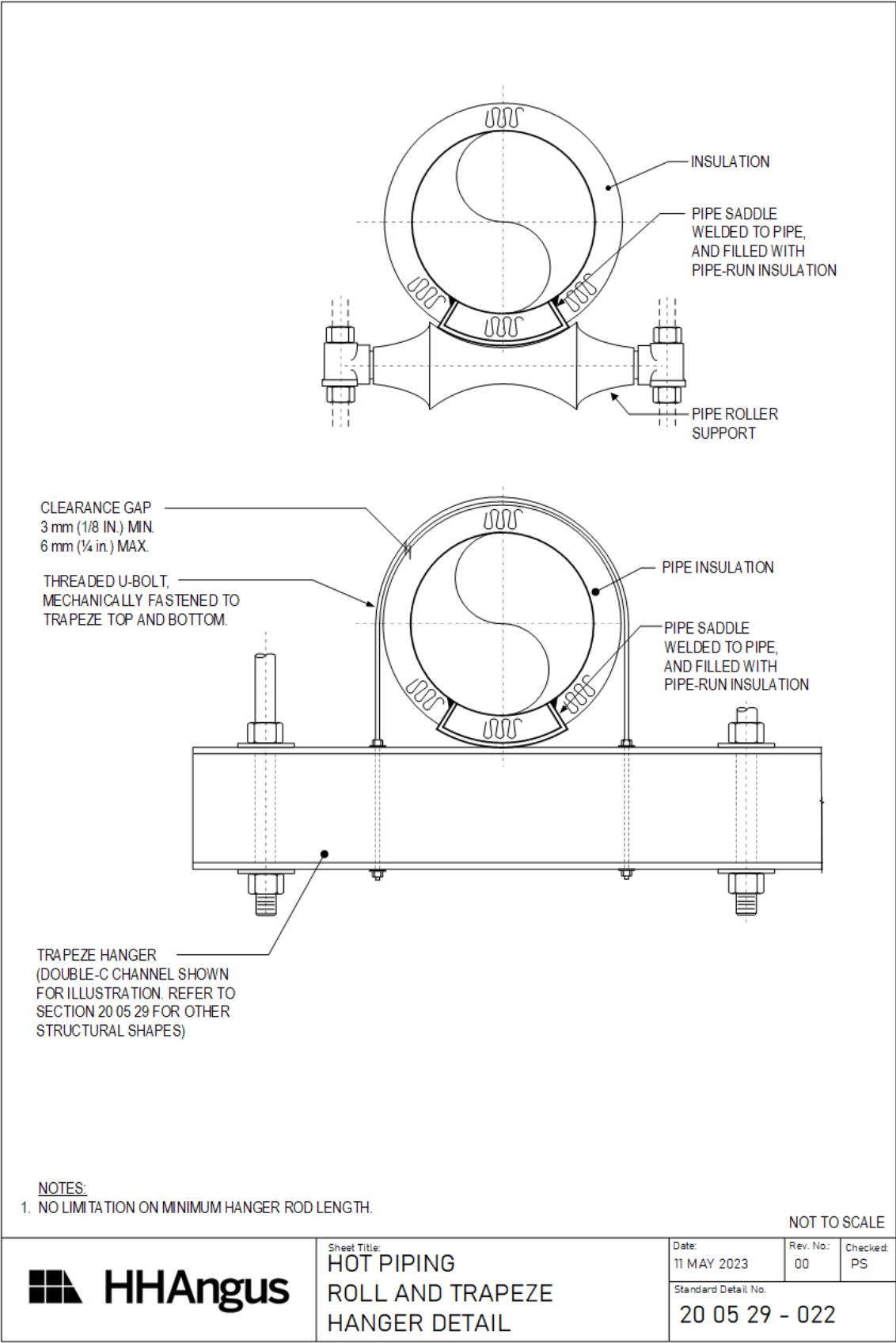
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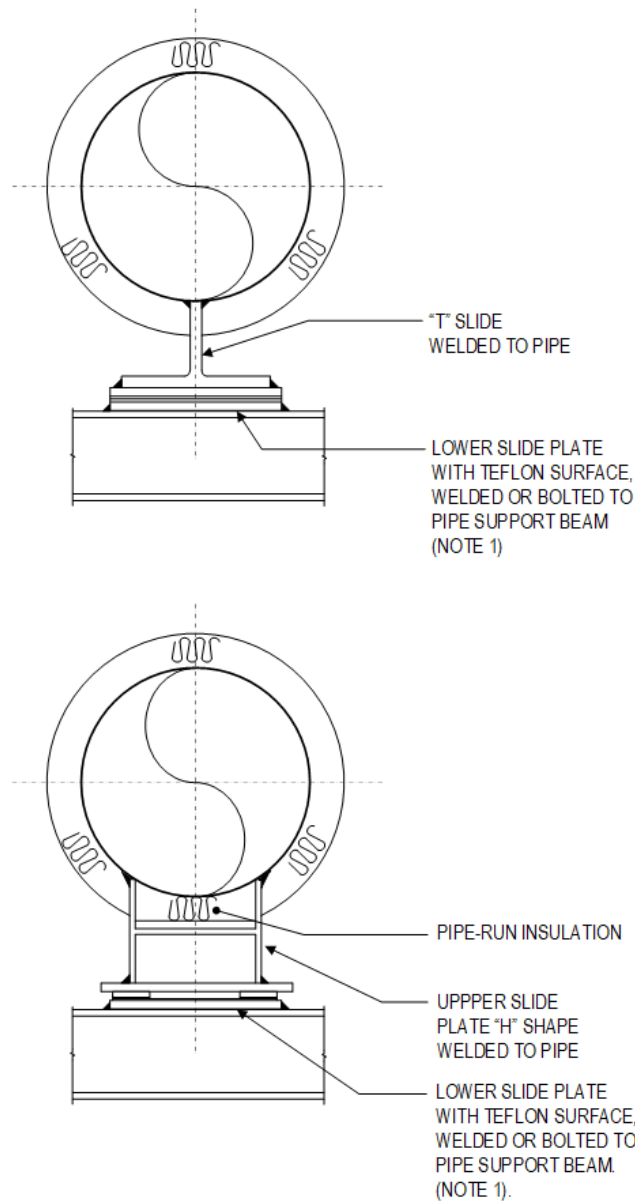
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Standard Detail No.
20 05 29-013









NOTES:

1. TEFLON SLIDE PLATES ONLY REQUIRED FOR HOT PIPING WITH SERVICE TEMPERATURE > 121° C, INCLUDING STEAM AT PRESSURES > 103 kPa.

NOT TO SCALE



Sheet Title:

**HOT PIPING
SLIDE SUPPORT DETAILS**

Date:

11 MAY 2023

Rev. No:

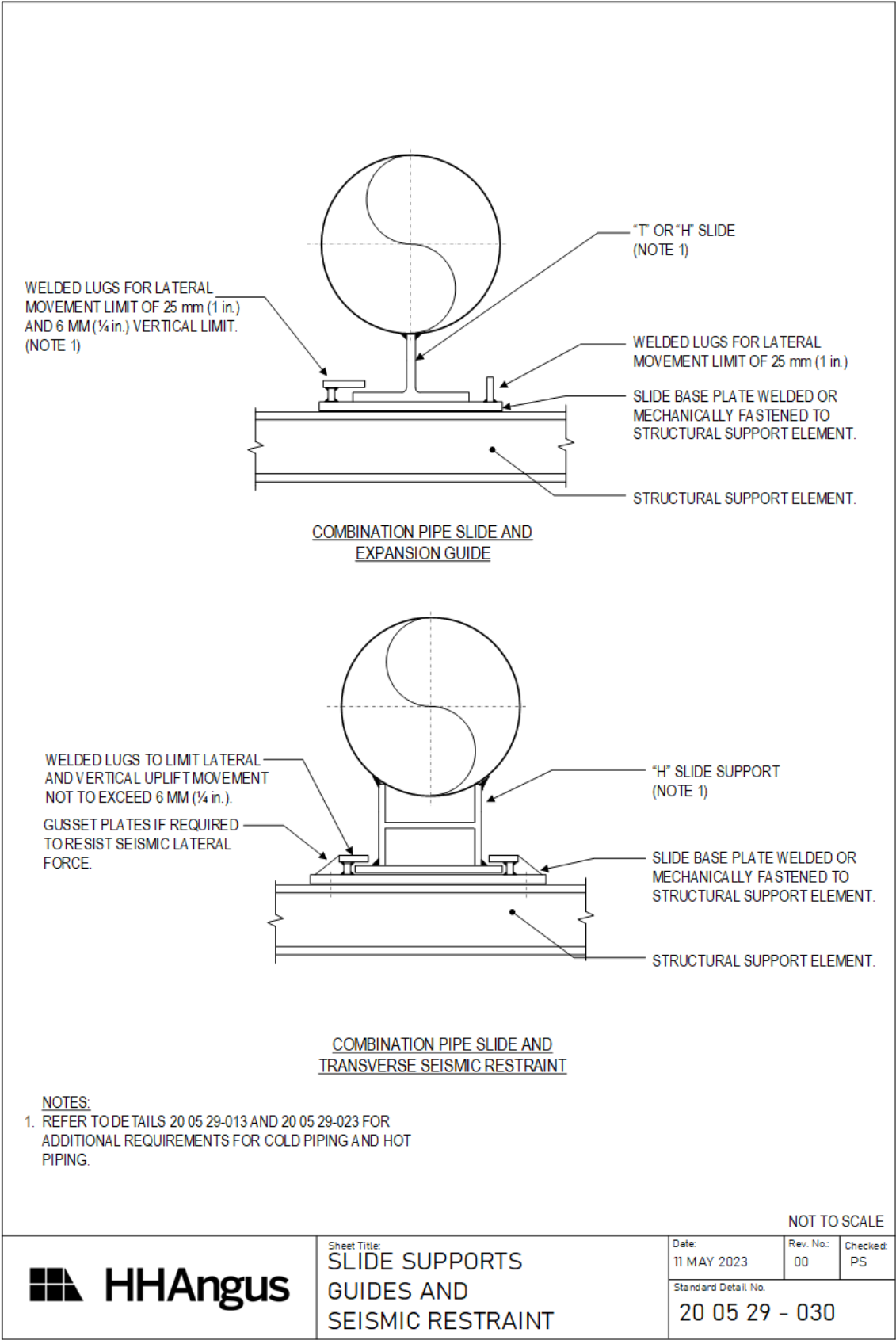
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Standard Detail No.

20 05 29 - 023



END OF SECTION

SEISMIC RESTRAINT FOR MECHANICAL SERVICES 20 05 49.20

1 GENERAL

1.1 Scope

- .1 Provide restraint devices to limit movement of piping, ducts, conduits, and equipment under seismic force and movement conditions and, where applicable, wind loads.
- .2 Provide engineering services for the design, selection of materials, installation instructions, and inspection of seismic restraint devices.
- .3 The requirements under this Specification section are in addition to the requirements for equipment, piping and duct supports and vibration isolation specified in other sections of Division 20.
- .4 Where specifications of materials of this section differ from those in other sections of Division 20, this section governs.

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 Common Hanger and Support Requirements
 - .2 26 05 49 Seismic Restraints for Electrical Services

1.3 Definitions

- .1 The following definitions apply for the purpose of this section.

Transverse restraint – means restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

Longitudinal restraint – means restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

Restraint: means a device which limits movement of an object due to imposed seismic forces acting on the object.

Brace: a restraint directly connected to an object that reacts against both tension and compression seismic loads.

Cable restraint: a restraint consisting of cables that reacts against only tension seismic forces, and that may have a small amount of slack to prevent vibration isolation short-circuiting during normal operation.

Snubber (restraint): a restraint that does not come into contact with the object under normal operating conditions.

Seismically qualify (seismically qualified): means equipment which has been evaluated by testing to withstand defined forces in amplitude and frequency which simulate seismically-induced movement, after which the equipment continues to function for its intended purpose.

- .2 The following abbreviations apply to this section:

“C_p” the horizontal seismic force coefficient as defined in NFPA 13.

- “**K_s**” horizontal seismic force coefficient equal to 0.3 S(0.2) I_E S_p, as defined in the 2020 National Building Code of Canada and represents a multiply of gravitational acceleration.
- “**K_v**” vertical seismic force coefficient and represents a multiple of gravitational acceleration.
- “**W_p**” the weight of the component subject to a seismic force.

.3 Interpretation:

- .1 In this specification, the parameter “S_s” (spectral response acceleration at 5 Hz) in NFPA 13, ASHRAE, SMACNA and MSS SP-127 used for estimating the horizontal seismic force, has the same meaning as the parameter “S(0.2)” for the Project site-specific design spectral response acceleration value at 0.2 seconds as defined in article 4.1.8.18 of the 2020 National Building Code of Canada.

1.4 Applicable Codes and Standards

.1 Legislation

- .1 2020 National Building Code of Canada, as adopted in the jurisdiction of the Project.

.2 Installation standards and codes:

- | | | |
|----|----------------|--|
| .1 | ASHRAE D-90316 | Practical Guide to Seismic Restraint |
| .2 | ANSI/SMACNA | Seismic Restraint Manual Guidelines for Mechanical Systems, 3 rd edition. |
| .3 | MSS SP-127 | Bracing for Piping Systems: Seismic - Wind - Dynamic Design, Selection, |
| .4 | NFPA 13 | Installation of Sprinkler Systems |

.3 Product standards:

- | | | |
|-----|---------------|--|
| .1 | ACI 355.2 | Qualification of Post-Installed Mechanical Anchors in Concrete |
| .2 | ASHRAE 171 | Method of Testing Seismic Restraint Devices for HVAC&R Equipment |
| .3 | ASTM A492 | Standard Specification for Stainless Steel Rope Wire |
| .4 | ASTM A1023 | Standard Specification for Stranded Carbon Steel Wire Ropes for General Purpose |
| .5 | ICC-ES AC01 | Expansion Anchors in Masonry Elements |
| .6 | ICC-ES AC106 | Predrilled Fasteners (Screws) in Masonry |
| .7 | ICC- ES AC156 | Acceptance Criteria for Seismic Certification by Shake-Table Testing of Non-structural Components |
| .8 | ICC-ES AC193 | Mechanical Anchors in Concrete Elements |
| .9 | ICC-ES AC308 | Post-Installed Adhesive Anchors in Concrete Elements |
| .10 | MSS SP-58 | Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation |

.4 Other documents:

- | | | |
|----|--------|--|
| .1 | ASCE 7 | American Society of Civil Engineers, Minimum Design Loads and Associated Criteria for Buildings and Other Structures |
|----|--------|--|

1.5 Seismic Analysis, Design and Inspection Services

- .1 Provide the services of a professional engineer, licensed in the province or territory of the Work and who specializes in seismic restraint of building services and equipment (the “Seismic Engineer”), for the design of seismic restraints and to provide inspection services of the completed installation.

- .2 Seismic Engineer design services;
 - .1 Provide the design of seismic restraint systems, including seismic restraint calculations for all connections of equipment to the structure.
 - .2 Provide design drawings showing locations of restraints and details of construction and attachment of restraints. Mark-ups of Consultant drawing or Contractor installation drawings may be used for this purpose.
 - .3 Analysis of dead loads, seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis to detail anchoring methods, bolt diameter, embedment and/or welded length. Design seismic restraint devices to accept, without failure, the seismic forces acting on the equipment or components and their support and restraint attachments to the building structure.
- .3 Seismic Engineer inspection services;
 - .1 At periods during installation and at completion of the installation of the seismic restraint devices, the Seismic Engineer shall inspect the installation, identify and report deficiencies (if any) which are observed, and re-inspect the installation after deficiencies have been corrected.
 - .2 Seismic Engineer to submit periodic inspection reports and a final inspection report after all work is completed and deficiencies have been corrected, confirming the installation conforms to the seismic design requirements. Prepare and submit any required declarations or similar document to this effect where required by local legislation.
- .4 Shop drawings of custom restraints, supporting calculations, and reports shall be sealed by the Seismic Engineer.
- .5 Prepare and submit reports of inspections of the installation and a final general review report of the completed seismic installation.

1.6 Manufacturer's Services – Seismic Restraints

- .1 Manufacturer of seismic control equipment are responsible for:
 - .1 determining seismic restraint sizes and locations,
 - .2 provide calculations and supply materials for restraint of vibration isolated and non-isolated equipment,
 - .3 provide installation instructions, drawings and trained field supervision to ensure proper installation and performance including welding details,
 - .4 field inspection of manufactured support systems including roof curbs and other rooftop equipment supports at time of installation.

1.7 Contractor Design Services – Pipe Risers

- .1 Notwithstanding the requirements of section 20 05 29, engineered design services for pipe riser supports are required for all pipe risers. These design services may be provided by the Contractor, the Seismic Engineer, or by a seismic restraint manufacturer.
- .2 Pipe riser supports design responsibilities include:
 - .1 complete engineering design of pipe riser support system including design and selection of pipe riser anchors, riser guides and riser isolators,
 - .2 provide calculations and supply materials for support of pipe risers to accommodate dead loads, dynamic loads and static seismic loads.
 - .3 provide installation instructions, drawings and trained field supervision to ensure proper installation and performance including welding details.

1.8 Design Criteria

- .1 Design seismic restraint systems to conform to the provincial or territorial building code requirements for seismic forces and movement as applicable for the place of the Work. Seismic restraint methods as described in ASHRAE D-90316, SMACNA seismic guideline and MSS SP-127 are acceptable as the baseline requirement.
- .2 Base the design of seismic restraints on actual equipment data (dimensions, weight, center of gravity, etc.,) obtained from submittals or the manufacturers of the equipment.
- .3 Testing and calculations of seismic restraints shall include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
- .4 Site design parameters shall be obtained for the existing building.
- .5 Building seismic force coefficient data;
 - .1 seismic horizontal force coefficients " K_s " and seismic vertical uplift force coefficient " K_v " for building service are listed in Schedule A attached to the end of this Section. These coefficients are the maximum values independent of the type of equipment or service being restrained. It is permitted to calculate a lower K_s coefficient where the C_p , A_r and R_p values, as defined in the building code specific to the actual equipment or service being restrained, are used.
 - .2 seismic force coefficient " C_p " for fire protection piping is listed in Table 3 of Schedule A attached to the end of this Section.
- .6 Seismic force calculation (except fire protection piping);
 - .1 the horizontal seismic force " V_p " applied to a component is:
$$V_p = K_s \times W_p,$$
 - .2 the vertical seismic force " V_{pv} " applied to a component is:
$$V_{pv} = K_v \times W_p$$
- .7 Seismic force calculation for fire protection piping, including automatic sprinklers constructed in accordance with NFPA 13 and fire standpipes constructed in accordance with NFPA 14;
 - .1 the horizontal seismic force applied to a component is
$$F_p = C_p \times W_p \times 1.15,$$
 - .2 the vertical seismic force applied to a component is equal to 15% of the horizontal seismic force F_p .
- .8 For suspended equipment, the building elevation height is measured to the level of the floor above the suspended equipment.
- .9 For vibration isolated equipment, where the clearance distance (air gap) between the equipment support frame and the restraint (e.g. snubber or integral limit stop) exceeds 6 mm (1/4 in.), the seismic horizontal force V_p is to be increased by 100%.
- .10 Where adhesive anchors for concrete are used, the seismic force for the restrained equipment is to be increased by multiplying the horizontal seismic force coefficient specified in Schedule A of this Specification section by the " R_p " equipment category as defined in article 4.1.8.18 of the National Building Code of Canada specific to the equipment being restrained.
$$K_{s,adhesives} = K_s \times R_{p,applicable\ equipment}$$
- .11 Where concrete inserts are used, the seismic force for the restrained equipment is to be increased by multiplying the horizontal seismic force coefficient specified in Schedule A of this Specification section by the " R_p " equipment category as defined in article 4.1.8.18 of the National Building Code of Canada specific to the equipment being restrained and divided by the value of 1.5.

$$K_{s,inserts} = K_s \times \frac{R_{p,applicable\ equipment}}{1.5}$$

1.9 Seismic Qualification of Equipment

- .1 Notwithstanding requirements in other specifications of Division 20 to 25 which require equipment to be seismically qualified, the following equipment which is completely factor assembled and supported directly on the building structure does not require seismic qualification:
 - .1 valves, strainers and filters, pipe and fittings,
 - .2 pneumatic operators,
 - .3 hydraulic operators,
 - .4 instrumentation and measurement gauges,
 - .5 any other equipment or components weighing not more than 9 kg (20 lbs) and is supported directly on the structure (and not mounted on other equipment or components), with supports that comply with this Specification section.

1.10 Submittals

- .1 Submit shop drawings in accordance with Division 1 and as follows.
- .2 Submittals for design of seismic restraint systems shall be sealed by a Professional Engineer licensed in the province or territory of the jurisdiction of the Project.
- .3 Seismic restraints:
 - .1 Provide test certificates for each seismic restraint device, identifying maximum tested load capacities.
 - .2 Provide calculations for each piece of restrained equipment, lengths of braced piping, ductwork and conduit, including seismic forces, restraint selection, and selection data.
 - .3 Provide seismic data in spreadsheet format for each piece of equipment and include the following information:
 - (a) Equipment ID,
 - (b) Building floor level,
 - (c) Horizontal seismic force factor K_v ,
 - (d) Equipment weight,
 - (e) Horizontal seismic force,-
 - (f) Vertical uplift seismic force (where applicable),
 - (g) Design condition (worst case) overturning moment,
 - (h) Number of restraint fastenings,
 - (i) Pull-out tension for worst case restraint,
 - (j) Compression for worst case restraint (vibration isolated equipment),
 - (k) Horizontal shear load per fastener,
 - (l) Worst case simultaneous tension and shear loads at each restraint and snubber,
 - (m) Pull-out tension load rating per fastener,
 - (n) Horizontal shear rating per fastener.
 - .4 Provide drawings for each type of restraint assembly, including details for connections to building structure, and associated bill of materials, and (where applicable) full welding details of field welds to structural elements.

- .5 For building connections in concrete, provide concrete anchor sizes and nominal and effective embedment depth.
- .6 Provide floorplan layout drawings indicating location of each restraint, identifying each restraint type in a manner to identify the restraint detail.
- .7 Provide layout and construction details for reinforced housekeeping pads based on actual equipment to be restrained and selected concrete anchors. Shop drawings to include:
 - (a) minimum housekeeping pad plan dimensions and height, including reinforcement,
 - (b) details for securing the housekeeping pad to the structural floor slab,
 - (c) dimensioned position of restraint devices or combination isolator/restraint devices,
 - (d) minimum distance from concrete anchors to edge of housekeeping pad.
- .4 Shop drawings for seismically qualified equipment:
 - .1 Provide seismic test data sheets for seismically qualified equipment. Alternatively, provide seismic qualification listing from HCAI Special Seismic Certification Preapproval (OSP)".
- .5 Calculations and designs shall be sealed by a Professional Engineer licensed in the province or territory of the jurisdiction of the project.
- .6 Pipe riser support system:
 - .1 Provide engineered layout drawings of pipe supports including anchors, guides, and isolators, with supporting load calculation including dead loads, dynamic loads and static seismic loads, and reaction loads at building connection.
 - .2 Include:
 - (a) riser drawing indicating location of each support element for each for each piping system,
 - (b) installation instructions for presetting of pipe guides and isolators,
 - (c) riser clamp products or fabrication details of pipe brackets,
 - (d) riser clamping details as applicable for each riser pipe material.

1.11 Quality Assurance

- .1 Without limiting Contractors responsibility for quality assurance of the Work, the following minimum quality control processes are required.
- .2 Pre-Construction meeting;
 - .1 Request and arrange a meeting with the Seismic Engineer and Consultant to review seismic restraint approach, prior to any restraint installation. Obtain approval from the Consultant before commencing work.
- .3 Initial installation and review;
 - .1 Install the first three transverse and three longitudinal braces for 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 Seismic Engineer and Consultant. Obtain approval of the installation before commencing remainder of the work.
- .4 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. For clarity, these inspections are separate from those performed by the Seismic Engineer.
- .5 Provide services by the Seismic Engineer to conduct periodic reviews of the work in progress, and final review of the completed seismic restraint installation, before any ceilings are installed or work is otherwise concealed.

- .6 All deficiencies identified by the Seismic Engineer, manufacturer, or Consultant are to be rectified before equipment or services are concealed.

2 PRODUCTS

2.1 General

- .1 Seismic restraint materials to be provided by manufacturers specializing in the field of seismic restraint.

Standard of Acceptance

- Vibro-Acoustics (Swegon North America)
 - Kinetics Noise Control Inc.
 - B.V.A. Systems
 - Korfund (VMC)
 - Tecoustics
 - Hilti
 - nVent
- .2 Manufactured seismic restraints, anchors and related materials to be tested in accordance with ICC ES AC156 for loads meeting or exceeding the applied seismic forces of the Work.
- .3 Demonstrate conformity of seismic restraint products by:
- .1 approved by a government agency and indicate maximum restraint ratings, or
 - .2 provided with test results verified by an independent testing laboratory which state the maximum restraint ratings.
- .4 Seismic restraints for equipment supported by vibration isolators to be either:
- .1 vibration isolators as specified in section 20 05 48 and provided with separate seismic snubbers, or
 - .2 combination vibration isolators with integral seismic snubbers.
- .5 The following product articles describe the more common type of restraint devices. Other restraint devices are permissible provided they are qualified by 3rd party testing laboratories for seismic force restraint.

2.2 Seismic Snubbers

- .1 Type "SS1" – Single-Axis/Single Direction Snubbers:
- .1 ASHRAE Type "I", designed to restrict movement in one axis,
 - .2 carbon steel construction with epoxy or electrostatic paint finish, attached to floor or housekeeping pad with minimum of two bolts, faced with minimum 6.4 mm (1/4 in.) thick neoprene pad of compounded to bridge bearing quality,
- .2 Type "SS2 / SS3" – Multi-Axis/Multi-Direction Snubber Assemblies:
- .1 ASHRAE Type "G" and "F", designed to restrict movement in two (2) lateral ("SS2") or three (3) axis ("SS3"),
 - .2 interlocking steel construction, attached to equipment structure and equipment, maximum of 6 mm (1/4 in) seismic movement,
 - .3 minimum 6 mm (1/4 in) thick resilient neoprene pads compounded to bridge bearing specifications, to prevent metal-to-metal impact,
 - .4 minimum two bolt attachments to the floor,

2.3 Seismic Restraint Brackets

- .1 Type "SRB" – Rigid Equipment Restraint Brackets:
 - .1 suitable for connection to equipment bases and tank bases,
 - .2 carbon steel "L" sections with epoxy or electrostatic paint finish, for fastening to both the floor structure/housekeeping pad and the equipment base,
 - .3 structure bolt opening equipped with neoprene bushing, compounded to bridge bearing quality,
 - .4 minimum two bolt fastening to equipment base using screws,
 - .5 suitable for equipment direct contact to floor with or without isolation pads,

2.4 Seismic Vibration Isolators

- .1 Type "2-S" – All Direction Neoprene Isolator:
 - .1 ASHRAE Type "E", designed to restrict movement in all directions with no metal-to-metal contact.
 - .2 molded, oil resistant neoprene compounded to bridge bearing quality, with encapsulated cast-in-place top steel load plate, and steel base plate with anchor holes,
- .2 Type "3-S" – Restrained Spring Isolator – Constant Load:
 - .1 ASHRAE Type "B", designed to restrict movement in all directions,
 - .2 colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm (¼ in.) neoprene pad,
 - .3 removable coil spring element without having to disturb supported equipment,
 - .4 lateral stiffness greater than 1.2 times rated vertical stiffness,
 - .5 minimum 50% overload capacity,
 - .6 non-welded spring elements: epoxy coated, with a minimum 1000-hour rating when tested in accordance with ASTM B-117,
 - .7 steel housing design to limit lateral and vertical movement of the supported equipment,
 - .8 neoprene snubber, to limit maximum equipment movement in any direction to 6 mm (¼ in.),
 - .9 location of snubbers designed to minimize prying action on floor bolts,
 - .10 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 mounted under spring(s),
 - .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 to allow unloading of water-bearing equipment,
 - .9 isolation washers,

- .10 bottom load plate with anchor holes,
- .11 hot dipped galvanized for outdoor installations,
- .12 neoprene snubber compounded to bridge veering quality, 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.

2.5 Restraints and Braces for Distribution Services

.1 Type "SCR" – Cable Restraints:

- .1 manufactured system consisting of cable, building attachment, and vertical hanger rod reinforcement assembly,
- .2 field-built assemblies are not acceptable,
- .3 steel wire strand cables:
 - (a) galvanized steel aircraft cable to ASTM A1023, or stainless steel to ASTM A492
 - (b) sized for seismic load with a safety factor of 2,
 - (c) arranged for restraint in both longitudinal and transverse directions under tension loads only,
 - (d) connector strength rating equal to 90% of cable breaking strength rating.
- .4 building and equipment attachment brackets:
 - (a) carbon steel assemblies, designed to permit rotation to the final installation angle, or 45° bent steel plates with holes to allow attachment of cable loops,
 - (b) protective loop thimbles at contact with connectors,
 - (c) rope connections: overlap wire "U" clips with at least two (2) bolt fasteners, or, tool-less wedge insert lock connectors,
 - (d) selected to exceed the cable working design load by 50%,
 - (e) single sided "C" beam clamps are not acceptable.
 - (f) fasteners to building structure designed to withstand simultaneous shear and tension loads, including prying action due to the bracket.

.2 Type "SSB" – Solid Braces:

- .1 factory-built or field assembled solid braces, consisting of structural-shapes, building attachment, and vertical hanger rod reinforcement assembly.
- .2 sized for seismic load with a safety factor of 2,
- .3 arranged for restraint in both longitudinal and transverse directions.
- .4 building and equipment attachment brackets:
 - (a) carbon steel assemblies, designed to permit rotation to the final installation angle, or 45° bent steel plates with holes to allow attachment of cable loops,
 - (b) selected to exceed the working design load by 50%,
 - (c) single sided "C" beam clamps are not acceptable.
 - (d) fasteners to building structure designed to withstand simultaneous shear and tension loads, including prying action due to the bracket.

.3 Vibration isolators for suspended pipes and ducts:

- .1 applies where vibration isolators are specified for pipes or ducts in Specification section 20 05 48.
- .2 type "H2" spring hanger in accordance with Specification section 20 05 48 and with two (2) travel-limit stops of neoprene washers with integral steel inserts which are located:

- (a) on the top of the isolator housing, with an air gap of 6 mm (1/4 in.) between the neoprene washer and the structure connection point,
 - (b) on the underside of the isolator housing, supported by a nut on the hanger rod, and provided with an air gap of 6 mm (1/4 in.) between the underside of the isolator housing and the top of the neoprene washer.
- .4 Bracing of vertical hanger rods for SCR restraints and SRB braces:
- .1 hanger rods braced to avoid potential for buckling;
 - (a) structural steel angle or formed channel brace selected to prevent support rod buckling,
 - (b) brace attached to support rod with a series of adjustable clips, without the use of hand-tools.
 - .2 hanger rods are not required where two SRB braces are provided at each seismic restraint location, and are installed at 180° opposition to each other.

2.6 Seismic Pipe Riser Support System for Piping Subject to Thermal Expansion

- .1 Application: for piping subject to thermal expansion including HVAC water systems, steam, domestic hot and cold water.
 - .1 not applicable to: drainage and vent piping systems, compressed gas and vacuum systems.
- .2 Complete engineered riser support system by support manufacturer.
- .3 Pipe riser anchors:
 - .1 outboard-mounted all-direction pipe anchors, designed for load bearing of pipe by means of pipe riser clamps or pipe support brackets,
 - .2 carbon-steel interlocking plates with bridge bearing quality neoprene pads, and painted finish,
 - .3 top-side loading plate with threaded UNC tapped mounting hole, for attachment by bolting to pipe riser clamp or welded to pipe bracket,
 - .4 variants for mechanical anchoring to concrete floor or field-welding to structural steel framing,
 - .5 one pair of guides per guide location.

Standard of Acceptance

- ° Vibro-Acoustics - fig. PRA, PRA-S

- .4 Pipe riser guides:
 - .1 outboard-mounted pipe guides, designed for load bearing of pipe by means of pipe riser clamps or pipe support brackets,
 - .2 carbon-steel sliding guides with EPDM lateral bushings and bridge bearing quality neoprene end pads, and painted finish,
 - .3 top-side loading plate with threaded UNC tapped mounting hole, for attachment by bolting to pipe riser clamp or welded to pipe bracket,
 - .4 one pair of guides per guide location.

Standard of Acceptance

- ° Vibro-Acoustics - fig. PRG, PRG-S

- .5 Pipe riser isolators:
 - .1 open spring assembly, with neoprene base and equipment loading plate, and mounting bolt hole for attachment by bolting to pipe riser clamp or welded to pipe bracket.

- .2 springs selected for four times the riser expansion or contraction at the supported location, to not exceed a maximum 25% load change between installed and operating condition.

Standard of Acceptance

- Vibro-Acoustics - fig. FST series

.6 Pipe riser clamps:

.1 Carbon steel pipe:

- (a) NPS 1-1/2 and under – carbon steel riser clamps, ANSI/MSS SP-58 type 8.

Standard of Acceptance

- Anvil - fig. 261

- (b) NPS 2 to 24 – 4 or 6 bolt carbon steel riser clamps, ANSI/MSS SP-58 type 42.

Standard of Acceptance

- Anvil - fig. 40

.2 Stainless steel pipe:

- (a) NPS ½ to NPS 12 – T304 stainless steel, ANSI/MSS SP-58 type 8.

- (b) special pattern with extended ears and 4 bolts to allow bearing on pipe riser anchors, guides and isolators.

Standard of Acceptance

- Anvil - fig. 261SS special.

.3 Copper tube:

- (a) NPS ½ to NPS 4 – carbon steel with copper plated finish, ANSI/MSS SP-58 type 8.

- (b) special pattern with extended ears and 4 bolts to allow bearing on pipe riser anchors, guides and isolators.

Standard of Acceptance

- Anvil - fig. CT-121 special.

.7 Pipe brackets:

- .1 purpose engineered, carbon steel structural shapes with reinforcing gussets, for full welding attachment to pipe and to load plates on pipe anchors, guides or isolators.

- .2 painted finish.

2.7 Seismic Pipe Riser Supports – Piping not Subject to Thermal Expansion

- .1 Use pipe riser clamps and guides in accordance with Specification section 20 05 29, except select components to have a load capacity equal to at least two times the combined dead weight, dynamic load and seismic load.

2.8 Mechanical Anchors

.1 General:

- .1 Post-installed mechanical anchors in concrete to be seismically qualified for installation in cracked concrete in accordance with ACI 355.2 by testing for seismic tension and shear loads in cracked concrete in accordance with ICC-EC AC193, and qualified by an ICC-ES seismic evaluation report.

- .2 Anchors installed in concrete masonry units to be seismically qualified in accordance with TMS 402/602 by testing for seismic tension and shear loads in accordance with ICC-ES AC01 or AC106, and be qualified by an ICC-ES seismic evaluation report.
- .3 Anchors to be selected for concurrent shear and tension loads with a safety factor not less than 2.0 times estimated load.
- .2 Undercut anchors for post-concrete installation:
 - .1 zinc-plated carbon steel bolt, nut, washer and cone-shape bearing-bell, with tungsten-tipped cutting radial edges, to create bearing force by keying into concrete,
 - (a) for outdoor use, all materials are to be stainless steel.
 - .2 special undercut stop-drill bit and installation setting tool,
 - .3 marking system to indicate when the anchor is completely installed,
 - .4 designed for pre-setting of anchors and/or fastening of anchors through the equipment attachment opening,

Standard of Acceptance

- Hilti - fig. HDA (indoor), HDA-R (outdoor)
- .3 Expansion wedge anchors for post-concrete or masonry unit installation:
 - .1 zinc-plated carbon steel bolt, nut, washer, expanding segments and wedge mandrel, to create restraint force by friction and keying against/into adjacent concrete,
 - (a) for outdoor use, all materials are to be stainless steel.
 - .2 torque- loading to determine complete installation,

Standard of Acceptance

- Hilti - fig. KB-TZ2 (concrete and masonry)
 - Hilti - fig. HSL-3 (concrete only)
- .4 Screw anchors for masonry units:
 - .1 Zinc-plated carbon steel masonry screw with hex washer head, to create restraint force by keying into concrete masonry units.
 - (a) for outdoor use, all materials to be stainless steel.

Standard of Acceptance

- Hilti - fig. KH-EZ series.
- .5 Housekeeping pad anchors:
 - .1 for installation prior to pouring of the housekeeping pad and post-installation of the structural floor,
 - .2 tapered ductile iron body, with openings sized for two runs of Ø10mm (#3) reinforcing bar, and body NC threaded receiver for connection to undercut or expanding wedge anchors,
 - .3 two pieces of Ø10mm (#3) reinforcing bar, of sufficient length to tie into housekeeping pad reinforcement,
 - .4 undercut or expanding wedge anchor for connection to the structural floor slab.

Standard of Acceptance

- Mason Industries - fig. HPA

2.9 Adhesive Anchors

- .1 Adhesive anchors for post-concrete installation:
 - .1 seismically qualified for installation in cracked concrete in accordance with ACI 355.2 by testing for seismic tension and shear loads in cracked concrete in accordance with ICC-EC AC308.
 - .2 to have an ICC-ES seismic evaluation report, and be suitable for installation in cracked and uncracked normal- and light-weight concrete.
 - .3 anchors to be selected for concurrent shear and tension loads with a safety factor not less than 2.0 times estimated load.
 - .4 injectable, two-component hybrid adhesive, matching threaded rod and accessories.

Standard of Acceptance

- ° Hilti - fig. HIT-HY 200

3 EXECUTION

3.1 General Requirements

- .1 Design and construct seismic restraints to;
 - .1 keep equipment and distribution services in place during and following seismic events,
 - .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 Select restraint fastening systems so that full restraint will be provided assuming one failed fastener.
- .4 Install seismic restraint devices in accordance with manufacturer's instructions and Seismic Engineer's installation shop drawings.
- .5 Secure each transverse or longitudinal brace to the building structure, and not any other building service.
- .6 Restraint installation:
 - .1 install cable restraints with slack not exceeding a deflection of 12 mm (1/2 in.) measured at its midpoint, where equipment being restrained is supported on/by vibration isolators or for piping which is subject to thermal expansion,
 - .2 install cable restraints snug in all other applications,
 - .3 use solid braces only in rigidly supported situations,
 - .4 brace hanger rods forming a part of a seismic restraint to accept resulting compressive loads,
 - .5 install transverse and longitudinal braces at angles between 45 and 60° measured from the horizontal, unless the seismic bracing details by the Seismic Engineer states otherwise.
- .7 Concrete or masonry walls may be used as transverse duct restraints (but not pipe restraints), provide the wall is not a fire separation requiring the duct to be installed with a fire damper, and the annual space on any side of the duct does not exceed 12 mm (1/2 in.). Where the annual space exceeds this value, provide separate braces or use angle channels to secure the duct to the wall.
 - .1 drywall partitions, including demountable partitions, are not to be used for restraint.
- .8 Trapeze support and racks piping systems may have the rack braced (transverse and longitudinally) provided each pipe supported by the rack is restrained to the rack, while allowing thermal expansion as necessary.

3.2 Use of Pre-Engineered Bracing Details for Distribution Services

- .1 Use of pre-engineered restraint and bracing details in accordance with SMACNA (for ducts, piping and conduit) or MSS-SP-127 (for piping) is permitted. Where the installation of these services exceeds the limits of these documents, provide specific engineering restraint devices and systems.
 - .1 for SMACNA details, refer to the seismic hazard level ("SHL") by floor level in Schedule A of this Specification Section.
- .2 Restrain fire protection automatic sprinkler systems and fire standpipe systems in accordance with NFPA 13.
- .3 Provide cable restraints or bracing for transverse and longitudinal seismic restraints at spacing and locations as specified in the above referenced standards.
- .4 Exemptions for seismic restraints for distribution services (pipes, ducts, conduit) described in ASHRAE, SMACNA or MSS SP-127 are limited to the explicit exemptions described herein.

3.3 Exemptions for Duct Seismic Restraints

- .1 Except as required in paragraph .2 below, the following ductwork is not required to have seismic restraints where all the following conditions are met;
 - .1 ducts and duct supports are constructed to SMACNA duct construction standards,
 - .2 the extent of the free movement of the duct under seismic forces will not cause the duct to come into contact with other building services or building elements,
 - .3 HVAC ducts having a cross-sectional area of 0.56 m² (6 ft²) or less or have a linear weight for ducts and any insulation of 248 N/m (17 lb/ft) or less,
 - .4 HVAC or process ducts supported on trapeze assemblies with rod hangers, where the duct and any insulation have a linear weight of 146 N/m (10 lb/ft) or less,
 - .5 for other ducts not described in items.3 or .4 above are exempt where:
 - (a) an individual duct is supported by hangers where the support height measured from the structural support to the top of the duct is 305 mm (12 in.) or less, and the hanger is attached to the duct within 50 mm (2 in.) of the top of the duct with a #10 sheetmetal screws, and
 - (b) rod hanger at the connection to the support structure are provided with a swivel in accordance with Specification section 20 05 29 to prevent bending of the hanger rod. Where such a device only provides rotation of the hanger rod in one plane, it shall be installed to allow transverse movement of the hanger rod.
- .2 Ducts conveying toxic or flammable gases, chemical or biological exhaust, or ducts used for smoke control or smoke venting are to be seismically restrained – no exemptions apply.

3.4 Exemptions for Pipe Seismic Restraints

- .1 Except as required in paragraph .2 below, the following piping is not required to have seismic restraints where all the following conditions are met;
 - .1 the pipe is supported by hangers where the support height measured from the structural support to the top of the pipe is 305 mm (12 in.) or less,
 - .2 piping is supported on a trapeze where the support height measured from the structural support to the top surface of the trapeze is 305 mm (12 in.) or less,
 - .3 the rod hanger at the connection to the support structure is provided with a swivel in accordance with Specification section 20 05 29 to prevent bending of the hanger rod. Where such a device only provides rotation of the hanger rod in one plane, it shall be installed to allow transverse movement of the hanger rod, and

- .4 the extent of the free movement of the piping under seismic forces will not cause the pipe to come into contact with other building services or building elements.
- .2 Piping conveying fuel oil, natural gas, propane gas and liquid, medical gases and compressed gases are to be seismically restrained – no exemptions apply.

3.5 Building Structural Connections

- .1 Select building connection devices based on seismic loads for actual provided equipment.
- .2 For connection to concrete structures:
 - .1 Select building structure anchors as follows:
 - (a) post-installed undercut anchors or wedge-expansion anchors,
 - (b) concrete inserts may be used in new construction but only where complete seismic design is completed and seismic forces are adjusted to suit,
 - .2 Spacing between anchors: not less than 3 x the effective embedment of the greatest embedment length.
- .3 Where adhesive anchors or concrete inserts are used, the anchors are sized for an increased seismic force as described in article "Design Criteria".
- .4 For connection to steel structures:
 - .1 use double sided beam clamp, loaded to the centerline of the beam web, or
 - .2 where permitted by the building structural engineer, specifically designed welded or bolted connection may be used.
 - .3 the use of single sided "C" type beam clamps is not permitted for the connection to the building steel structure for hanger rods and seismic restraints.

3.6 Duct Restraints General Requirements

- .1 Use cable restraints or braces. Do not mix cable restraints and rigid bar restraints on the same duct system.
- .2 Use cable restraints for ductwork suspended on vibration isolators. Provide a small amount of slack in the cable to prevent vibration short-circuiting, with the slack not exceeding a lateral displacement of 12 mm (1/2 in.) at the center point of the cable.
- .3 Provide reinforcement of hanging rods to prevent buckling of the rod.

3.7 Piping Restraints General Requirements

- .1 Use cable restraints for piping subject to thermal expansion, including but not limited to chilled water, heating water, steam and glycol heating/cooling water.
- .2 Use cable restraints for piping supported on vibration isolation hangers or supports.
- .3 Use cable restraints or braces for all other piping.
- .4 Thermal expansion pipe anchors and guides on piping systems may be used as both a transverse and longitudinal seismic restraint where they are designed for concurrent thermal and seismic loadings.
- .5 Provide reinforcement of hanging rods to prevent buckling of the rod.
- .6 Where clevis hangers are used, provide a brace for the clevis cross bolt consisting of Schedule 40 pipe of the smallest size to fit over the clevis cross bolt, of a length to provide a 6 mm (1/4 in.) total gap between the reinforcement and the clevis frame.
- .7 For trapeze hangers, provide U-bolts over piping to limit lateral and vertical movement, but allow approximately 6 mm (1/4 in.) total clearance to allow pipe thermal expansion movement.

- .8 Attach restraints to pipe hangers and trapezes. For existing piping, restraints may be attached to the pipe using pipe clamp assemblies manufactured for this purpose.
- .9 Where pre-engineering restraints in accordance with SMACNA or MSS SP-127 are used, the spacing for transverse and longitudinal restraints are to be reduced to 50% of the stated spans in these documents for the following piping systems:
 - .1 steel piping with threaded joints,
 - .2 plastic piping including but not limited to PVC, CPVC, PP, and PVDF,
 - .3 fiberglass-reinforced pipe,
 - .4 cast iron drainage piping with no-hub connectors,
 - .5 glass drainage piping.

3.8 Piping Risers Restraints

- .1 Use pipe anchors and guides for seismic restraints of vertical pipe risers. Do not use separate cable restraints or braces.
- .2 For horizontal seismic forces acting on vertical pipe risers, use the seismic force coefficient “Ks” value at the floor location of the pipe anchor or guide (as applicable), and the restrained weight is to include 50% of the pipe and fluid content weight between the anchor or guide and the next anchor or guide, in both vertical directions.
- .3 For piping subject to thermal expansion:
 - .1 provide fully engineered pipe riser support system,
 - .2 for steel pipe;
 - (a) provide an anchor at the location shown,
 - (b) construct the anchor assembly using heavy-duty pipe riser clamps or pipe brackets with full-welded connections to the pipe, and full-welded or bolted connections to the anchor. Use mechanical anchors to bolt the pipe anchor to concrete floor, and weld pipe anchors to steel framing.
 - (c) unless otherwise shown, use a heavy-duty pipe riser clamp with a load capacity not less than two times the combined dead weight of pipe and water, dynamic load and seismic loads.
 - .3 for copper tube,
 - (a) attach a copper sleeve that matches the OD of the tube and fully braze the sleeve to the tube.
 - (b) alternatively, use a slip-on flange over the tube and fully-braze the flange to the tube,
 - (c) position the sleeve or flange immediately above and bearing on a pipe riser clamp, which is bolted to the riser anchor.
 - .4 based on engineered support design, provide intermediate isolator supports.
- .4 For piping not subject to thermal expansion;
 - .1 provide pipe guides and riser clamps for piping not subject to thermal expansion in accordance with Specification section 20 05 29,
- .5 For all piping;
 - .1 for cast iron DWV pipe, plastic DWV pipe, and glass DWV pipe, provide a guide at each floor level.
 - .2 for all other piping, provide guide or riser clamp at every other floor but not to exceed 7.6 m (25 ft) spacing, unless engineering design determines other spacing dimensions,

3.9 Conduit Restraints

- .1 Conduits for mechanical wiring are to be restrained in accordance with the requirements of section 26 05 49.

3.10 Equipment Restraints - Surface Wall-Mounted Equipment and Panels

- .1 Application: for non-rotating mechanical equipment, electrical panels, control panels, motor controllers, and other electrical distribution equipment.
- .2 Attach equipment to horizontal galvanized steel channels and fasten with bolts equipped with neoprene isolation grommet washers. Channels to extend past the side of the equipment to allow anchoring to wall. Select bolts for concurrent shear dead-weight without deduction for uplift load, and tension restraint load.
- .3 Attach channels to concrete or masonry walls with not less than four (4) anchors with each anchor having a not less than a 1.5 safety factor.

3.11 Equipment Restraints - Recessed Wall-Mounted Equipment

- .1 Application: for non-rotating mechanical equipment, electrical panels, control panels, motor controllers, and other electrical distribution equipment.
- .2 Mount recessed equipment through the top, bottom and sides of the equipment housing to adjacent block wall or wall studs.

3.12 Inspection, Testing, Adjustment and Reporting

- .1 For equipment supported on vibration isolators, field measure air gaps on each restraint and if necessary adjust the restraint so that the clearance air gap does not exceed 6 mm (1/4 in.). Provide a written report identifying the results of each test and adjustment, to the Seismic Engineer and Consultant for review.
- .2 Arrange for the seismic restraint manufacturer to inspect and report on the installation at completion of the work. Make corrections of deficiencies identified by the manufacturer. This work is to be performed prior to the final field review by the Seismic Engineer.
- .3 Arrange for Seismic Engineer to conduct a final inspection prior to substantial performance of the Work. Make corrections of deficiencies identified by Seismic Engineer. This work is to be performed prior to the final field review by Consultant.
- .4 Make corrections of deficiencies identified by Consultant.
- .5 Submit the following reports prior to application for substantial performance of the Work, or where applicable, ready-for-takeover of the Work:
 - .1 Seismic Engineer periodic and final inspection reports,
 - .2 seismic restraint manufacturer inspection reports,
 - .3 Seismic Engineer declaration of general review.

END OF SECTION

IDENTIFICATION FOR MECHANICAL SERVICES

20 05 53

1 GENERAL

1.1 Scope

- .1 Provide identification nameplates, labeling for piping, ductwork, equipment, and valves, and specialty signage.

1.2 Applicable Codes and Standards

- .1 Installation codes and standards:
 - .1 ANSI Z535.1 Standards for Safety Signs and Labels
 - .2 ASME A13.1 Scheme for the Identification of Piping Systems
 - .3 CSA Z7396.1 Medical Gas Pipeline Systems – Part 1: Pipelines for Medical Gases, Medical Vacuum, Medical Support Gases, and Anaesthetic Gas Scavenging Systems

1.3 Submittals

- .1 Shop drawings:
 - .1 Submit product data sheets for materials specified herein.

2 PRODUCTS

2.1 General

- .1 Manufactured identification systems:
 - .1 resistant to general chemical, and ultraviolet stabilized for outdoor use,
 - .2 minimum operating temperature: -25°C (-12°F),
 - .3 maximum operating temperature: 121°C (250°F).
 - .4 language: English

Standard of Acceptance

- Brady - identification tapes, bands, and markers.
- Seton - Setmark Pipe Markers.
- Smillie McAdams Summerlin.
- Craftmark Identification Systems.
- Primark

2.2 Engraved Equipment Identification Nameplates

- .1 Laminated nameplates:
 - .1 laminated two-layer coloured plastic plates, with engraved lettering,
 - .2 minimum size: 90 mm x 40 mm x 2.5 mm (3 in x 1½ in x ¼ in),
 - .3 letter height:
 - (a) ID and name: 20 mm (¾ in.) minimum
 - (b) power source: 10 mm (⅜ in) minimum,
 - .4 provided with Class 125 barcode and tag file,

.5 nameplate colours:

(a) nameplate and letter colours are dependent on type of electrical power supply to equipment.

Power Source	Background Colour	Letter Colour
Normal or None	White	Black
Life-Safety/ Emergency	Red	White
Stand-by (non-life safety)	Orange	White
UPS	Blue	White

2.3 Piping Identification - Medical Gas Systems

.1 Self-adhesive plastic marking tape:

.1 text with integral flow direction arrow markers,

(a) reversing text may be used,

.2 text and field colour: to CSA Z7396.1,

.3 tape width: sized to suit pipe O.D. and to overlap itself a minimum 19 mm (3/4 in),

.4 text height and marker length:

Pipe/Tube NPS	Marker Length mm (in)	Text Height mm (in)
≤ 1-1/4	200 (8)	13 (0.5)
1.5 to 2	200 (8)	19 (0.75)
2.5 to 6	300 (12)	32 (1.25)

.2 Coil-wrap pipe markers are not permitted.

2.4 Piping Identification – Piping Systems other than Medical Gas Systems

.1 General:

.1 conform to ASME A13.1 and as shown in Schedule A at the end of this Section for marking colours and global harmonization system (GHS) hazard identification symbols.

.2 text height:

Pipe/Tube NPS	Marker Length mm (in)	Text Height mm (in)
≤ 1-1/4	200 (8)	13 (0.5)
1.5 to 2	200 (8)	19 (0.75)
2.5 to 6	300 (12)	32 (1.25)
8 to 10	600 (24)	65 (2.5)
>10	800 (32)	90 (3.5)

.2 Flexible coil-wrap manufactured markers:

- .1 PVC plastic coated markers with integral printing, or plastic cover with field applied self-adhesive markers,
- .2 reversing text with integral arrow markers,
- .3 application method:
 - (a) NPS ½ to NPS 6: full wrap of pipe
 - (b) NPS 8 and over: partial pipe wrap with perforations for securing with nylon tie-wraps, tie-wraps included.
- .3 Self-adhesive polyester pipe name marking tape:
 - .1 reversing text with integral flow direction arrow markers,
 - .2 tape height: 65 mm (2.5 in) minimum.
- .4 Self-adhesive vinyl flow direction marking bands:
 - .1 colour band tape with flow direction arrows,
 - .2 colours: as specified for pipe name markers.
 - .3 tape width: 50 mm (2 in)
 - .4 tape length: wrapped around pipe or covering with ends overlapping one pipe diameter but not less than 25mm (1 in).
 - .5 flow arrow: 20 mm (¾ in) minimum high

2.5 Ductwork Identification

- .1 Punched stencils in PVC or card material, suitable for application of field painting.
- .2 Letter height: 50 mm (2 in).
- .3 Letter paint colour: black.

2.6 Valve and Steam Trap Identification

- .1 Engraved plastic laminate tags:
 - .1 text for valves:
 - (a) piping system fluid service, area location description, following by a series number
 - (b) where a valve is shown on drawings to be normally closed, include "Normally Closed"
 - .2 tag background colour and test colour: same as for pipe markers in accordance with Schedule A at the end of this section.
 - .3 brass or stainless steel chain.

2.7 Medical Pipeline Valve Lockout Tags

- .1 Printed vinyl lock-out valve tags with brass grommets:
 - .1 text:
 - (a) 1st line: "Medical Gas Valve"
 - (b) 2nd line: "Normally Closed" or "Normally Open)" as applicable.

2.8 Miscellaneous Identification

- .1 Self-adhesive polyester marking labels with global harmonized system (GHS) hazard pictograms.
 - .1 red border on white field,
 - .2 symbol height: 100 mm (4 in) minimum.

2.9 Signage

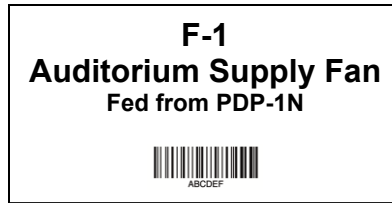
- .1 Rigid plastic signs, UV stabilized and suitable for indoor and outdoor installation, for surface mounting.
- .2 Graphic symbols:
 - .1 graphic image in accordance with WHIMS and ISO 7010,
 - .2 sign dimensions:
 - (a) indoors: 300 x 300 mm (12 in. x 12 in.)
 - (b) outdoors: 450 x 450 mm (18 in. x 18 in.)
- .3 Colours:
 - .1 Field and text colours in accordance with ANSI Z535.1

Information Type	Background Colour	Letter Colour	Primary Notification Text
General information	Blue	White	NOTICE
General Safety, Exiting	Green	White	---
Caution	Yellow	Black	CAUTION
Warning	Orange	Black	WARNING
Danger	Red	White	DANGER
Biological	Fluorescent Orange	Black	BIOHAZARD

3 EXECUTION

3.1 Equipment Identification

- .1 Where required:
 - .1 provided for equipment identified with number designations shown in equipment schedules, drawings, specifications, and/or equipment selection sheets.
 - .2 marked with equipment ID, service name, and power source using wording and numbering used in contract documents.
 - .3 for clarity, equipment identification nameplates are in addition to manufacturers plates.
- .2 Locate nameplates to be easily read, and fasten securely with mechanical fasteners. For pressure vessels, secure nameplates to equipment with high-tensile epoxy adhesive.
- .3 Do not paint over equipment manufacturer or field installed nameplates.
- .4 Provide metal standoffs on insulated equipment.
- .5 Examples:
 - .1 at equipment (fan, pump, etc.), illustrated for Normal Power:



- .2 at motor starter, adjustable frequency drive, and separate local disconnect, illustrated for Emergency Power:



3.2 Piping Identification - General

- .1 Except where otherwise specified herein, provide manufactured pipe markers of the following types based on area of the building:
 - .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 any type of jacket.
 - .3 Install self-adhesive markers on cleaned and prepared surfaces free of dirt and oil.
- .2 Install pipe markers in the following locations:
 - .1 maximum every 15 m (50 ft) along length of pipe, except for 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 Marker colours and hazard identification:
 - .1 Provide pipe markers with the colour coding and hazard identification symbols in accordance with Schedule A at the end of this section.

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.

.2 Marker colours and hazard identification:

- .1 Provide pipe markers with the colour coding and hazard identification symbols in accordance with Schedule A at the end of this section.

3.4 Valve Lockout Tags – Medical Gas Systems

- .1 Provide valve lockout tags at each valve which is not located in a zone control panel. Tags to be provided as Normally Open or Normally Closed as shown on drawings.

3.5 Ductwork identification

.1 Paint stenciled letters showing;

- .1 duct service,
.2 fan number, and
.3 arrows showing direction of flow,

.2 Paint stencil markings at the following locations:

- .1 exposed ducts at 15 m (50 ft) intervals in service rooms,
.2 exposed ducts at wall and floor penetrations in other than service rooms,
.3 concealed ducts above drywall-ceilings next to access doors, and
.4 concealed ducts above removable tile ceilings at wall and floor penetrations, and at 15 m (50 ft) intervals.

.3 Stencil indication on prepared surfaces, and locate on both sides of any penetration.

.4 Hazard warning labels:

- .1 provide hazard marking symbols on ductwork and associated equipment in accordance with Schedule B at the end of this Section.
.2 install labels adjacent to ductwork identification system, and on designated equipment adjacent to equipment identification nameplate and on each access opening into the equipment.

3.6 Valve Identification

.1 Provide valves with a numbered tag showing valve type and size, attached to valve stem or wheel handle with chain.

.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) plumbing fixture service stops,
(d) within 4 m (12 ft) and in sight of equipment, fixtures, or apparatus that the valve controls provided there is no branch piping between the valve and equipment served,
(e) existing valves that are not provided under this project.

.2 Identification information – manual valves:

- .1 each valve tag to indicate fluid service, sequential valve number (unique for each service) including supply or return, location identifier, and normal operating position
.2 examples (colour coding shown for illustration):

Domestic Cold Water
Riser C/1
No. 12

Natural Gas
Boiler Plant
No. 2
Normally Closed

- .3 Identification information – automatic control valves:
- .1 provide valve tags for all automatic control valves except as follows:
 - (a) within sight of equipment that the valve controls.
 - .2 each valve tag to indicate fluid service, control function, control valve identification number,
 - .3 examples (colour coding shown for illustration):





Chilled Water
Constant Pressure
Differential Valve
CV-3





- .4 Provide a tag schedule for each system, designating valve numbers, fluid service, function, valve size, and location of each tagged item and normal operating position of each valve. Submit copies in original file format (Excel, Word) on two (2) removable mass storage devices.

3.7 Schedules









- .1 The following Schedules form part of this specification section.
- .1 Schedule A: Piping Marker Colours and Hazard Labels
 - .2 Schedule B: Ductwork and Equipment Hazard Labels

Schedule A – Piping Marker Colours and Hazard Labels

Fluid Service Category	Piping Services	Background Colour	Lettering Colour	GHS Hazard Symbol
Water	Potable (city) water, Non-potable water, Treated City Water, Sanitary, Storm Drainage, Chilled water, Condenser water, Cooling water, Heating water, Glycol heating or cooling water, Brine water, Boiler feedwater, Steam condensate	Green	White	None
Vapour from Water	Steam, Steam Vents	White	Black	None
Fire Protection Fluids	Sprinklers, Standpipe, Foam, Gaseous	Red	White	None
Combustible Liquids	Heating oil, Diesel, Lubrication oil, Hydraulic oil	Brown	White	None
Flammable Fluids	Natural Gas, Propane	Yellow	Black	None
	Gasoline	Yellow	Black	  
Compressed Air	Compressed Air, Instrument Air, Laboratory Air	Blue	White	None
Compressed Gases	Nitrogen, Helium, Carbon Dioxide	Grey	White	
Other Gases	Vacuum, Laboratory Vacuum, Plumbing Vents	Grey	White	None

Fluid Service Category	Piping Services	Background Colour	Lettering Colour	GHS Hazard Symbol
Oxidizing Fluids	Chlorine	Yellow	Black	
Toxic and Corrosive Fluids	HVAC chemical treatment, Acid Drain, Acid Vent Decontamination Drain and Tank	Orange	Black	 
Radioactive Fluids	Isotope Drain, Isotope Vent	Orange	Black	 (ISO 7010)

Schedule B – Ductwork and Equipment Hazard Labels

Duct System	Equipment	GHS Hazard Labels
Chemical Fume Hood Exhaust	Exhaust Fans	 
Level 1 or 2 Biological Laboratory Exhaust	Exhaust Fans	
Level 3 or 4 Biological Containment Laboratory	Exhaust HEPA Filter Housing	
Hazardous Pharmaceutical Sterile Room Exhaust	Exhaust HEPA Filter Housing	
Isolation (medical) Room Exhaust	Exhaust Fans	
Flammable Storage Exhaust	Exhaust Fans	
Perchloric Acid Exhaust	Exhaust Fans	

END OF SECTION

CLOSEOUT REQUIREMENTS FOR MECHANICAL WORK

20 77 19.20

1 GENERAL

1.1 Scope

- .1 Provide documentation deliverables at completion of the Work for the following milestone events:
 - .1 Occupancy permit (where applicable) (Form OP1M),
 - .2 Substantial Performance of the Work (Form SP1M),
 - .3 Ready for take-over by Owner (Form RFT1M),
 - .4 Total Performance of the Work (Form TP1M).

1.2 Definitions

- .1 The following definitions apply to this section.
 - .1 **Occupancy permit** – means either: (i) a permit issued by a regulatory authority to allow the Owner to occupy the building subject to the building permit, or (ii) a building permit close-out procedure where documentation must be submitted to the building authority for that purpose.

1.3 General

- .1 The prerequisites and submittal of supporting documentation for the aforementioned milestone events may be combined as a single submission at one point in time for the following combination of events:
 - .1 Occupancy Permit, and Substantial Performance.
- .2 Where a prerequisite is listed in more than one milestone event, it shall be included in the earliest-occurring milestone event unless expressly specified otherwise.

1.4 Occupancy Permit

- .1 Submit the reviewed final record of the Testing of Integrated Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit, where such a report is required.
- .2 Complete the Occupancy Permit Checklist and submit with required documentation to support the Owner's application for occupancy.

1.5 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 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.

1.6 Ready-for-Takeover by Owner

- .1 The basic prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions and Supplementary General Conditions of the Contract.
- .2 Complete the Ready-for-Takeover Checklist and submit with required documentation when applying for Ready-For Takeover of the Work.

1.7 Total Performance

- .1 Complete the Total Performance Checklist and submit with required documentation when applying for Total Performance of the Work.

Form OP1M: OCCUPANCY PERMIT CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Building department inspection reports.
- ☐ AHJ pressure piping inspection reports (if applicable).
- ☐ AHJ fuel system inspection reports (if applicable).
- ☐ AHJ electrical systems inspection reports.
- ☐ Sprinkler installation certification report to NFPA 13.
- ☐ Standpipe installation certification report to NFPA 14.
- ☐ Fire pump installation and test certificate to NFPA 20.
- ☐ Integrated Fire Protection and Life Safety test report to ULC-S1001.
- ☐ Medical gas inspection report and certificate.
- ☐ Air and Water Balancing reports (Interim) for ventilation and heating.

Consultant Review	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

Form SP1M: SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Occupancy permit has been issued by the AHJ (where applicable).
- ☐ Systems have been started-up, tested, and demonstrated to Owner or Consultant.
- ☐ First submission TAB reports have been submitted to Consultant.
- ☐ Acoustic survey report submitted to Consultant (if specified).
- ☐ Vibration survey report submitted to Consultant (if specified).
- ☐ Controls / BMS operation report submitted to Consultant (if specified).
- ☐ Equipment, pipeline, and valve identification completed
- ☐ Spare parts and replacement parts turned over to Owner, transmittal attached.

Consultant Review	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

Form RFT1M: READY-FOR-TAKEOVER APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Substantial Performance has been certified or verified.
- ☐ Occupancy permit has been issued by the AHJ (where applicable).
- ☐ Final cleaning and waste removal completed.
- ☐ Delivery to Owner of Operating and Maintenance documents for systems being taken-over by Owner.
- ☐ Submit copies of up-to-date as-built drawings.
- ☐ Final start-up, testing and balancing reports completed and submitted to Owner, including any items requiring corrections identified by Consultant.
- ☐ The portions of the building being turned over to the Owner can be secured by Owner.
- ☐ Demonstration and training are completed, or Contractor and Owner has agreed to a schedule to provide such training to be completed within one month after the date of Ready-for-Takeover.
- ☐ All commissioning activities except for those activities that are identified or otherwise agreed by the Owner to be deferred commission activities which may be completed after Ready-for-Takeover of the Work.
- ☐ Integrated systems testing of fire protection and life safety systems.
- ☐ All warranties have been submitted to the Owner.
- ☐ A comprehensive list of items to be completed or corrected is provided to Owner and Consultant and included in the application for Ready-for-Takeover, and includes a schedule of when such work will be completed.

Consultant Review	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

Form TP1M: 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 final Operating and Maintenance documents have been delivered to Owner.
- ☐ All final up-to-date as-built drawings have been delivered to Owner.
- ☐ Any follow-up testing and balancing reports, including alternate season testing reports, have been submitted to Owner.
- ☐ All demonstration and training are completed.
- ☐ All commissioning activities are completed, including deferred alternate season commissioning activities.
- ☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- ☐ All inspections and tests required to be performed by Contractor or manufacturer's prior to expiry of the warranty period have been completed, and documentation for those inspections and tests are included in this application.

Consultant Review	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

End of Section

COMMON WORK RESULTS FOR FIRE SUPPRESSION

21 05 01

1.1 GENERAL

1.2 Scope

- .1 Fire suppression work includes;
 - .1 Commissioning of fire suppression systems,
 - .2 Fire Extinguishers,
 - .3 Wet Pipe Sprinkler System,
 - .4 Pre-action Sprinkler System.
- .2 Piping materials specified herein are limited to design pressures not exceeding 2000 kPa (300 psi).

1.3 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 20 05 29 Common Hanger and Support Requirements for Piping

1.4 Applicable Codes and Standards

- .1 Installation codes and standards:
 - .1 Fire suppression work to conform to standards of the National Fire Prevention Association (NFPA) and relevant sections of the provincial Building Code applicable to the location of the Work.
 - .2 CSA B64.10 Selection and Installation of Backflow Preventers / Maintenance and Field Testing of Backflow Preventers
- .2 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 B16.4 Cast Iron Threaded Fittings, Class 125 and 250
 - .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 B16.15 Cast Bronze Threaded Fittings, Classes 125 and 250
 - .9 ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
 - .10 ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges.
 - .11 ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - .12 ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings; Class 150, 300, 400, 600, 900, 1500, & 2500.
 - .13 ASME B16.39 Malleable Iron Threaded Pipe Unions: Classes 150, 250 and 300.
 - .14 ASME B18.2.1 Square and Hex Bolts and Screws,

.15 ASME B18.2.2	Square and Hex Nuts
.16 ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
.17 ASTM A135	Standard Specification for Electric-Resistance-Welded Steel Pipe
.18 ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts and Bolts for High-Pressure or High-Temperature Service, or Both.
.19 ASTM A795	Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire suppression Use
.20 CSA B64.4	Backflow Preventers, Reduced Pressure Principle Type (RP)
.21 ULC-B65.5	Backflow Preventers, Double Check Valve Type (DCVA)
.22 CSA B242	Groove and Shoulder Type Mechanical Pipe Couplings
.23 UL 203	Pipe Hanger Equipment for Fire suppression Service
.24 UL 393	Indicting Pressure Gauges for Fire Protection Service
.25 UL 1468	Standard for Direct Acting Pressure Reducing and Pressure Restricting Valves
.26 UL 1739	Standard for Pilot-Operated Pressure-Control Valves for Fire-Protection Service
.27 ULC/ORD-C203	Pipe Hanger Equipment for Fire suppression Service
.28 ULC/ORD-C213	Rubber Gasketed Fittings for Fire suppression Service
.29 ULC/ORD-C213B	Welded Outlet Fittings
.30 ULC-S548	Alarm Initiating and Supervisory Devices for Water Type Extinguishing Systems

1.5 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.

1.6 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.

1.7 Design Criteria

- .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 System design criteria are described in the relevant Division 21 system specifications.
- .3 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 allowable design pressures applicable to any Class rating.

2 PRODUCTS

2.1 Carbon Steel Pipe

- .1 Piping materials:
 - .1 to ASTM A53 Grade B, seamless or electric-resistant-welded (ERW),
 - .2 to ASTM A135 Grade B, ERW,
 - .3 to ASTM A795. Grade B, ERW.
- .2 Pipe wall thickness: as specified in each applicable fire suppression specification section.
- .3 Piping to be hot-dipped galvanized where required in each system specification section in Division 21.

2.2 Steel Pipe Joints and Fittings

- .1 Threaded fittings:
 - .1 end connections: NPT thread to ANSI B1.20.1.
 - .2 fittings:
 - (a) Class 125 cast iron to ASME B16.4,
 - (b) 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 special welding outlet fittings for fire protection:
 - (a) weld-on branch outlet fittings for groove-end and threaded-end connections for fire protection services,
 - (b) listed to ULC/ORD-C213B for fire protection service,
 - (c) forged from materials meeting ASTM A53 Gr. B.,
 - (d) pressure rating: 2067 kPa (300 psi) for fire protection water,
 - .4 socket welded fittings:
 - (a) forged to ASTM A105,
 - (b) dimensions and pressure ratings to ASME B16.11, Class 3000.

- .5 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:
 - (a) styrene butadiene rubber sheet to ANSI B16.21.
 - (b) 1.6 mm (1/16 in) thick.
 - Standard of Acceptance*
 - Chesterton - fig. 100
 - Beldam
- .4 Grooved fittings and couplings:
 - .1 couplings listed to CSA B242,
 - .2 listed for combination of fittings, couplings and gaskets to ULC/ORD-C213,
 - .3 rolled or cut grooved (depending on pipe wall thickness), standard or rigid style,
 - .4 fittings and couplings NPS 2 to 12: malleable iron to ASTM A47 or ductile iron to ASTM A536,
 - .5 gaskets: dry lubricated EPDM,
 - .6 design temperature rating: -34°C (-30°F) to 110°C (230°F),
 - (a) design pressure rating: 2400 kPa (350 psig),
 - Standard of Acceptance*
 - Victaulic
 - Gruvlok

2.3 Multi-axis Flexible Pipe Loops

- .1 Application:
 - .1 for steel piping and copper tube systems,
 - .2 two or three element flexible piping loops with flexible metallic hose and rigid elbow fittings, for thermal expansion and/or for use at crossing building seismic or movement control joints, and designed to restraint pressure thrusts across the pipe loop,
 - .3 listed to ULC/ORD-C213,
 - .4 size:
 - (a) copper tube: NPS ½ to NPS 3
 - (b) steel pipe: NPS ¾ to NPS 4.
- .2 Multi-axis displacement movement: as shown on drawings.
- .3 Construction:

- .1 metallic hose elements for copper tubing:
 - (a) inner hose: corrugated bronze hose,
 - (b) outer jacket: braided bronze wire mesh, to restrain hose from elongation and to limit hose movement,
- .2 metallic hose elements for steel piping:
 - (a) inner hose: corrugated T316 or T321 stainless steel,
 - (b) outer jacket: braided T300 series stainless steel wire mesh, to restrain hose from elongation and to limit hose movement,
- .3 rigid fittings; schedule 40 carbon steel pipe, or bronze fittings as applicable,
- .4 pipe end connections:
 - (a) copper tube: female sweat or grooved,
 - (b) steel pipe: flanged, weld-end, or grooved.
- .5 working pressure: 1030 kPa (150 psig) at up to 121°C (250°F),
- .6 field pressure test: capable of being hydrostatically pressure tested at not less than 150% of unit MAWP, at a test temperature of 21°C (70°F),
- .7 factory tested to 1 ½ times maximum working pressure,
- .8 CRN to CSA B51.

Standard of Acceptance

- Hyspan - fig. 4500 V-Flex
- Metraflex - fig. Metraloop
- Flex-Hose Co. - fig. Tri-Flex Loop

2.4 Pipe Supports

- .1 Pipe supports and hangers to conform to specification section 20 05 29 except/and as specified herein.
- .2 Pipe hangers and supports to be listed ULC/ORD-C203 or UL 203 for fire suppression service, except where such listing requirement is excluded under applicable NFPA standards.

3 EXECUTION

3.1 Piping 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, except where specific installation details are shown.
- .4 Support piping in accordance with the requirements of the NFPA standard applicable to the system type, subject to and in accordance with the requirements of specification section 20 05 29.
- .5 Ream pipe after cutting to length and clean off scale and dirt inside and outside of pipe before threading, grooving or welding.
- .6 Provide bends, expansion loops, hoses or joints to compensate for pipe seismic movement.
- .7 Anchor, guide and laterally support vertical and horizontal piping to support filled weight and absorb thrust under operating conditions.

- .8 Erect piping so that gravity forces and thrust from changes in direction do not stress connections to apparatus.
- .9 Provide di-electric couplings or flanges where steel pipe connects to copper tube.
- .10 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.
- .11 Do not use galvanized materials in contact with glycols.
- .12 Personnel involved in installation of grooved joint piping and fittings to be trained by product manufacturer and 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 in accordance with CSA
 - .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 Pipe Joints

- .1 Refer to applicable fire suppression system specification sections for permissible type of pipe joints to be used and any restrictions therein.
- .2 Use flat-faced steel flanges when attaching to cast iron flanges.

3.3 Welding Procedures

- .1 Welding of fire suppression piping to be in accordance with specification section 20 05 24 except as otherwise required by the NFPA standard applicable to the type of fire suppression system.
- .2 Welding acceptance criteria to be in accordance with the NFPA standard applicable to the type of fire suppression system.

3.4 Pressure and Leak Testing

- .1 In accordance with the applicable specification sections of Division 21.

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 or territory of the 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 21 05 01 Common Work Results for Fire Suppression

1.3 Definitions

- .1 The following definitions apply to this section.
 - .1 **Pressure reducing valve** – a valve that reduces the inlet water pressure to a regulated constant outlet pressure under static (no flow) and dynamic (water flowing) conditions (“pressure reducing” and “pressure controlling” valves have the same meaning).

1.4 Applicable Codes and Standards

- .1 Legislation:
 - .1 Ontario Building Code
- .2 Installation codes and standards:
 - .1 ASTM C636 Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustic Tile and Lay-In Panels
 - .2 NFPA 13 Standard for the Installation of Sprinkler Systems
- .3 Insurance company standards:
 - .1 FM Global Engineering Data Sheets
- .4 Product standards:
 - .1 ASTM C635 Standard Specification for Manufacture, Performance and Testing of Metal Suspension systems for Acoustic Tile and Lay-in Panel Ceilings
 - .2 UL 199 Standard for Automatic Sprinklers for Fire Protection Services
 - .3 UL 1478A Standard for Pressure Relief Valves for Sprinkler Systems
 - .4 UL 2443 Flexible Sprinkler Hose with Fittings for Fire Protection Service
 - .5 ULC/ORD-C312 Check Valves for Fire Protection Service

1.5 Qualified Subcontractors

- .1 Sprinkler work to be undertaken by specialist fire protection installation firm with an established reputation in this field, and licences or otherwise qualified to perform such work where required by regulation.

1.6 Design Criteria

- .1 Piping design temperature: 38°C (100°F)
- .2 Piping design pressure: 1200 kPa (175 psig)
- .3 Sprinkler system type: stand-alone
- .4 Consultant's indicative system layout is designed to NFPA 13 and FM requirements using hydraulic method for hazard classification shown with design densities and design areas for each zone as detailed.
 - .1 Hydraulic calculations are based on water supply test results, down-rated in accordance with requirements of the AHJ.
- .5 Changes to pipe sizes, pipe layout and head layouts accompanied with modified hydraulic calculations and sealed by a professional engineer licensed in the jurisdiction of the Work may be submitted for approval at the time of shop drawing submission, but prior to installation, purchasing or fabrication of associated materials and equipment.

1.7 Design Services

- .1 Provide engineering design services for the automatic sprinkler systems, including piping system detailed fabrication and installation drawings, supported by contractor's own hydraulic calculations and water supply test flow data.
- .2 Design of wet-pipe sprinkler systems is to conform with the requirements of NFPA 13 of the edition adopted by the AHJ, except/and as otherwise specified herein.
- .3 Coordinate sprinkler system layout with the work of other Trades. Prepare fabrication/installation drawings taking into account this coordination.
- .4 Conduct a site water flow test and prepare hydraulic calculations based on those test results.

1.8 Submittals

- .1 Submit manufacturer data sheets for products specified herein.
- .2 Prepare and submit shop drawings for sprinkler system fabrication and installation drawings including hydraulic calculations;
 - .1 forward three copies 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 to Consultant for review.

1.9 Maintenance Materials

- .1 Provide special sprinkler wrench for sprinklers installed.

2 PRODUCTS

2.1 Pipe, Fittings and Valves

- .1 Pipe and fittings: in conformance with specification section 21 05 01 except/and as specified herein.
- .2 Valves: in conformance with specification section 21 05 23.
- .3 Pipe minimum wall thickness: in accordance with Table 1 except as follows:
 - .1 use schedule 40 of either ASTM A53 or A135 in the following locations:
 - (a) exposed vertical piping in parking garages, truck docks and other areas subject to vehicular traffic, between floor level and to a height of 3.0 m (10 ft) above floor level,

- (b) exposed vertical piping in factories and manufacturing plants, between floor level and to a height of 5.0 m (15 ft) above floor level or the bottom of the roof structural steel, whichever is lower,
- (c) do not use ASTM 795 in the above listed locations.

Table 1: Pipe Selection and Minimum Pipe Wall Thickness			
Pipe Size	Joining Method	ASTM A53, ASTM A135	ASTM A795
≤ 2-1/2	Threaded, Cut Groove	Schedule 40	Standard Weight
2-1/2 to 6	Welded, Roll Groove	Schedule 40	Standard-Weight
	Cut Groove	Schedule 40	Standard- Weight
8 to 10	Welded Roll Groove	Schedule 40	Standard-Weight
	Cut Groove	Schedule 40	Standard-Weight
≥ 12	Welded, Roll Groove	9.5 mm (0.375 in)	Not applicable

.4 Mechanical Tees for grooved pipe fittings:

- .1 restricted use; refer to Part 3,
- .2 gasket-sealed mechanical Tee's, for installation of branch piping to mains pipe,
- .3 ductile iron body to ASTM A-395, with EPDM gasket,
- .4 gull-wrap coupling around pipe mains; half-coupling with U-bolt arrangement not permitted.

Standard of Acceptance

- Victaulic - fig. 920/920N
- Gruvlock

2.2 Pipe Supports, Hangers and gaskets

- .1 To section 21 05 01.

2.3 Sprinkler Heads

- .1 Ratings:
- .1 listed to UL 199 for Canada and FM approved 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.

Standard of Acceptance

- Viking
- Tyco
- Reliable
- Victaulic

.2 General purpose sprinkler head types in accordance with Table 1.

Table 1: Sprinkler Head Types						
Type	Orientation	Feature	Body Finish	Escutcheon Finish	Release	Remarks
D-2	Pendent	Dry type, Concealed	Bronze	White	Glass Bulb	Fusible cover plate

.3 Dry sprinkler heads:

- .1 pendant and sidewall style dry-heads, with white escutcheon,
- .2 extension barrel with remote seat and plug at the pipeline connection.
- .3 minimum ambient operating temperature: -30°C (-22°F),
- .4 coverage: standard,
- .5 response: standard,
- .6 temperature rating: 68°C (155°F),

Standard of Acceptance

- Tyco - fig. DS-1
- Viking
- Reliable

2.4 Signage

.1 Construction:

- .1 1.2 mm (18 ga.) thick aluminium, with Mylar protective facing, red enamel background, white letters, inscription in accordance with NFPA standards,

.2 Size:

- .1 230 x 180 mm (9 x 7 in) for automatic control valves and alarm valves,
- .2 50 x 150 mm (2 x 6 in) for other valves,
- .3 130 x 180 mm (5 x 7 in) for hydraulic calculation signs,

2.5 Maintenance Materials

.1 Included maintenance materials:

- .1 special sprinkler wrench.

3 EXECUTION

3.1 Piping Installation General Requirements

- .1 Install sprinkler piping and supports in accordance with specification section 21 05 01 except/and as specified herein.
- .2 Extend piping from existing mains and branches and connect to sprinklers.
- .3 Provide NPS $\frac{3}{4}$ drain valves with hose end and caps in the following locations:
 - .1 at the bottom of sprinkler risers,
 - .2 at trapped low points in piping system.
- .4 Provide NPS $\frac{3}{4}$ manual air vent valve with cap and chain at the top of each sprinkler riser and where shown;
 - .1 run NPS $\frac{3}{4}$ air vent piping from top of riser and down to a location where the manual vent valve is accessible,
 - .2 manual vent valve to be located at a height of not more than 2.1 m (7 ft) above local floor level, and positioned so outlet is pointed down.
- .5 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.

3.2 Pipe Joints (other than Mechanical Tees for Branch Piping)

- .1 Make pipe joints using jointing methods in accordance with Specification section 21 05 01

3.3 Mechanical Tees for Branch Piping

- .1 The use of mechanical Tees for grooved joint installation is restricted by the following conditions:
 - .1 may be used in existing buildings for connection of single- sided branch piping connections to existing installations,
 - .2 may be used in new buildings, for single-sided branch piping connections in areas without ceilings, and
 - .3 where specifically authorised by Consultant on a case-by-case basis.

3.4 Sprinkler Head Selection and Layout

- .1 Use concealed dry 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. Examine architectural reflected ceiling plan to coordinate sprinkler head layout and locations.

3.5 Electric Control Devices and Control Wiring

- .1 Provide electric control devices in accordance with specification section 21 05 01 except/and as specified herein.
- .2 Fire alarm system monitoring points to be zoned to associated sprinkler zone identification shown; coordinate with the fire alarm system contractor under Division 28 to ensure consistency between fire alarm annunciation and associated tagging of sprinkler system control devices.

3.6 Identification and Signage

- .1 Provide signs at each valve, including control valves, shut-off valves, drain valves, vent valves and test valve, identifying portion of system controlled. Provide hydraulic design parameters nameplate on each alarm check valve.
- .2 Fasten signs to pipe in immediate vicinity of valve.
- .3 Coordinate with Electrical Division 26 to ensure consistency between fire alarm annunciation and associated tagging.

3.7 Pressure Testing

- .1 Conduct pressure testing of sprinkler piping systems in accordance with requirements of NFPA 13 and building insurer requirements, if any, and as follows.
- .2 In existing buildings, conduct an initial pneumatic pressure test of the new and modified work before connection to the existing system, to test for significant leaks before filling the modified installation or new work with water.
 - .1 isolate the new piping from the existing system,
 - .2 pressure test the new piping at 280 kPa (40 psig) using oil-free compressed air or nitrogen,
 - .3 maintain pressure test for one hour without loss of pressure,
 - .4 if any leaks are discovered, repair leaks and retest.
- .3 Conduct hydrostatic pressure tests at the test pressures and for the test durations as follows:
 - .1 for new piping systems with a working pressure of 1030 kPa (150 psi) or less:
 - (a) a minimum of 1380 kPa (200 psi) for a test period of not less than two hours,
 - .2 for new piping systems or portion thereof with a working pressure of greater than 1030 kPa (150 psi):
 - (a) a minimum of the working pressure plus 345 kPa (50 psi) for a test period of not less than two hours,
 - .3 for modifications or additions to an existing systems involves more than 20 sprinkler heads:
 - (a) the test pressure and duration as specified for a new installation, except only the new piping is to be tested with the new piping isolated from the existing systems,
 - (b) the new piping section may be isolated by a service valve at the tie-in point to the existing system, or it may be isolated by installation of a temporary plug,
 - (c) for installation of a temporary test plug, a section of the new pipe at the connection to the existing system is removed; this spool piece is not to exceed a length of 300 mm (12 in.) nor contain more than two pipe joints.
 - (d) after pressure testing is completed and the spool piece is reinstalled, conduct an in-service pressure test of the spool piece and its joints.
 - .4 where the work only involves the modification to an existing system that impacts not more than 20 sprinkler heads, only an in-service pressure test is required,
 - .5 where modifications to an existing system only involves relocating sprinkler heads and associated pipe drops (but without any changes to any other system piping), only an in-service pressure test is required.
- .4 In-service pressure test:
 - .1 where an in-service pressure test is required, return the sprinkler system to its normal operating condition and bleed-off trapped air as much as possible,
 - .2 visually inspect the subject joints, using joint leak detection solution.

- .5 Pressure testing of multi-storey buildings:
 - .1 pressure test the sprinkler risers separate and isolated from on-floor piping, except that the feed main connecting the risers may be included in the riser pressure test,
 - .2 pressure test each on-floor sprinkler zones separately and independently of the system sprinkler risers; isolate each floor from the system riser during the test.
- .6 Pressure test acceptance criteria:
 - .1 pressure loss not exceeding 10 kPa (1.5 psi) as measured by installed pressure gauge, or where visual examination of all pipe joints determines there are no visible leaks.

3.8 Operational Testing

- .1 Conduct an operational test of all flow control and alarm devices. Test sprinkler systems in accordance with requirements of NFPA 13, and building insurer requirements (if any).
- .2 Schedule testing to give at least two weeks' notice to AHJs having jurisdiction for:
 - .1 building/plumbing Inspector,
 - .2 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 and in-service.

3.9 Integrated Testing of Life Safety and Fire Protection Systems

- .1 Participate as required in the integrated system testing of the standpipe system in accordance with specification section 20 08 11.

3.10 Testing Reports and Certificates

- .1 Provide completed and signed Contractor's Material and Test Certificate for above ground piping.
- .2 Submit copies of completed Certificates to the Consultant, and include copies in the Operating and Maintenance manuals.

END OF SECTION

PREACTION SPRINKLER SYSTEM

21 13 19

1 GENERAL

1.1 Scope

- .1 Revise piping and sprinklers downstream of an existing preaction cabinet.
- .2 Preaction sprinkler systems to conform with the requirements of specification section 21 13 13 except/and as specified herein.
- .3 Provide installation drawings and hydraulic calculations, designed and sealed by a professional engineer licensed in the province or territory of the 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 49 Seismic Restraint
 - .2 21 13 13 Wet Pipe Sprinkler Systems

1.3 Applicable Codes and Standards

- .1 Product standards:
 - .1 ULC-S527 Standard for Control Units for Fire Alarm Systems
 - .2 ULC/ORD-C260 Guide for the Investigation of Dry Pipe, Deluge, and Pre-Action Valves for Fire-Protection Service

1.4 Design Criteria

- .1 Piping design temperature: -30 to 38°C (-22 to 100°F)
- .2 Piping design pressure: 1200 kPa (175 psig)
- .3 Sprinkler system type: stand-alone

1.5 Design Services

- .1 Conform with specification section 21 13 13.

1.6 Seismic Qualification

- .1 Seismically qualify (certify) control panels for preaction sprinkler systems to remain operational after being subjected to the design seismic forces assuming a building height factor (NBCC) $A_x = 3.0$ with equipment rigidly mounted, by the shaker table method in accordance with Specification section 20 05 49.

1.7 Submittals

- .1 Conform with specification section 21 13 13.

2 PRODUCTS

2.1 Piping Materials

- .1 Conform with specification section 21 13 13 except/and as follows.

- .2 All carbon steel piping, fittings, unions, and flanges downstream of the pre-action valve, and all drain and vent piping, to be galvanized.

2.2 Sprinkler Heads

- .1 Conform with specification section 21 13 13 and refer to drawings for requirements for locations of sprinkler head types.

3 EXECUTION

3.1 General

- .1 Installation of dry valve sprinkler systems is to conform to the requirements of specification section 21 13 13 except/and as specified herein.

3.2 Pipe Joints (other than Mechanical Tees for Branch Piping)

- .1 Make pipe joints using jointing methods in accordance with Specification section 21 05 01

3.3 System Drains

- .1 Provide double-valved auxiliary drains at trapped low points in piping system,

3.4 Installation of Preaction System Detectors

- .1 Provision of fire detection system and connection to preaction system control panel will be provided under this division.

END OF SECTION

MEDICAL GAS PIPING 22 60 13.70

1 GENERAL

1.1 Scope

- .1 Provide medical gas pipeline distribution systems including:
 - .1 piping, fittings, and valves,
 - .2 local gas regulation control panels,
 - .3 line pressure regulators and safety valves,
 - .4 terminal units, including terminal units to be installed in Medical Supply Units.
 - .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,
 - .2 Medical support gases for powering devices and not respired as part of any medical treatment:
 - (a) nitrogen NF.
 - .3 Medical vacuum and AGSS.

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 20 05 29 Common Hanger and Support Requirements for Piping
 - .3 22 63 26.70 Medical Gas Control Equipment

1.3 Definitions

- .1 The following definitions apply to this section and reference sections:
 - .1 **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.
 - .2 **Corrugated Metal Tubing (“CMT”):** flexible copper metallic tubing
 - .3 **Diameter index safety system (“DISS”):** threaded connections that comply with the requirements of CGA V-5.
 - .4 **Medical gas, medical support gas, medical vacuum and AGSS:** means all services within the scope of CAN/CSA-Z7396.1.
 - .5 **Medical supply unit:** means prefabricated equipment of Class I, Type B, that supplies medical gases, medical support gases, medical vacuum and AGSS singly or in combination with other services at the point of patient care and within the scope of CSA Z305.8. Commonly used terms such as headwall, ceiling mounted service column(s), ceiling column, ceiling pendants, articulating arms, boom arms are all types of Medical Supply Unit.

- .6 **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.
- .7 **Pipeline distribution system:** the portion of a medical gas, medical support gas, medical vacuum or AGSS located: (a) from and including the main supply shut off valve to (and including all terminal units), junction pints, or demarcation points; (b) intake piping from indoors or outdoors to medical air or instrument air compressors; and (c) exhaust piping from medical vacuum supply systems and AGSS supply systems to the outdoors.
- .8 **Qualified installer:** a competent person or company responsible for the installation of medical gas pipeline systems or components within a medical gas system.
- .9 **Terminal unit:** an outlet assembly (inlet for medical vacuum and AGSS) in a medical gas pipeline system at which the operator makes connections and disconnections.
- .10 **USP:** United States Pharmacopeia.
- .11 **USP-NF:** USP National Formulary
- .12 **Zone, zone alarm, and zone valve:** have the same meaning as defined in CAN/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 Z7396.1-22 Pipelines for Medical Gases, Medical Vacuum, Medical Support Gases, and Anaesthetic Gas Scavenging Systems
 - .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 on medical gas systems to be performed by:
 - .1 a specialist firm that: has experienced in this type of work; is knowledgeable of the applicable regulations, installation codes and standards pertaining to medical gas systems; has registered procedures for silver brazing; and regularly employs tradespersons qualified in pressure piping installation,
 - .2 a qualified, licensed and recognized firm which has the requisite license to perform medical gas piping installation, issued by the AHJ for boiler and pressure vessels where such licensing is required under applicable provincial legislation,
 - .3 tradespersons holding applicable certificates of competency for pressure piping and brazing work, and
 - .4 tradespersons who are certified in accordance with the *CSA Medical Gas Piping & Systems Installation Personnel Certification Program*.
- .2 Prior to commencing work on site,
 - .1 supply copies of certification record to the Owner for each qualified tradesperson performing work on the medical gas system, and
 - .2 supply copies of tradespersons certificates of competency for brazing to the Owner for their records.
- .3 Installers of CMT shall complete and pass the manufacturer's training course and supply copies of the certificate to the Owner for their records.

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 where required by legislation in the place of the Work.

1.7 Design Criteria – Medical Gas and Vacuum Piping

- .1 Piping design and installation code:
 - .1 to ASME B31.1
- .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)
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 piping/CMT,
 - .2 valves,
 - .3 terminal units,
 - .4 line pressure regulators, safety valves and assemblies.

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(s) shall be responsible for commissioning 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 Valves, piping, CMT and terminal units shall be cleaned in accordance with CGA G-4.1 or CAN/CSA Z15001, capped and sealed in a plastic bag, labelled to state that the product has been so cleaned and

- visually inspected, 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 ASME 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 copper material.
- .2 flange provided with a powder coated finish, and an EPDM insulator to isolate the copper tailpiece from 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 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.
 - .2 required MCPR: 4100 kPa (600 psig) at 38°C (100°F).
 - .3 lever handle with locking device.
 - .4 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.
 - .5 cleaned for oxygen service and with tube ends capped.

Standard of Acceptance

- Amico - fig. VV-ISO-G2L series
- Class I - fig. 7300 series
- Beacon Medaes - 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 Local Gas Regulation 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 inlet shut-off valve,
 - .2 inlet shut-off valve: integral 2000 kPa (300 psi) quarter-turn valve,
 - .3 supply pressure regulator: self-actuated, adjustable from 0 to 1700 kPa (0 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 Maximum 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

2.8 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
- Beacon Medaes

2.9 Pipeline Distribution System 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 or cartridge type with serviceable primary check valve.
 - (a) match existing.
 - (b) 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 ganging 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 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 ceilings,
 - (d) recess mount for medical supply units,
 - (e) non-ferrous material compatible for installation in MRI Rooms.
 - (f) recess mount in tamper-proof enclosure for psychiatric mental health rooms
- .1 Listed to CAN/CSA-Z9170-1.
- .2 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

2.10 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 permanent 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, CMT, 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 Keep cutting and reaming tools scrupulously clean and free from oil or grease.
- .3 Do not use organic solvents such as carbon tetrachloride under any circumstances.

3.2 Piping Fabrication

- .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 overlaid with plastic and held in place with tape.

3.3 Pipe Supports

- .1 Support piping in accordance with specification section 20 05 29 except as specified herein.

- .2 For multi-service support, provide tubing clips on trapeze channels to secure piping to channel. Install U-plates or similar on each side of pipe clamp to prevent horizontal movement of each pipe,
- .3 For individual horizontal support, provide adjustable PVC coated clevis hangers, rods and anchors as specified,
- .4 Support horizontal piping at intervals in accordance with the following Table 1:

Table 1: Horizontal Tube Support for Medical Gas Piping		
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)

- .5 Support vertical tubing risers:
 - .1 at the base (bottom) of the riser by a support that is independent of any adjacent horizontal pipe supports,
 - .2 at every other floor level with pipe riser clamps, but not to exceed a vertical spacing of more than 10 m (33 ft).
- .6 Do not support medical gas piping from other building services. Do not support other building services from medical gas piping.

3.4 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 use AWS brazing flux No. 3A,
 - .2 brush flux over end of fitting and keep inside of pipe and fittings free from flux,
 - .3 after brazing dissimilar metals, wash exterior surfaces with hot water to remove residual flux,
 - .4 wire brush joints after brazing.
- .3 During brazing, continuously purge the inside of the pipe to maintain a nitrogen atmosphere. Prior to brazing, purge air from the tube with nitrogen so that the oxygen content inside the pipe does not exceed 1% by volume (10,000 ppm) before brazing commences.
- .4 Where connections of new piping are made to an existing system, for the final connection to the existing system;

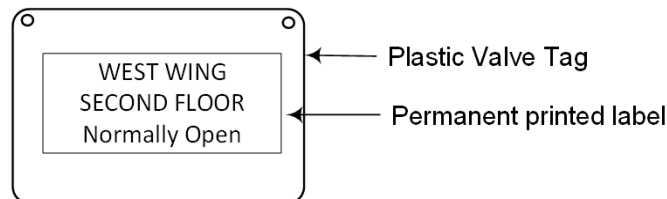
- .1 in the new piping portion, relieve the nitrogen purge gas pressure down to atmospheric pressure before making tie-in connection to the existing piping systems,
- .2 during brazing of the tie-in joint, do not introduce nitrogen purge gas to the pipeline system.

3.5 Valves

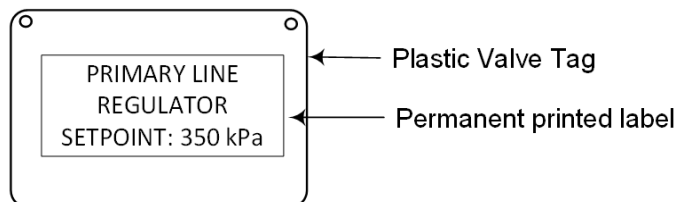
- .1 Provide valves as shown.
- .2 Provide zone valves and/or combination zone valves/zone alarm panels in accordance with specification section 22 63 26. Install zone valves or combination zone valve/zone alarm panels so that the height of the center-most valve is approximately 1500 mm (5 ft.) above floor level.
- .3 For pipeline distribution system valves other than those located in zone valve boxes, provide common-keyed padlocks on each valve. 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.

3.6 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.



3.7 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.

3.8 Terminal Units for Installation in Medical Supply Units

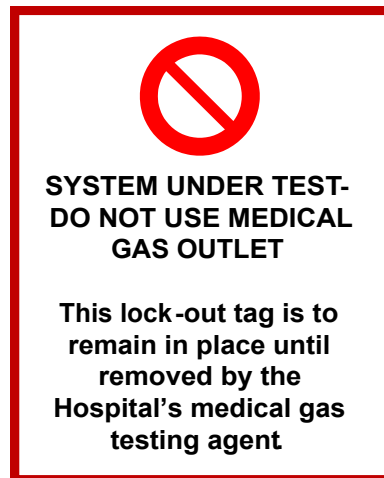
- .1 Medical supply units are provided under Division 11 and/or Division 26 and include:
 - .1 internal medical gas, pipeline distribution system piping using copper tubing or flexible hose as applicable to the equipment,
 - .2 installation of terminal units.
- .2 Supply pipeline distribution system terminal units to the vendor supplying the medical supply units for factory installation in the medical supply units.
- .3 Coordinate with the Division providing the medical supply units including:
 - .1 Scheduling delivery of pipeline distribution system terminal units to the medical supply unit's vendor(s) manufacturing facility.
- .4 Make connections of pipeline distribution system piping to medical supply units provided with capped tube connections as follows:
 - .1 A permanently brazed connection between the pipeline and the medical supply unit.
- .5 Make connections of pipeline distribution system piping to medical supply units equipped with flexible hoses as follows:
 - .1 terminate each pipeline with a gas/vacuum specific DISS body without check valve (and complete with gas tight specific cap) and mount it on the medical supply 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 medical supply unit.)
- .6 Where a zone valve controls a single (1) medical supply unit equipped with flexible hoses, provide a gas tight cap for the specific DISS body adapter for each medical gas, medical support gas, medical vacuum and AGSS serving the medical supply unit.
- .7 Where a zone valve controls two (2) or more medical supply units, each equipped with flexible hoses, each medical supply unit shall be isolated for maintenance and repair as follows:
 - .1 provide dedicated service isolation ball valves downstream of the zone valve on each medical gas, medical support gas, medical vacuum and AGSS pipeline supplying a medical supply unit.
 - .2 for clarity, service isolation ball valves shall isolate the gas/vacuum service to one (1) medical supply unit only without interruption of gas/vacuum service to other medical supply units controlled by the same zone valve.
- .8 Witness the final testing of the installed medical supply units and assist the certification agency as necessary. The responsibility for pipeline distribution system piping inside the medical supply unit including pressure testing remains with the medical supply unit vendor.
- .9 Refer to architectural and/or electrical design documents for locations of medical supply units and quantity of terminal units required.

3.9 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 pipeline distribution system 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 Medical Supply Units (as applicable) and install test caps on medical vacuum and AGSS DISS terminal units,
 - (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 Medical Supply Units test".
- .2 Test gas for all tests: oil-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 Medical Supply Units (as applicable) and install test caps on medical vacuum and AGSS DISS terminal unit,
 - (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 gases and medical support 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 Medical Supply Units (as applicable) disconnected and keep test caps on medical vacuum and AGSS DISS terminal units,
 - (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 gases and medical support 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 flexible hoses inside of Medical Supply Units (if applicable) and purge the pipeline distribution system piping. 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 gases and medical support 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 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 Medical Supply Units (as applicable) and install test caps on medical vacuum and AGSS DISS terminal units.
 - .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 pipeline distribution system.
 - (a) Label each gauge with the applicable pipeline distribution system 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 pipeline distribution system 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 Medical Supply Units:
 - .1 After completion and acceptance of the main cross-contamination test (including correction of any cross-connection defects), reconnect the internal flexible hoses in the Medical Supply Units (as applicable) and perform a final pressure test and cross-contamination test of the Medical 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 Medical Supply 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 Medical Supply Unit.
 - .3 After completion of the Medical Supply Unit pressure test, individually test each pipeline distribution system service to the Medical Supply Units, with only the one specific pipeline distribution system 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.

3.10 Contractor Responsibilities During Certification Testing

- .1 Pipeline distribution system 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 Supply system alarm 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 Pipeline distribution system installation contractor shall provide qualified representative who are knowledgeable in pipeline distribution system 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 pipeline distribution systems 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 pipeline distribution system 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 medical gas pipeline system with applicable medical gases or, medical support gases sufficiently to remove the test gases. Purge airflow through each terminal unit.
- .6 Assist the inspection body in any subsequent retesting.

3.11 Authority 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.

3.12 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.

3.13 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 copy of installing firm's certification for installation of medical gas systems under regulatory requirements for pressure piping systems,
 - .4 copies of each brazer's certificate of competency (license) who performed all or part of the work,
 - .5 copies of each tradesperson's certificate issued under the CSA *Medical Gas Piping & Systems Installation Personnel Certification Program*,
 - .6 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),
 - .7 in-process examination records of brazed joints,
 - .8 pressure test reports,
 - .9 particulate matter test report,
 - .10 cross-contamination test records,
 - .11 operating and maintenance manuals which
 - .12 filled out, signed and dated commissioning test plant reports,
 - .13 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)

CSA Z7396.1:22		Medical gas pipeline systems — Part 1: Pipelines for medical gases, medical vacuum, medical support gases, and anaesthetic gas scavenging systems																																																									
<p>Annex L (informative) Pipeline installation test report</p> <p>Note: This Annex is not a mandatory part of this Standard.</p> <p align="center">Figure L.1 Pipeline installation test report (See Clauses 11.4.1.4, 12.3, and 12.5.2.)</p> <table border="1"> <tr> <td>Health care facility:</td> <td colspan="3">Area/floor:</td> </tr> <tr> <td colspan="4">Medical gas installation report</td> </tr> <tr> <td>Task</td> <td>Action required</td> <td colspan="2">Complete</td> </tr> <tr> <td>24-hour standing pressure test as per Clause B.2.2</td> <td>Provide test report</td> <td colspan="2"></td> </tr> <tr> <td>Perform final leak test as per Clause B.2.3</td> <td>Verify performed</td> <td colspan="2"></td> </tr> <tr> <td>Purge terminal units as per Clause B.2.4</td> <td>Verify performed</td> <td colspan="2"></td> </tr> <tr> <td>Perform cross connection test as per Clause B.3</td> <td>Verify performed</td> <td colspan="2"></td> </tr> <tr> <td>Perform particulate filter test as per Clause D.4</td> <td>Verify performed</td> <td colspan="2"></td> </tr> <tr> <td>CSA medical gas piping & installation personnel certification number (Each installers individual number to be submitted) As per Clause 11.4.1.2</td> <td>1. 2. 3. 4. 5.</td> <td colspan="2"></td> </tr> <tr> <td>Brazing qualification licence number (Each installers individual licence to be submitted) As per Clause 11.4.1.3</td> <td>1. 2. 3. 4. 5.</td> <td colspan="2"></td> </tr> <tr> <td>Quality assurance program certification number as per Clause 11.4.1.6</td> <td></td> <td colspan="2"></td> </tr> <tr> <td>Installer:</td> <td>Date:</td> <td colspan="2"></td> </tr> <tr> <td>Witnessed by:</td> <td></td> <td colspan="2"></td> </tr> <tr> <td>Notes:</td> <td></td> <td colspan="2"></td> </tr> </table> <p>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.</p>				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:	Date:			Witnessed by:				Notes:			
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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

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 for building hydronic heating 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 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),
 - .2 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 - 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 Radiant panels,
- .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)
Radiant ceiling panels	93 (200)	82 (180)	96 (205)	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 Composite 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: 2800 kPa (400 psi) at 121°C (250°F)

Standard of Acceptance

- ° CTS Flange Canada - fig. BF / WBG

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 Ream pipe after cutting to length and clean off scale and dirt inside and outside of pipe before threading, grooving or welding.

- .4 Provide clearance for installation of insulation and access for maintenance of equipment, valves and special fittings such as expansion joints.
- .5 Cap ends during construction to prevent entry of foreign matter.
- .6 Refer to piping system specifications for additional requirements.

3.2 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.

3.3 Pressure and Leak Testing - Liquid Service Piping

- .1 This test procedure applies to piping normally containing water, including HVAC and process water and glycol/water mixes, and steam-condensate piping.
- .2 Pressure test liquid 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) test pressure for ASME B31.1 systems: 175 kPa (25 psig),
 - (b) test pressure for ASME B31.9 systems: 70 kPa (10 psig).
 - .2 Remove compressed air source and maintain this pressure for the time necessary to inspect for leaks, but not less than 2 hours.
 - .3 Maintain pressure and examine each joint with commercial leak detector solution.

Standard of Acceptance

- Snoop
 - Leak-tec
- .4 Repair leaks where found prior to performing hydrostatic pressure tests.
- .5 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 gradually increase the system pressure to 150% of the design pressure and hold for 10 minutes, then reduce pressure to the design pressure.
- .4 Inspect each pipe joint for leaks.
- .5 As an alternative to inspection of each joint for leaks, 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 at the design pressure. Record ambient air temperature at the same time.
 - (c) at the end of the 24 hour standing test period, record the test pressure and ambient air temperature. Make adjustments to the measured end-of-test pressure to account for change in fluid density due to change in ambient air temperature,
 - (d) acceptance criteria: maximum pressure loss over 24 hours not to exceed 1% of test pressure, corrected for ambient temperature,
 - (e) where acceptance criteria is not met, inspect pipe joints for leaks.
- .6 Where leaks are found, repair leaks and retest piping as specified above.

3.4 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.

3.5 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	HTS/R HS/R	Carbon Steel	23 21 13.23	23 05 23.13
		Copper	23 21 13.33	23 05 23.13

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 copper 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 Conform to the requirements of Specification section 20 05 23 except/and as follows.
- .2 For double regulating valves, in addition to manufacturer data sheets, submit a schedule listing all double regulating valves and include the following information:
 - .1 a valve reference number,
 - .2 valve service (e.g. associated equipment, or distribution piping service by drawing, room, etc.)
 - .3 associated pipeline size, NPS
 - .4 valve body size, NPS
 - .5 specified design flow rate,
 - .6 valve minimum and maximum flow rate limits,
 - .7 valve pressure drop at specified design flow rate,
 - .8 expected valve open position (number of valve turns open, percent valve stroke, etc.)

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:

- i) NPS 2-12: 1200 kPa (174 psig) at 121°C (250°F).
- ii) 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:

- i) NPS 2-12: 1200 kPa (174 psig) at 121°C (250°F).
- ii) 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 inhibitor 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

.3 NPS 14 to NPS 24, for grooved end pipe:

- .1 To CSA B242, ductile iron body with corrosion inhibitor finish, with grooved ends.
- .2 Stainless steel shaft, corrosion-inhibitor encapsulated ductile iron disc with offset design, and replaceable EPDM resilient seat 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, 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 2 ½ 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:
 - i) NPS 2-12: 1200 kPa (174 psig) at 65°C (150°F).
 - ii) 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 2 ½ 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:

- i) NPS 2-12: 1200 kPa (174 psi) at 121°C (250°F)
- ii) 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:

- i) NPS 2-12: 2700 kPa (390 psi) at 121°C (250°F)
- ii) 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.

3.5 Double Regulating Valves Installation

- .1 [[Where double regulating valves are used, supply one flow meter for double regulating and triple duty valves and turn over to operating staff during operations and maintenance training. Obtain and provide a copy to the owner of a signed receipt showing time, date, and name of recipient.]
- .2 Consult with double regulating valve manufacturer to ensure correct valve selection. Balancing valves to be sized according to design flow rate.
- .3 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 1 identifies the nominal valve size selection:

Table 1: Double Regulating Valve Nominal Sizing				
Valve Size NPS	Nominal Flow			
	Min.	Max.	Min.	Max.
	L/s	L/s	gpm	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

- .4 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.
- .5 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

Master revised: 7 March 2023

TESTING ADJUSTING AND BALANCING FOR RENOVATIONS 23 05 93.14

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 Test existing HVAC systems to record existing operating conditions, at the start of the Work but before any demolition or new construction work is performed.

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 23 05 93.23 Testing, Adjusting and Balancing Supplement for Healthcare

1.3 Definitions and Abbreviations

- .1 The following definitions apply to this section:
 - .1 **Terminal inlet** – means a room or space return air or exhaust air grille, or other exhaust air inlet connection.
 - .2 **Terminal outlet** - means a room or space supply air grille or diffuser,
 - .3 **Terminal unit** – means a manufactured automatic airflow control-damper unit intended to control airflow to a space or a zone, with or without a reheat coil.
 - (a) **Constant Air Volume terminal unit (CAV)** – means a terminal unit where the airflow control damper is automatically controlled to maintain a constant supply airflow, and space temperature control is by other means.
 - (b) **Exhaust Air Volume terminal unit (EAV)** – means a terminal unit used to control return or exhaust air flow from a room or space, where the automatic control damper is operated to regulate space pressure.
 - (c) **Variable Air Volume terminal unit (VAV)** – means a terminal unit where the airflow control damper is automatically controlled to vary supply airflow to maintain space temperature.
 - (d) **Limited VAV terminal unit (VAVLM)** – a terminal unit that operates as a VAV at maximum cooling or heating demand under temperature control, and as a CAV at other times to maintain a minimum airflow rate to the room or space. For clarity, the CAV function occurs during normal occupancy times.
 - .4 **Zone** – means rooms or spaces, or portion thereof, that defines the supply air and return/exhaust air flow being evaluated.

1.4 Applicable Codes and Standards

- .1 Installation codes and standards:
 - .1 ANSI/ASHRAE 41.2 Standard Methods for Air Velocity and Airflow Measurement
 - .2 ANSI/ASHRAE 111 Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems
 - .3 SMACNA HVAC Systems Testing, Adjusting, & Balancing
 - .4 AABC National Standards for Total System Balance

.5 NEBB**Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems****1.5 Qualified Tradesperson**

- .1 Work to be performed by qualified, licensed and recognized firm with an established reputation in this field, using tradesperson holding applicable certificates of competency.
- .2 Balancing to be performed under supervision of recognized expert with an established reputation in this field.
- .3 TAB contractor to be a member of CAABC or NEBB.

1.6 Audit Verification

- .1 After review of the draft TAB report by Consultant, the Consultant may at their sole discretion require re-measurement of TAB results on an audit sample rate of [5][10][30] percent of all measured equipment, at no cost extra to the Contract Price or change to project schedule.
- .2 If audited results indicate a variance of more than 10% between the original reported value and the audit measured value for a piece of equipment, re-balance the audited device. If this excessive variance condition occurs at more than 25% of the number of audited equipment sample, re-balance the entire affected system at no cost extra to the Contract Price or change to project schedule.

1.7 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 at appropriate stages of construction to ensure that arrangements for TAB are incorporated. Confirm proper placement of test ports, balancing valves, balancing dampers, splitter dampers, and access doors.
- .3 Calibrate instruments in accordance with recognized standards.
- .4 Commence on-site TAB measurements when work is sufficiently advanced including;
 - .1 installation of ceilings, doors and windows,
 - .2 application of sealing, caulking, and weather stripping,
 - .3 normal operation of mechanical systems,
 - .4 duct pressure testing is complete,
 - .5 duct cleaning is complete.

1.8 Pre-Construction Air and Water Measurement Audit

- .1 Conduct an HVAC air and water audit of existing HVAC systems prior to commencement of demolition or new construction work.
- .2 Measure existing air conditions for the systems affected by the Work:
 - .1 measure airflow, pressure, and temperature in each space.
- .3 Submit a report to Consultant to record all as-found measured values.

2 PRODUCTS

2.1 Not Used

3 EXECUTION - AIR MOVING SYSTEMS

3.1 Measurement Parameters

- .1 The following measurement parameters identify the minimum requirements for inclusion in the TAB process:
 - .1 Air flow parameters;
 - (a) air velocity,
 - (b) flow cross sectional area,
 - (c) static pressure,
 - (d) velocity pressure.
 - .2 Pressure parameters;
 - (a) gauge pressure,
- .2 Measurement are required at and around equipment to establish air side performance of;
 - .1 terminal units.
- .3 Measurement are required to characterize system performance;
 - .1 at each supply air outlet diffuser or grille, and exhaust and return air inlet grille.

3.2 General criteria

- .1 Balanced modified systems so that the total air flow after modification is not greater than the pre-construction airflow rate.
- .2 Only balance ductwork and spaces which are modified by the Work, unless otherwise shown.
- .3 Air quantities at each exhaust system inlet and supply system outlet are to be set at values noted on drawings. Supply air discharge throw and pattern is to be adjusted at each supply outlet as noted on drawings.

3.3 Use of Terminal Unit Flow Stations for Balancing Purposes

- .1 Where terminal units are equipped with integral air flow stations and the associated controllers provide pressure independent control of the terminal unit, the terminal unit controller may be used for balancing purposes provided that;
 - .1 a sample of each terminal unit size is selected and the terminal unit airflow station measured value is within 5% of the measured values at the space terminal outlets,
 - .2 a correction factor based on the preceding test is incorporated into the terminal unit controller for terminal unit air flow measurement,
 - .3 on completion of balancing, the terminal unit damper is at least 60% open when space thermostat is calling for full cooling or full heating, and
 - .4 there is no excessive noise in the space served by the terminal unit.
- .2 If terminal unit control damper is less than 60% open at maximum design airflow rate, or there is excessive noise in the opinion of the Consultant, then adjust the upstream balancing damper to reduce inlet pressure to the terminal unit until terminal unit control damper is at least [60][70]% open at maximum design airflow rate.

3.4 Branch Air Quantity Measurement Procedure

- .1 Determine branch air quantities using pitot tube traverses in accordance with the procedures defined in ASHRAE 111 and ANSI/ASHRAE 41.2.
- .2 Take measurements of floor duct main at its connection to the duct riser.

3.5 Space Balancing Procedure

- .1 Application:
 - .1 single zone systems with constant airflow,
 - .2 constant volume systems using CAV terminal units,
 - .3 constant volume systems with terminal reheat coils,
 - .4 variable volume systems,
 - .5 constant volume exhaust systems.
- .2 Where a system has CAV units, or a system has a mixture of no units and CAV units, set the CAV units for 100% design airflow at all times.
- .3 Where a system has EAV units, set EAV units to 100% design airflow prior to balancing the supply air to the space.
- .4 Balance the branch duct, or use CAC, VAV, VAVLM or EAV terminal units where previously qualified, that serves the space to the required design airflow rates.
- .5 Acceptance criteria:
 - .1 total of terminal outlets/inlets airflow measurement in each zone: $\pm 10\%$ of design flow.

4 EXECUTION - HYDRONIC SYSTEMS

4.1 Parameters

4.2 Measurement Parameters

- .1 The following measurement parameters identify the minimum requirements for inclusion in the TAB process:
 - .1 volume flow rate,
 - .2 temperature,
 - .3 pressure (gauge),
- .2 Measurement are required at and around equipment to establish fluid side performance of;
 - .1 reheat coils.
- .3 Measurement are required to characterize system performance;
 - .1 at floor branch connections (where measurement devices are installed),

4.3 General Requirements

- .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 Check and clean strainers prior to balancing.

- .4 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, with flowrate determined from manufacturer's literature, or
- .5 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing.
- .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.

4.4 Reheat Coils

- .1 Balance coils to values noted on schedules/drawings.

5 EXECUTION – MISCELLANEOUS

5.1 Accuracy

- .1 Adjust systems until operating values are within $\pm 5\%$ of design values are achieved.

5.2 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.

5.3 Spot checks

- .1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 100% 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 EXECUTION - REPORT PRESENTATION AND VERIFICATION

6.1 Required Reports

- .1 Provide the following reports:
 - .1 Air and water balancing report.

6.2 Record Keeping

- .1 Keep records of trial and final balance and submit preliminary report as each system is completed.
- .2 Do not submit the final TAB report until all audit verification re-measurements, and any required re-balancing, is completed to the satisfaction of Consultant.

6.3 Report Format

- .1 Reports to incorporate approved standard forms, with values expressed in in the same units as shown on Contract Documents.
- .2 Include "as-built" system schematics showing flow quantities and measurement points. Use as-built drawings and ventilating line diagrams for references.
- .3 After any revisions requested by Consultant have been made and final review accepted by Consultant, submit the final TAB report in the following formats:
 - .1 two (2) hard copies of the completed report, each with index tabs and bound in "D" ring binders,
 - .2 electronic file PDF copies by email or drop-box as coordinated with Owner and Consultant.

6.4 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.

6.5 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 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

TESTING, ADJUSTING & BALANCING SUPPLEMENT FOR HEALTHCARE 23 05 93.23

1 GENERAL

1.1 Scope

- .1 Test, adjust, and balance ("TAB") airflows for rooms and spaces in healthcare facilities.
- .2 This section is supplementary to Specification section 23 05 93.14 and is to be read in conjunction with that section.

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 23 05 93.14 Testing, Adjusting & Balancing for HVAC Renovation

1.3 Definitions and Abbreviations

- .1 The following definitions apply to this section.
 - .1 **Differential airflow** – means the difference in the aggregate airflow rates of supply terminal outlets in a room or space minus the aggregate airflow rates of return air and exhaust air terminal inlets in the room or space, for design or measured flow rates.
 - .2 **Differential pressure** – means the design or measured air pressure of an enclosed room relative to the adjacent corridor, room or space.
 - .3 **Negative pressure (room)** – means a room where the net airflow movement is from adjacent spaces into the room.
 - .4 **Neutral pressure (room)** – means a room where the net airflow movement into/out from the room is essentially zero but may have limited airflow into or out from the room.
 - .5 **Positive pressure (room)** – means a room where the net airflow movement is from the room to adjacent spaces,
 - .6 **Specialty Rooms** – means those room types as listed in Schedule A of this Specification section.

2 PRODUCTS

2.1 Not Used

3 EXECUTION

3.1 General

- .1 Balance air systems in accordance with Specification section 23 05 93.14 before performing room differential pressure balancing as specified herein.
- .2 For differential pressure, measure the room air pressure relative to the adjacent connecting corridor or room unless otherwise shown.
- .3 Where a space has dynamic differential pressure control, coordinate with the Division 25 contractor and supply measured data to allow configuration of Division 25 control sequences.

3.2 General Room and Space Differential Pressure Balancing Process

- .1 Application: all rooms and spaces that are not Specialty Rooms or Odour/Vapour Generating rooms specified herein.

- .2 For the purpose of this balancing process, the following definitions apply;
 - .1 A "positive pressure room" is one in which the design supply airflow rate exceeds the design return/exhaust airflow rates by 25 L/s (53 cfm) or more,
 - .2 A "negative pressure room" is one in which the design return/exhaust airflow rate exceeds the design supply air flow rate by 25 L/s (53 cfm) or more,
 - .3 A neutral pressure room is one that where the difference between the design supply airflow rate and the design return/exhaust airflow rate is less than 25 L/s (53 cfm).
- .3 Calculate the design differential airflow rates from design supply and return/exhaust airflow rates as shown on drawings. Record the design differential airflow rates in the TAB report.
- .4 Adjust room pressurization based on differential airflow:
 - .1 for positive and negative pressure rooms, adjust exhaust airflow rate until a balanced differential airflow of not less than 25 L/s (53 cfm), positive or negative as applicable to the room design differential airflow rate, is achieved unless a greater value is calculated or is as otherwise shown,
 - (a) acceptance criteria: measured differential airflow is within -0/+15% of design differential airflow.
 - .2 for neutral pressure rooms, adjust exhaust airflow rate until it is within the lessor of $\pm 5\%$ or 10 L/s (22 cfm) of the measured supply airflow rate,
- .5 Alternate method for rooms which are fully enclosed and provided with doors: balance room to achieve a differential pressure relative to adjacent connecting corridor or room, measured across the closed door;
 - .1 for positive pressure rooms, adjust exhaust airflow rate until a positive pressure of between +1.5 to +2.5 Pa (+0.006 to +0.01 in.w.c) is achieved and maintained for a time period of one (1) minute,
 - .2 for negative pressure rooms, adjust exhaust airflow rate until a negative pressure of between -1.5 to -2.5 Pa (-0.006 to -0.01 in.w.c) is achieved and maintained for a time period of one (1) minute,
 - .3 for neutral pressure rooms, adjust exhaust airflow rate until a relative pressure between -1.5 and +1.5 Pa (-0.006 and +0.006 in.w.c.) is achieved and maintained for a time period of one (1) minute.

3.3 Odour or Vapour Generating Rooms Differential Pressure Balancing Process

- .1 Application: washrooms, utility rooms, bathing rooms, shower rooms, wash-down rooms, waste storage rooms, and other contaminated storage rooms.
 - .1 Adjust room exhaust airflow rates to achieve a negative room differential pressure of not less than 2.5 Pa (0.03 in.w.c.) and maintained for a time period of two (2) minutes,
- .2 Acceptance criteria: measured differential pressure is within -0/+15% of design differential pressure.

3.4 Specialty Room Differential Pressure Balancing Process

- .1 Application: all rooms with permanent differential pressure sensors used for differential pressure control (directly or indirectly) as listed in Schedule A at the end of this specification section.
- .2 Adjust room airflow rates to achieve the required room differential pressure as listed in Schedule A at the end of this specification section, and which is maintained for a test time period of ten (10) minutes,
 - .1 for positive pressure rooms, adjust the return/exhaust airflow rates,
 - .2 for negative pressure rooms, adjust the return/exhaust airflow rates. If necessary, the supply airflow rate may be reduced by up to 5% of design supply airflow value to achieve the required negative pressure.
- .3 For rooms which have anterooms (vestibules);

- .1 first adjust airflow rates to achieve required differential pressure between the room and the connecting corridor,
- .2 then adjust airflow rates in the anteroom to achieve required differential pressures.
- .4 Acceptance criteria: measured differential pressure is within -0/+15% of design differential pressure.

3.5 Site Acceptance Testing

- .1 After completion of differential pressure balancing, conduct Site Acceptance Testing ("SAT") of the Specialty Rooms in the presence and to the satisfaction of the Owner's representative(s) before equipment is permanently placed into service, for up to 10% of Specialty Rooms as selected by the Owner or Consultant.
- .2 SAT to include the following:
 - .1 Continuous measurement and recording of room differential pressure under static conditions, with all doors to the rooms closed for at least 5 minutes prior to the test, and measured for a period of ten (10) minutes,
 - .2 continuous measurement and recording of room differential pressure during an upset condition caused by the opening of a door to the connecting corridor for a period of 30 seconds;
 - (a) record the differential pressure vs time from the start of the door opening until time required after the door has closed for the room to return to 90% of the static differential pressure.

3.6 Commissioning Program

- .1 Comply with the project commissioning requirements in accordance with specification section 20 08 15 and Division 01 requirements.
- .2 The verification and testing requirements specified in this section may be concurrent with, or conducted separate from, the commissioning program, as coordinated with the Contractor and the commissioning authority.

3.7 Test and Installation Records

- .1 Provide the following test records to the Owner and a copy to Consultant.
 - .1 design and measured differential airflow and differential pressures for each room, to be included in the main TAB report,
 - .2 SAT results, to be included in the main TAB report.

3.8 Schedules

- .1 The following equipment schedules form part of this specification section.
 - .1 Schedule A: Specialty Room Differential Pressure Values

SCHEDULE A – Specialty Room Differential Pressure Values

Notes for the following table:

[1] Open areas with no physically closed interior boundary, or enclosed rooms where doors are frequently open.

[2] Unless otherwise stated, room pressure is measured relative to adjacent corridor serving the room.

Occupancy	Room Type	Measurement Parameter (minimum)	Positive or Negative [Note 2]
Healthcare	Treatment rooms, Operative birthing rooms, Operating rooms, Sterile storage and core spaces, Medical device reprocessing, Invasive imaging rooms,	2.5 Pa (0.01 in.w.c.)	Positive
	Biomedical waste treatment, Autopsy	2.5 Pa (0.01 in.w.c.)	Negative
	Protective Environment Rooms (PER)	7.5 Pa (0.03 in.w.c.)	Positive to corridor
	Airborne Isolation Rooms (AIR)	7.5 Pa (0.03 in.w.c.)	Negative to corridor
		7.5 Pa (0.03 in.w.c.)	Negative to adjacent (non-communicating) spaces
	AIR anteroom	2.5 Pa (0.01 in.w.c.)	Negative to corridor
			Positive to AIR room
	Combination PER/AIR Room	7.5 Pa (0.03 in.w.c.)	Positive to corridor (PER mode)
			Negative to Corridor (AIR mode)
	Combination PER/AIR Room Anteroom	2.5 Pa (0.01 in.w.c.)	Negative to corridor
			Negative to PER/AIR room
	Airborne Isolation Process Rooms	7.5 Pa (0.03 in.w.c.)	Negative to corridor
		2.5 Pa (0.01 in.w.c.)	Negative to corridor

Occupancy	Room Type	Measurement Parameter (minimum)	Positive or Negative [Note 2]
	Combination Airborne Isolation/Protective Isolation Process Room Anteroom		Negative to process room
Laboratories	Rooms with chemical fume hoods	2.5 Pa (0.01 in.w.c.)	Negative
	Rooms with biological hoods	5.0 Pa (0.02 in.w.c.)	Negative
Pharmacies	Hazardous compounding	2.5 Pa (0.01 in.w.c.)	Negative
	Hazardous compounding anteroom	5.0 Pa (0.02 in.w.c.)	Positive to corridor
		2.5 Pa (0.01 in.w.c.)	Positive to compounding room
	Clean compounding	12.5 Pa (0.05 in.w.c.)	Positive
	Clean compounding anteroom	7.5 Pa (0.03 in.w.c.)	Positive to corridor
		5.0 Pa (0.02 in.w.c.)	Negative to compounding room

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 2070 kPa (300 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 B36.10 Welded and Seamless Wrought Steel Pipe
 - .8 ASME B16.11 Forged Steel Fittings, Socket-Welding and Threaded
 - .9 ASME B16.20 Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.
 - .10 ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges.
 - .11 ASME B16.39 Malleable Iron Threaded Pipe Unions: Classes 150, 250 and 300.
 - .12 ASTM A47 Standard Specification for Ferritic Malleable Iron Castings.
 - .13 ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - .14 ASTM A105 Standard Specification for Carbon Steel Forgings for Piping Applications

- | | |
|---------------|--|
| .15 ASTM A106 | Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service |
| .16 ASTM A193 | Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service |
| .17 ASTM A194 | Standard Specification for Carbon and Alloy Steel Nuts for 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 pipe:
 - .1 to ASTM A53 Grade B, seamless or electric resistance welded (type “A53”),
 - .2 to ASTM A106 Grade B (type “A106”),
- .2 Pipe wall thickness:
 - .1 Refer to Schedule A1 appended to the end of this specification section.
 - .2 Select pipe material and wall thickness/schedule (as defined in ASME B36.10), based on pipe size, design temperature and jointing method.
 - .3 Acceptable substitutions:
 - (a) where only type A53 is specified, then A106 may be used,
 - (b) where only type A106 is specified, then piping with dual certification for meeting both ASTM A53 Grade B seamless and ASTM A106 Grade B seamless may be used.

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 butt welding 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 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 Selection

- .1 Select ASME Class rated fittings 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 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.

.3 For clarity, pipe size of NPS 2-1/2 may be either type of joint specified.

3.4 Welding

.1 Comply with section 20 05 24 and as specified herein.

3.5 Pressure Testing

.1 Conduct pressure and leak tests in accordance with section 23 05 01.

3.6 Flushing and Cleaning

.1 After pressure testing, clean piping.

.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.

3.7 Schedules

.1 The following appended equipment schedules form part of this specification section.

.1 Schedule A1 Pipe Wall Thickness.

Schedule A1 – Pipe Wall Thickness				
Pipe Size NPS	Piping Design Temperature	Pipe Joint Method	Pipe Material	Pipe Wall Thickness
≤ 2-1/2	≤ 105°C (220°F)	All	A106, A53	Schedule 40
	>105°C (220°F)	Threaded	A106	Schedule 80
		Welded	A106, A53	Schedule 40

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 as further specified in other Specification sections of Division 20 to 25.

1.2 Qualified Tradesperson

- .1 Work to be performed by qualified, licensed and recognized firm with an established reputation in this field, using tradesperson holding applicable certificates of competency.

2 PRODUCTS

2.1 Not Used

3 EXECUTION

3.1 Ductwork

- .1 Ductwork system routing is shown diagrammatically. Drawings are not to be considered as 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 external live loads, and to absorb pressure thrust.

3.2 Air Supply Equipment

- .1 Install and connect air handling units, air conditioning units, fans and associated equipment, 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 Units

- .1 Locate and install terminal units, registers, diffusers, and grilles. Coordinate with Architectural reflected ceiling plans for position of ceiling mounted elements.

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

METAL DUCTS

23 31 13.13

1 GENERAL

1.1 Scope

- .1 Provide metal HVAC ductwork including casings and plenums as shown.

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 01 Basic Materials and Methods
 - .2 20 05 49 Seismic Restraint
 - .3 23 33 05 Duct Accessories.

1.3 Definitions and Abbreviations

- .1 The following definitions apply to this section and as applicable to related sections.
 - .1 **Casing(s)** – a fabricated metal construct of some combination of walls, roofs, and/or floors for the conveyance of air at relatively low air velocities (typically below 5 m/s (1000 fpm) and which encloses equipment such, as but not limited to, fans, coils, and filters.
 - .2 **Ductwork** – a network of metallic or flexible material distributed through a building or space for the conveyance of air: (a) from an HVAC unit to one or more spaces, or (b) exhausted from those spaces.
 - .3 **Plenums** – a form of ductwork for the conveyance of air at relatively low velocities (typically below 3.5 m/s (700 fpm)).
- .2 In SMACNA 006 - *HVAC Duct Construction Standard – Metal and Flexible*, a reference to requirements for construction of “casings” in chapter 9 applies equally to construction of plenums, except/and as specified herein.

1.4 Applicable Codes and Standards

- .1 Installation codes and standards:
 - .1 NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 ASHRAE Letter and number designations, shown as “CR3-16” etc., are taken from ASHRAE Duct Fitting Data Base.(DFDB)
 - .3 ANSI/SMACNA 006 HVAC Duct Construction Standards - Metal and Flexible (4th edition)
 - .4 ANS/SMACNA 002 Rectangular Industrial Duct Construction Standards (2nd edition)
 - .5 ANSI/SMACNA 016 HVAC Air Duct Leakage Test Manual (2nd edition)
- .2 Product standards:
 - .1 ASTM A90 Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
 - .2 ASTM A653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
 - .3 ASTM A924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

- | | | |
|-----|----------------|--|
| .4 | ASTM A1011 | 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 | Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |
| .6 | ASTM A36 | Standard Specification for Carbon Structural Steel |
| .7 | ASTM A480 | Specification for General requirements for Flat Rolled Plate, Sheet, and Strip |
| .8 | ASTM A463 | 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 |
| .10 | ANSI/MSS SP-58 | Pipe Hangers and Supports |

1.5 Qualified Tradesperson

- .1 Work to be performed by qualified, licensed and recognized firm with an established reputation in this field, using tradesperson holding applicable certificates of competency.

1.6 Design Criteria

- .1 Outdoor ductwork, rooftop duct support frames, and weather shields are to be designed to meet the local wind loading in accordance with the building code requirements at the location of the Work.
- .2 Seismic design loading for duct supports to conform to Specification section 20 05 49.

1.7 Submittals

- .1 Submit manufacturer's catalogue literature for:
 - .1 proprietary joints.
- .2 Submit fabrication shop drawings for the following ductwork elements:
 - .1 integral drain pans and external drain pans including drain pipe connection,
 - .2 water-resistant ductwork,
 - .3 casings and plenums.

1.8 As-Built Drawings

- .1 As work progresses, mark-up field drawings as to actual location of ductwork, balancing dampers and other duct accessories and submit as part of record of "As-Built" conditions.

2 PRODUCTS**2.1 Common Material**

- .1 Galvanized steel:
 - .1 Ducts and connectors: lock forming quality to ASTM A653 or ASTM A924, type Z180 (G60) or Z275(G90) as specified in Part 3 – EXECUTION.
 - .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,

- .2 finish: 2B mill, except where otherwise shown.
- .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 Fabricated joints: to ANSI/SMACNA 006 as applicable to duct pressure class, duct size, duct-wall thickness, and reinforcing requirements.
- .2 Bolted companion flange – rectangular ductwork:
 - .1 formed flanges, corner pieces, integral edge seals, gaskets and cleats.
 - .2 material to match that of ductwork being joined,
 - .3 Neoprene gaskets.

Standard of Acceptance

- Ductmate – fig. System 25/35/45
- Hardcase (Carlisle) – fig. Nexus

- .3 Barrel-rim clamped companion flange – round ductwork:
 - .1 roll-formed companion flanges, field installed, mechanically fastened and sealed to ends of duct,
 - .2 barrel ring clamp with bolted or no-tool cam locking clamp,
 - .3 Neoprene gaskets.

Standard of Acceptance

- Ductmate - fig. Spiralmate
- Nordfab - fig. Quick-Fit Ducting

2.3 Sealant and Tape

- .1 To Specification section 23 33 05.

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 Hanger straps:

- .1 Galvanized steel strap hangers for indoor use only.

- .3 Hanger rod:

- .1 Continuous threaded rod:

- (a) carbon steel, USS national course thread,
 - (b) tension load ratings to MSS SP-58,

Standard of Acceptance

- Anvil - fig. 146
- Taylor – fig. 54

- .2 Welded eye rod:

- (a) carbon steel, USS national course thread,
 - (b) tension load ratings to MSS SP-58,
 - (c) tension load rating to be the same as continuous welded rod.

Standard of Acceptance

- Anvil - fig. 278
- Taylor

- .4 Seismic supports and restraints to Specification section 20 05 49.

2.5 Duct Access Doors

- .1 To Specification section 23 33 05.

3 EXECUTION

3.1 General Fabrication and Installation Requirements

- .1 Construction details, sheet gauges, reinforcing, and bracing for ductwork, casings, and plenums to be in accordance with SMACNA 006, except/and as otherwise shown.
- .2 Material selection: refer to Schedule A at the end of this section where otherwise shown.
- .3 Rectangular ductwork seams and joints:
 - .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 for sealing requirements.
- .4 Round ductwork seams and joints, 500 Pa (2 in wg) pressure class and higher:
 - .1 spiral flat type longitudinal seam, button punched.

3.2 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.

3.3 Finishing, Fastening and Supports

- .1 Hammer edges and slips to leave smooth finished surface inside duct.
- .2 Support vertical ducts with steel angles riveted to duct and bearing on building structure;
 - .1 design and fabricate duct riser supports using supplementary structural steel supports in accordance with SMACNA 006 and Specification section 20 05 01.
 - .2 use plain carbon steel for duct riser supports located indoors,
 - .3 use galvanized carbon steel for duct riser supports located outdoors.
- .3 Duct hangers;
 - .1 for ducts with both dimensions not exceeding 500 mm (20 in):
 - (a) supported with strap hangers of same material as duct but one sheet metal thickness heavier, or on steel angles as specified below.
 - (b) extend strap hangers down duct side and turn under 50 mm (2 in) fastening securely to side and underside of duct.
 - .2 for ducts with any dimension greater than 500 mm (20 in):
 - (a) supported with trapeze hangers constructed from galvanized steel angle with steel rods in accordance with table 1;

Table 1 : Duct Hangers		
Duct size mm (in)	Angle size mm (in)	Rod size mm (in)
up to 750 (up to 30)	25x25x3 (1x1x1/8)	6 (1/4)
750 to 1050 (30 to 40)	40x40x3 (1 1/2x1 1/2x1/8)	6 (1/4)
1050 to 1500 (40 to 60)	40x40x3 (1 1/2x1 1/2x1/8)	10 (3/8)
1500 to 2400 (60 to 90)	50x50x3 (2x2x1/8)	10 (3/8)
2400 and over (90 and over)	50x50x6 (2x2x1/4)	10 (3/8)

- .3 maximum hanger spacing: 2.4 m (8 ft) on centre.
- .4 For additional requirements for seismic restraints, refer to Section 20 05 49.

3.4 Pressure Classification and Seal Class

- .1 Low pressure ductwork construction classification in accordance with Table 2.

Table 2: Duct Pressure Classification			
Pressure class Pa (in wg)	Operating pressure Pa (in wg)	Velocity m/s (fpm)	Leakage Test Pressure Pa (in wg)
125 (1/2)	up to 125 (1/2)	10.0 (2000)	125 (1/2)
250 (1)	125 to 250 (1/2 to 1)	12.5 (2500)	250 (1)

Table 2: Duct Pressure Classification			
Pressure class Pa (in wg)	Operating pressure Pa (in wg)	Velocity m/s (fpm)	Leakage Test Pressure Pa (in wg)
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 3.

.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 3: Duct System Pressure and Seal Class – Healthcare and Laboratories

No.	Ductwork System	Static pressure construction class Pa (in.wg.)	Seal class	Sealing requirements (1)(2)(3)(4)
1	Supply duct risers in vertical service space (duct shafts).	+1000 (4)	A	Transverse joints, longitudinal seams, ductwall penetrations, and other connections
3	Supply air ductwork from discharge side of fan to inlet of terminal units or reheat coil	+1000 (4)		
4	Return/exhaust air ductwork between a Heat Recovery Wheel and suction side of fan.	-1000 (4)		
5	Supply, return and exhaust ductwork located outdoors.	All classes as otherwise specified herein		
6	Autopsy exhaust ductwork.	-1000 (4)		
7	Process exhaust air ductwork between exhaust HEPA filters and suction side of fan.	-1000 (4)		

Table 3: Duct System Pressure and Seal Class – Healthcare and Laboratories

No.	Ductwork System	Static pressure construction class Pa (in.wg.)	Seal class	Sealing requirements (1)(2)(3)(4)
8	Process exhaust upstream of exhaust filters, or upstream of exhaust fan if there are no exhaust filters	-750 (3)		
9	Chemical fume hood exhaust ductwork on suction side of exhaust fan	-750 (3)		
10	Biohazard exhaust ductwork	-750 (3)		
11	Exhaust ductwork on discharge side of fans for: autopsy exhaust, process exhaust, chemical fume hood exhaust, biohazard exhaust	+500 (2)		
12	Perchloric Acid exhaust system on suction side of exhaust fan	-1500 (6)		
13	Perchloric Acid exhaust system on discharge side of exhaust fan	+500 (2)		
14	Return air and general exhaust risers in mechanical rooms and in vertical service spaces (duct shafts).	-750 (3)	B	Transverse joints, longitudinal seams, and other connections
15	Supply air ductwork upstream of HEPA filters, including diffusers with integral HEPA filters. ⁽⁵⁾	+750 (3)		
16	Supply air ductwork downstream of terminal units or reheat coil with terminal HEPA filters	+500 (2)		
17	Return air and general exhaust air ductwork on suction side of fans <u>other than</u> in mechanical rooms and vertical service spaces.	-500 (2)	C	Transverse joints and other connections
18	Supply air ductwork downstream of terminal units or reheat coil.	-250 (1)	C	Transverse joints only
19	Relief air ductwork on discharge side of return fan; Fan coil units, suction and discharge.	+250 (1)	C	Transverse joints only

Notes for table 3:

- (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 unit or reheat coil which serve diffusers with integral HEPA filters.*

3.5 Fittings - Rectangular Ductwork

- .1 Refer to Schedule B 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 4.
- (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 4: 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 Un-vaned 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

- .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 5.

Table 5 : 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.wg) 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 6.

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 duct side and direction of flow,
.2 diverging: maximum 15° angle between duct side 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.

3.6 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

Table 7 : Round Duct, Wye and Tee Branch Fittings			
Ref. No.	Supply Ductwork System	Fitting Type	ASHRAE Fitting No
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
5	Return or exhaust duct branches; smaller branch size.	Tee, tapering, with 45° elbow	SD5-12

3.7 Temporary 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.

3.8 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 8.

Table 8 : 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)

3.9 Duct Pressure Testing

- .1 Duct pressure testing must be completed to the satisfaction of Consultant before ductwork is insulated or concealed.

- .2 Pressure test air duct systems for leaks at 1.33 times the system, or portion of the system, pressure class specified and as follows;
 - .1 between supply air handling units and terminal units,
 - .2 between supply air handling units and final connection to supply outlets on supply systems without terminal units (excluding flexible ductwork)
 - .3 between inlet grilles and the exhaust/return fan inlet,
 - .4 between the return fan discharge outlet and the mixing plenum on recirculating return systems,
 - .5 between the exhaust fan discharge outlet and the point of discharge before leaving the building, but only for process exhaust systems conveying any materials other than general building exhaust air,
- .3 The following parts of system are exempt from pressure testing;
 - .1 short duct runs of 15 metres (45 feet) or less, operating at 37 Pa (1/8 in) SP or less.
 - .2 ductwork installed downstream of terminal boxes and fan coil units.
- .4 Conduct test in accordance with Associated Air Balance Council (AABC) recommended procedures.
- .5 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.

3.10 Duct Leakage Testing

- .1 Duct leakage testing must be completed to the satisfaction of Consultant before ductwork is insulated or concealed.
- .2 Conduct duct leakage tests in accordance with SMACNA *HVAC and Duct Leakage Test Manual* and as specified herein.
- .3 For each duct systems, calculate the maximum allowable ductwork airflow leakage rate based on duct surface area, pressure class and duct seal class in accordance with the following:

$$L = F \times D_{SA}$$

$$\text{and } F = K \times C_L \times P^{0.65}$$

where these parameters are unique to each section of duct:

L is the maximum allowable leakage airflow rate,

D_{SA} is the duct surface area,

F is the leakage rate coefficient,

C_L is the duct leakage class, and is listed in Table 10,

P is the duct design pressure,

K is a conversion factor depending on the units of measure and is listed in Table 9.

Table 9: Duct Leakage Measurement Units			
	Parameter	Flow Measurement Units	
		L/s	CFM
L	Allowable leakage units	L/s	CFM
D_{SA}	Duct surface area units	m ²	ft ²
F	leakage rate coefficient	L/s per m ²	CFM per 100 ft ²

Table 9: Duct Leakage Measurement Units			
	Parameter	Flow Measurement Units	
		L/s	CFM
C _L	Leakage Class	Refer to table 10 below	Refer to table 10 below
P	Duct Class pressure units	Pa	in.w.c.
K	unit conversion (multiplier)	1.4 x 10 ⁻³	1

Table 10: 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

- .4 Conduct duct leakage tests for each duct system at an air pressure equal to the duct system pressure class. Where a duct system has multiple pressure classes for different sections, test each section of the system independently.
- .5 If leakage rate exceeds the calculated maximum allowable value, examine ductwork for excessive leakage, re-seal and then repeat the leak test until the measured leakage rate is less than the calculated maximum allowable value for the section of the system under test.
 - .1 for clarity, where a duct system consists of multiple sections of different pressure classes, the acceptance criteria is based on not exceeding the aggregate of the calculated maximum allowable leakage of all sections in the same duct system.
- .6 Maintain a 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 the TAB Agent, identifying each segment of duct system tested, showing calculation of maximum allowable leakage (duct surface area, pressure class, seal class, leakage class "C_L" and calculated leakage air flow rate for the section), along with the test pressure and measured leakage airflow rate, and certifying that leakage testing has been satisfactorily completed.
- .8 Submit the report for review by Consultant before duct insulation is installed and branch take-offs are made for terminal units.

3.11 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.

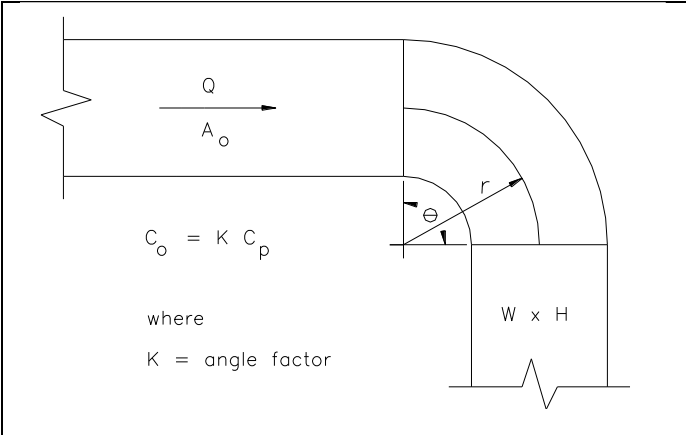
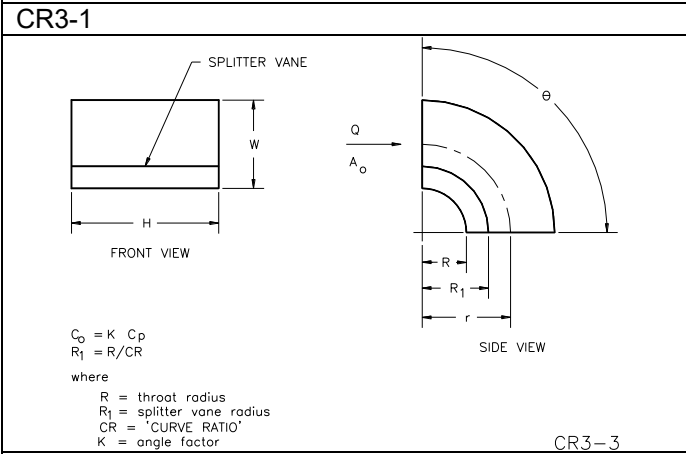
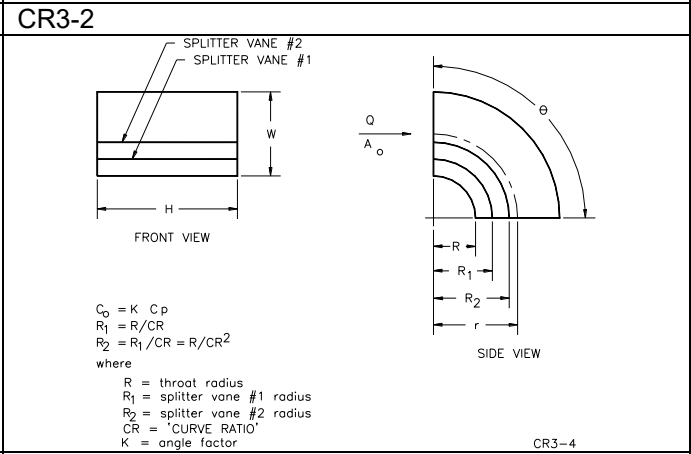
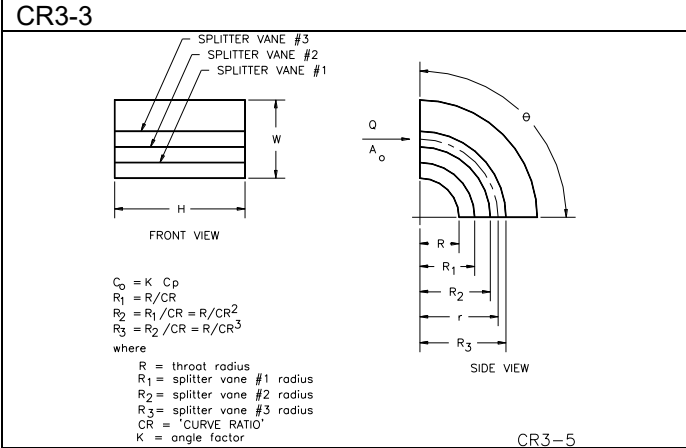
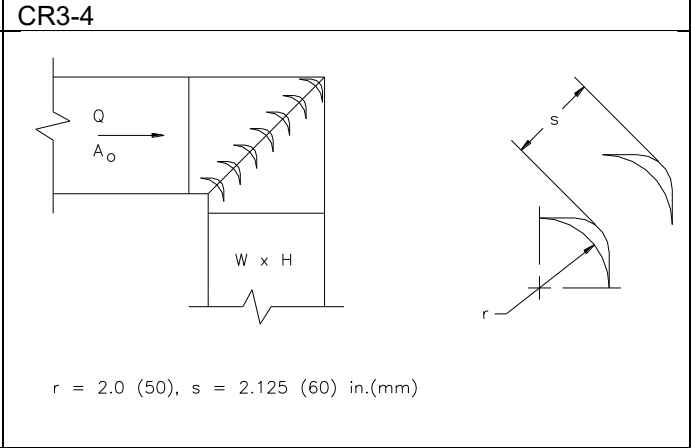
3.12 Schedules

- .1 The following schedules form part of this specification section.
 - .1 Schedule A – Ductwork, Casings and Plenum Materials
 - .2 Schedule B – Illustrations of Referenced Fittings.

Schedule A – Materials for Ductwork, Casings and Plenums					
<p style="text-align: center;"><u>Legend</u></p> <p style="text-align: center;">"Yes" means permitted material "---" means not permitted</p> <p style="text-align: center;">Where more than one material is indicate as permitted for a particular application or location, than any of those permitted materials may be used.</p>					
Application or Location	Galvanized Steel Z180 (G60)	Galvanized Steel Z275 (G90)	Stainless Steel	Aluminum	Notes
Indoor locations	Yes	Yes	---	---	

Schedule B – Illustration of Referenced Fittings

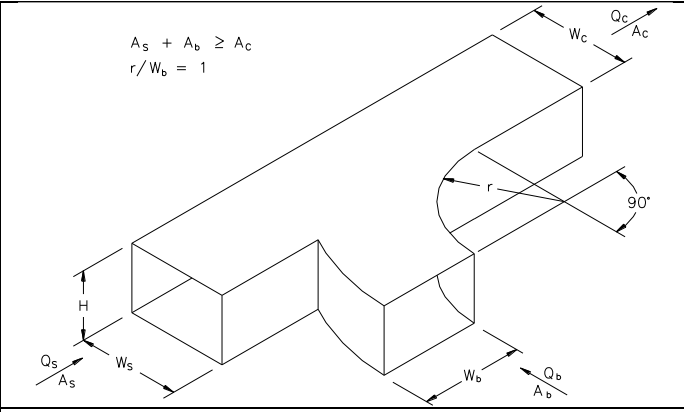
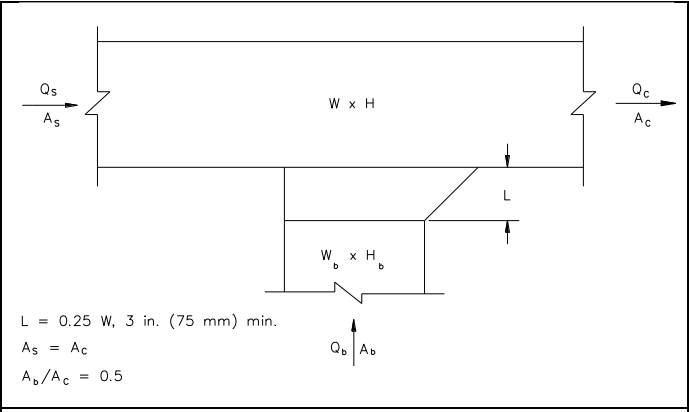
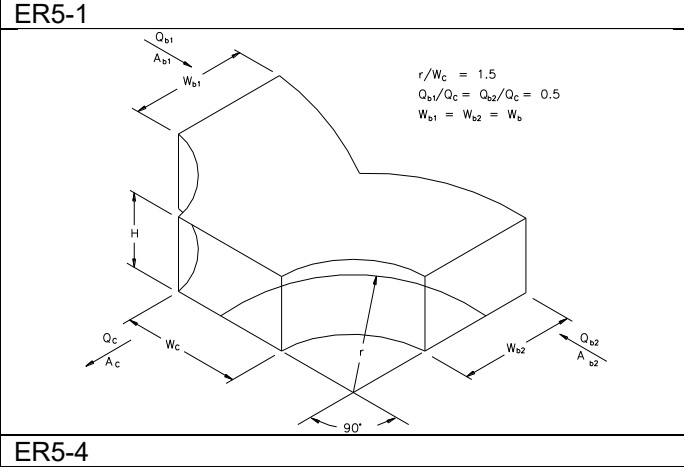
Rectangular Elbows (see Table 4 in Part 3.)

 <p>$C_o = K C_p$</p> <p>where</p> <p>$K = \text{angle factor}$</p> <p>$W \times H$</p>	
<p>CR3-1</p>  <p>FRONT VIEW</p> <p>SIDE VIEW</p> <p>$C_o = K C_p$ $R_1 = R/CR$</p> <p>where</p> <p>$R = \text{throat radius}$ $R_1 = \text{splitter vane radius}$ $CR = \text{'CURVE RATIO'}$ $K = \text{angle factor}$</p> <p>CR3-3</p>	<p>CR3-2</p>  <p>FRONT VIEW</p> <p>SIDE VIEW</p> <p>$C_o = K C_p$ $R_1 = R/CR$ $R_2 = R_1/CR = R/CR^2$</p> <p>where</p> <p>$R = \text{throat radius}$ $R_1 = \text{splitter vane \#1 radius}$ $R_2 = \text{splitter vane \#2 radius}$ $CR = \text{'CURVE RATIO'}$ $K = \text{angle factor}$</p> <p>CR3-4</p>
<p>CR3-3</p>  <p>FRONT VIEW</p> <p>SIDE VIEW</p> <p>$C_o = K C_p$ $R_1 = R/CR$ $R_2 = R_1/CR = R/CR^2$ $R_3 = R_2/CR = R/CR^3$</p> <p>where</p> <p>$R = \text{throat radius}$ $R_1 = \text{splitter vane \#1 radius}$ $R_2 = \text{splitter vane \#2 radius}$ $R_3 = \text{splitter vane \#3 radius}$ $CR = \text{'CURVE RATIO'}$ $K = \text{angle factor}$</p> <p>CR3-5</p>	<p>CR3-4</p>  <p>$r = 2.0 (50), s = 2.125 (60) \text{ in. (mm)}$</p> <p>CR3-15</p>

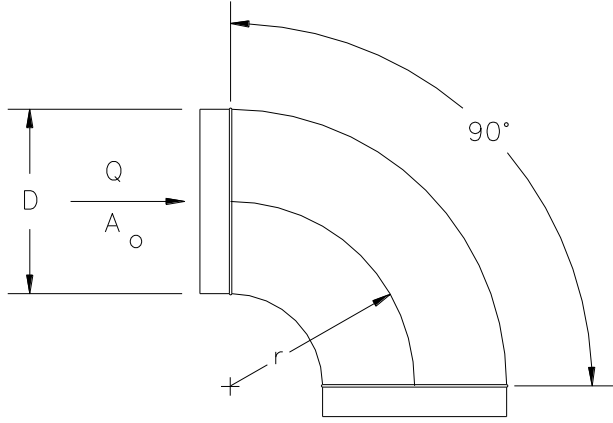
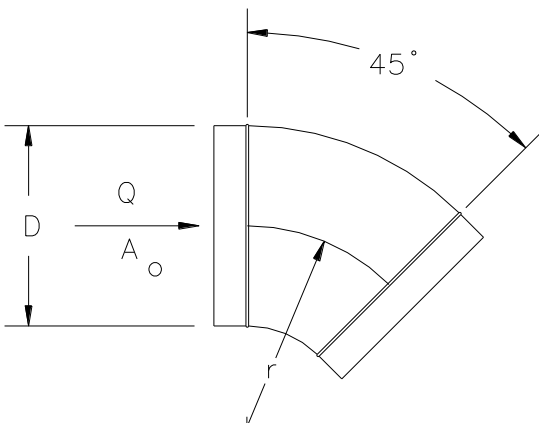
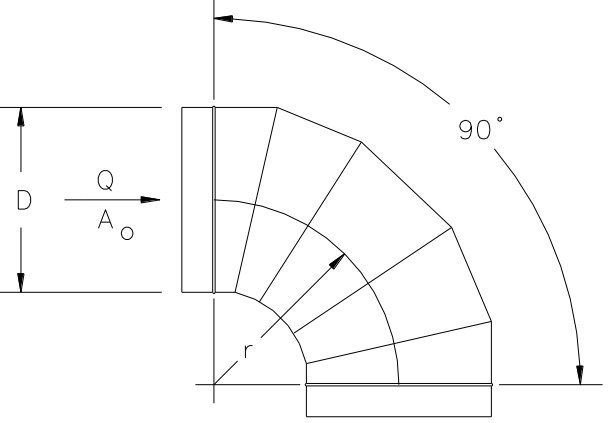
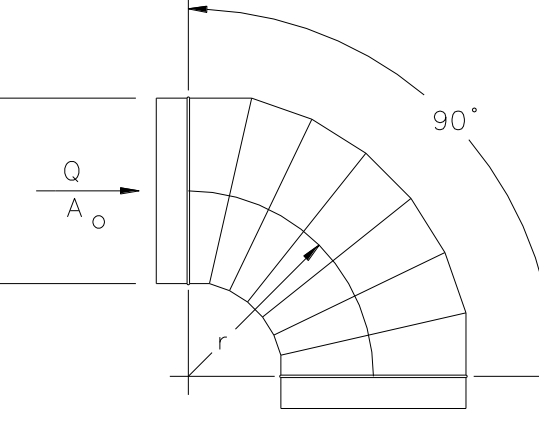
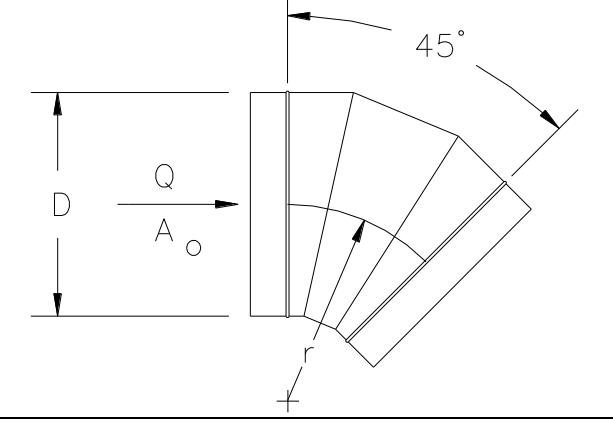
Rectangular Wyes and Tee's – Supply Ductwork (see Table 5 in Part 3)

<p> $A_s = A_b \geq A_c$ $r/W_b = 1.0$ </p>	<p> $L = 4in.(100mm)$ </p>
<p>SR5-1</p> <p> $L = 0.25W_b, 3 \text{ in. (75mm) min.}$ </p>	<p>SR5-12</p> <p> $r/W_c = 1.5$ $Q_{b1}/Q_c = Q_{b2}/Q_c = 0.5$ $W_{b1} = W_{b2} = W_b$ </p>
<p>SR5-13</p> <p> SMACNA Fig. 4A/4B </p>	<p>SR5-14</p>

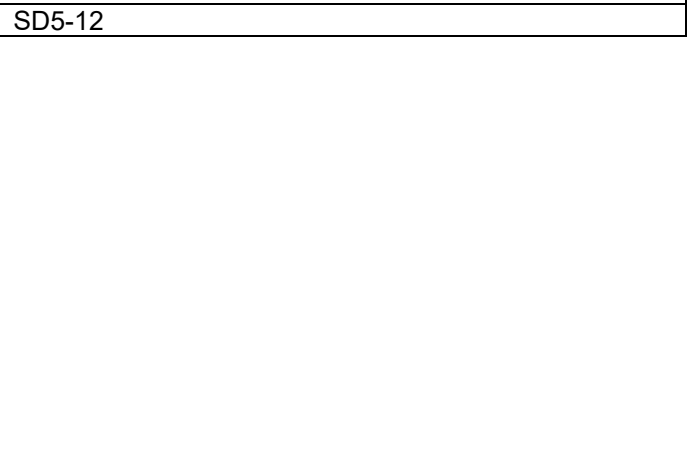
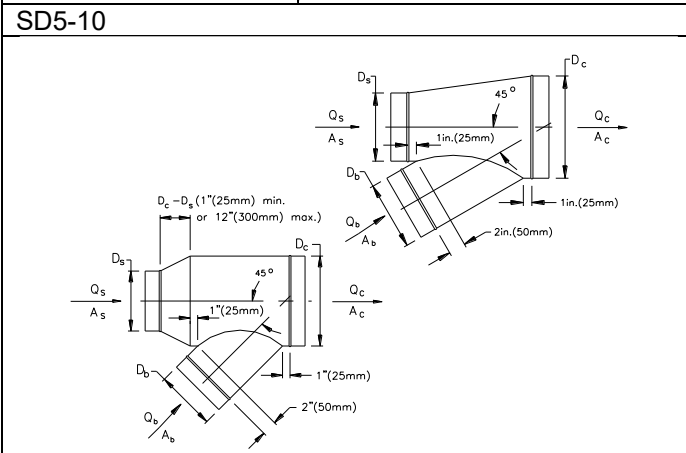
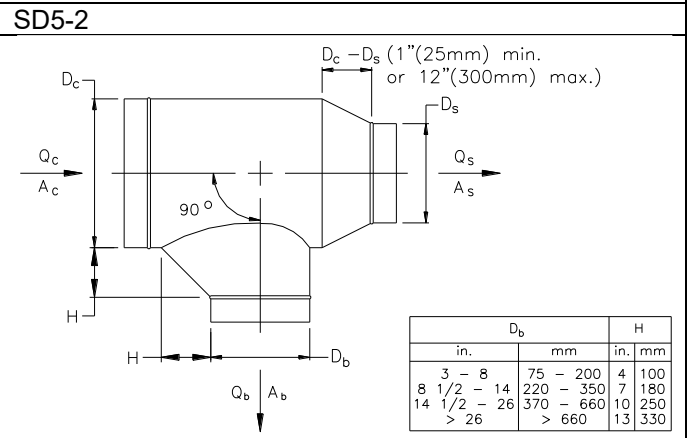
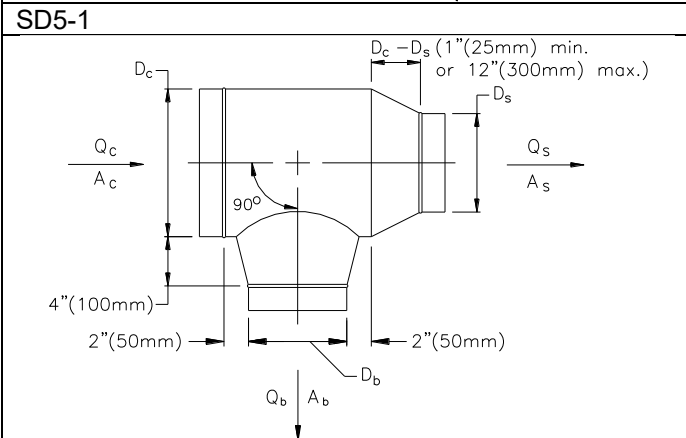
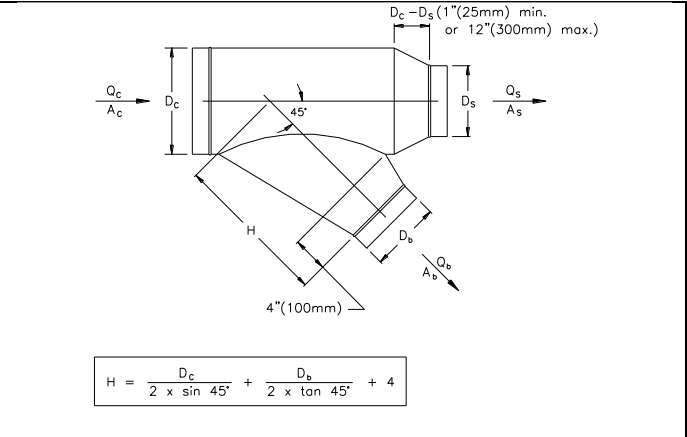
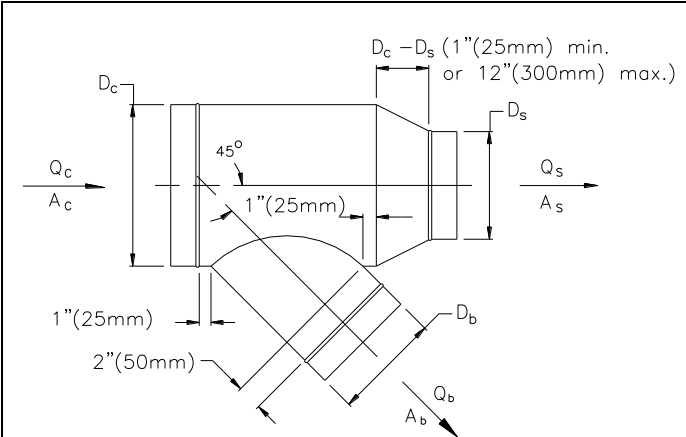
Rectangular Wyes and Tee's – Return/Exhaust Ductwork (see Table 5 in Part 3)

 <p>$A_s + A_b \geq A_c$ $r/W_b = 1$</p>	 <p>$L = 0.25 W, 3 \text{ in. (75 mm) min.}$ $A_s = A_c$ $A_b/A_c = 0.5$</p>
<p>ER5-1</p>  <p>$r/W_c = 1.5$ $Q_{b1}/Q_c = Q_{b2}/Q_c = 0.5$ $W_{b1} = W_{b2} = W_b$</p> <p>ER5-4</p>	<p>ER5-3</p>

Round Elbows (see Table 6 in Part 3)

	
CD3-1	CD3-3
	
CD3-9	CD3-10
	
CD3-14	

Round Wyes and Tees (see Table 7 in Part 3)



ED5-2

END OF SECTION

DUCT ACCESSORIES

23 33 05

1 GENERAL

1.1 Scope

- .1 Provide duct accessories as shown.

1.2 Applicable Codes and Standards

- .1 Product standards:
 - .1 ULC-S110 Standard Methods of Test for Air Ducts

1.3 Submittals

- .1 Submit product data sheets for:
 - .1 flexible fan connectors,
 - .2 sealants,
 - .3 tapes,
 - .4 duct access doors and hardware,
 - .5 instrument test ports.

2 PRODUCTS

2.1 Duct 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).
- .3 Operating pressure: tested to operate at 2.5 kPa (10 in.w.c.) duct static air pressure,
- .4 Meets requirements for SMACNA Class A, B and C duct sealing requirements.
- .5 Listed to ULC-S102 with flame-spread rating of 25 or less and smoke-development classification of 50 or less.
- .6 LEED requirements:
 - .1 meets requirements for LEED BD+C v4 credit for low emitting material – Paints and Coatings.
 - .2 manufacturer to supply documentation demonstrating compliance.

Standard of Acceptance

- Bakor - fig. Duck-Seal
- RCD - fig. #6 Mastic
- Childers - fig. CP-146
- McGill Air Seal - fig. United Duct Sealer (Water Based)
- Duro Dyne - fig. DWN (water based)

2.2 Tape

- .1 Polyvinyl treated open weave glass fibre tape, 50mm (2") wide.

2.3 Access Doors for Standard-Duty Ducts

- .1 Application: for general purpose HVAC ductwork.

- .2 Low-pressure access doors:
 - .1 manufactured duct access doors, of same material as associated duct,
 - .2 pressure rating: 500 Pa (2 in.w.c.) positive and negative pressure,
 - .3 door panel:
 - (a) double-wall construction encapsulating 25 mm (1 in.) thick fibreglass insulation,
 - (b) minimum 0.7 mm (24 ga.) sheet thickness for both inner and outer panel,
 - (c) inside face of access door does not protrude into interior space of duct,
 - .4 door frame: minimum 0.7 mm (24 ga.) thick channels, with mounting tabs and neoprene door gasket,
 - .5 door size: 150x150 mm (6 x 6 in.) up to 600x600 mm (24x24 in.)
 - .6 door hardware:
 - (a) hinge: continuous length, galvanized steel piano hinge of same material as door,
 - (b) latch - standard: galvanized steel cam-latch,
 - (c) latch – secured: common-key operated latch,
 - (d) security chain when only provided with cam-latches.

Standard of Acceptance

- Ductmate
- Duro-Dyne

2.4 Instrument Test Ports

- .1 Manufactured test ports:
 - .1 nominal size: Ø25 mm (1 in) minimum inside diameter, length to suit insulation thickness,
 - .2 extended body to accommodate 25 and 50 mm (1 and 2 in.) insulation thickness as applicable to the duct system,
 - .3 1.6 mm (16 ga.) thick steel body zinc plated after manufacture,
 - .4 chain-secured neoprene expansion plug with cam lock handle,
 - .5 Neoprene mounting gasket: flat for rectangular duct and moulded for round duct.

Standard of Acceptance

- Duro-Dyne - fig. TH1 or IP2

- .2 Sealant for test port: high temperature silicone.

Standard of Acceptance

- Duro-Dyne - fig. Red High Temperature Silicon

3 EXECUTION

3.1 Sealant and Tape

- .1 Apply sealant to ductwork joints and seams as detailed in other sections.
- .2 Use of tape is limited to low-pressure systems requiring Class C

3.2 Access Doors for Standard Ducts

- .1 Provide access doors in HVAC standard ducts in accordance with the following table:

Access Point	Location
Reheat coils	Both sides of coil
Fire dampers - replaceable thermal link type	Either side of damper
Motorized fire dampers, smoke dampers and combination smoke fire	On actuator side of damper
Motorized Dampers	Either side of damper
Duct smoke detectors	Across from or beneath sensor tube
Bottom of duct risers	Bottom of duct riser, or on backside of elbow

- .2 Weld door frames in place for high velocity ductwork having air velocities in excess of 10 m/s (2500 fpm).
- .3 Access 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.

3.3 Instrument Test Ports

- .1 Install test ports 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 test ports for velocity traverses in the following locations:
- .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 ducts where branch serves more than one outlet. Ports in main to be upstream of branch in both diverging and converging flow.
- .4 Install test ports 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

MANUAL BALANCING DAMPERS

23 33 13.11

1 GENERAL

1.1 Scope

- .1 Provide manual balancing dampers.
- .2 This section does not apply to dampers installed in kitchen grease exhaust duct systems.

2 PRODUCTS

2.1 Splitter Dampers

- .1 Shop-fabricated, single thickness construction, of same material as duct but one sheet metal gauge thickness heavier where both dimensions of damper blade are less than 300 mm (12 in).
- .2 Double thickness construction, one metal gauge thickness lighter than duct, where either dimension of damper blade is 300 mm (12 in) or larger,
- .3 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 Manufactured product.
- .2 Blades and shaft:
 - .1 constructed of same material as the duct, with longitudinal V-grooves,
 - .2 blade thickness: 1.0 mm (20 ga.) minimum,
 - .3 blade length: 915 mm (36 in) maximum.
 - .4 bronze bearings,
 - .5 shaft extension with locking quadrant with 50 mm (2 in.) stand-off bracket.
- .3 Frame:
 - .1 channel section of same material as duct, minimum 1.3 mm (18 ga.) thickness,
 - .2 angle blade stop.

Standard of Acceptance

- ° Nailor - fig. 1870
- ° Ruskin
- ° Greenheck

2.3 Multi-Blade Dampers in Rectangular Ductwork

- .1 Manufactured product.
- .2 Blades and shaft:
 - .1 constructed of same material as the duct, with longitudinal V-grooves,
 - .2 opposed blade configuration, with link assembly located out of airstream,
 - .3 blade thickness: 1.6 mm (16 ga.) minimum,
 - .4 blade height: 150 mm (6 in) maximum,

- .5 blade length: 1200 mm (48 in) maximum.
- .6 synthetic polymer or bronze bushings,
- .7 shaft extension with locking quadrant with 50 mm (2 in.) stand-off bracket.
- .3 Frame:
 - .1 channel section of same material as duct, minimum 1.6 mm (16 ga.) thickness,
 - .2 angle blade stop,

Standard of Acceptance

- Nailor - fig. 1820
- Ruskin
- Greenheck

2.4 Single Blade Dampers in Round Ductwork

- .1 Manufactured product.
- .2 Blades and shaft:
 - .1 constructed of same material as the duct,
 - .2 blade thickness: 0.86 mm (22 ga.) minimum,
 - .3 blade diameter: Ø100 to 500 mm (4 to 20 in. dia.),
 - .4 bearings: synthetic self-lubricating bushing,
 - .5 shaft extension with locking quadrant with 50 mm (2 in.) stand-off bracket.
- .3 Frame:
 - .1 round duct section of same material as duct, minimum 0.86 mm (22 ga.) thickness, with stiffening beads,
 - .2 angle blade stop,
 - .3 stand-off bracket for locking quadrant for insulated ducts.

Standard of Acceptance

- Nailor - fig. 1890
- Ruskin
- Greenheck

2.5 Single Blade Dampers in Round Ductwork with Remote Cable Adjustment

- .1 Manufactured product.
- .2 Blades and shaft:
 - .1 constructed of same material as the duct,
 - .2 blade thickness: 1.0 mm (20 ga.) minimum with V brake centreline,
 - .3 blade diameter: Ø100 to 500 mm (4 to 20 in. dia.),
 - .4 bearings: synthetic self-lubricating bushing,
 - .5 shaft extension with 50 mm (2 in.) stand-off bracket.
- .3 Frame:
 - .1 round duct section of same material as duct,

- .2 wall thickness:
 - (a) Ø100 to 250 mm (4 to 10 in. dia.): 0.7 mm (24 ga.)
 - (b) Ø300 to 500 mm (12 to 20 in. dia.): 1.0 mm (20 ga.).
- .3 angle blade stop,
- .4 stand-off bracket for insulated ducts.
- .4 Remote cable operator:
 - .1 damper blade gear operator:
 - (a) self-locking worm-gear regulator, suitable for 9.5 mm (3/8 in.) square or Ø13 mm (½ in.dia) damper shaft,
 - .2 flex-shaft cable:
 - (a) Ø6 mm (1/4 in.dia.) multi-core wound cable in flexible non-binding protective sheath,
 - (b) length: standard and custom lengths up to 15 m (50 ft),
 - (c) with brass end caps and threaded end fittings to attached to damper gear operator and adjustment operator,
 - .3 remote cable operator fixture:
 - (a) cable termination end for tool access,
 - (b) termination kit:
 - i) Ø60 mm (2-1/4 in. dia) zinc coated termination access housing, with prime coated cover plate, for self-clamping installation in drywall ceilings,
 - ii) remote cable operator kit for installation in slot diffuser plenum to allow tool access through diffuser slot.

Standard of Acceptance

- ° Young Regulators - fig. 5020CC with 270-275 cable operator

3 EXECUTION

3.1 Balancing Damper Locations and Type

- .1 Provide balancing dampers in the following locations:
 - .1 at floor branches from a duct riser, use a single or multiple blade damper in the branch duct,
 - (a) where a wye-fitting is installed directly after the duct riser take-off, provide a balancing damper in each outlet branch after the wye fitting,
 - .2 for supply branch ducts that do not directly serve outlet grilles or diffusers, use a single or multiple blade damper in the branch duct,
 - .3 for exhaust or return branch ducts that do not directly serve inlet grilles, use a single or multiple blade damper in the branch duct,
 - .4 for branch duct which directly serve three or more grilles or diffusers (supply, return or exhaust), use splitter damper in the take-off fitting, or use a single or multiple blade damper in the branch duct,
 - .5 on the inlet to a supply air terminal unit, use a damper of the style to match the inlet duct connection to the air terminal unit,
 - .6 on the outlet from a return or exhaust air terminal unit, use a single or multiple blade damper in the branch duct.
- .2 Provide other manual dampers as shown.

3.2 Access for Adjustment

- .1 Locate dampers to allow adjustment of blade position and for locking of the quadrant.

3.3 Remote Cable Adjustment Station

- .1 Use round balancing dampers with remote cable operators where:
 - .1 ceiling height is greater than 3.0 m (10 ft),
 - .2 ceiling height is less than 3.0 m (10 ft) and is not accessible, or
 - .3 elsewhere at the Contractor's discretion.
- .2 Review with Consultant approximate location for each group of remote cable operators;
 - .1 exception: Consultant's review is not required when remote cable operator is located in a slot diffuser plenum.
- .3 Group operators together within the limits of the allowable cable length.
- .4 For ceilings up to 3.0 m (10 ft) in height, remote cable operators may be located in the following locations:
 - .1 within slot diffuser plenums, or
 - .2 mounted in or immediate above ceilings, with termination kit which passes through the ceiling to allow adjustment tool access from below ceiling.
- .5 For ceilings greater than 3.0 m (10 ft) in height, group remote operators together in wall chase access in locations agreed by Consultant, positioned between 1200 and 1800 mm (4 and 6 ft) above the floor. Provide a wall mounted access cover with screwdriver door operator and prime coated finish.
- .6 Where a service room, including mechanical rooms, electrical rooms, and janitor closets are available, mount the remote cable operator in those rooms on a wall mounted bracket. A panel enclosure is not required.
- .7 Label each remote cable operator with a unique reference number, and mark-up as-built drawings to include the reference number for each applicable balancing damper.

END OF SECTION

RADIANT CEILING PANELS

23 83 16

1 GENERAL

1.1 Scope

- .1 Demolish radiant ceiling panels as shown.

2 PRODUCTS

2.1 Ratings

- .1 Assume existing radiant panels meet the capacities below:
 - .1 Entering water temperature: 93°C (200°F)
 - .2 Water temperature drop: 11°C (20°F)
 - .3 Ambient air temperature: 19.5°C (67°F) and natural convection.
- .2 design pressure: 1000 kPa (150 psi)

2.2 Linear Ceiling Panels

- .1 Construction:
 - .1 aluminum extrusions with 13 mm (½ in) copper tubing mechanically attached and thermally connected with heat conductive paste.
- .2 Edge mouldings:
 - .1 aluminum extrusions for exposed linear panels as shown.
- .3 Drywall frame:
 - .1 aluminum sections with welded corners, with finishing flange suitable for drywall installation.

3 EXECUTION

3.1 Co-ordination

- .1 Co-operate with other trades working within ceiling space.

3.2 Panel Demolition

- .1 Assume ceiling side of panels are insulated with 50 mm (2") fibreglass bat insulation. Insulation extends 100 mm (4") beyond edges of panel.
- .2 Demolish all piping, valves, fittings, and other ancillaries.
- .3 Demolish all controls unless they are shared with other existing panels to remain.

END OF SECTION

**Electrical
Specifications**

FOR

M2 OR3 and OR4 Lead Lining Project

Sunnybrook Health Sciences Centre

2075 Bayview Avenue

Toronto, Ont.

M4N 3M5

Issued for Tender
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LIST OF SECTIONS
26 00 01

DIVISION 26

26 00 01 – LIST OF SECTIONS
26 05 01 - ELECTRICAL GENERAL REQUIREMENTS
26 05 10 - FIRE STOPPING & SMOKE SEALS
26 05 19 - WIRES & CABLES 0-1000 VOLTS
26 05 27 - GROUNDING SECONDARY
26 05 29 - FASTENINGS AND SUPPORTS
26 05 32 - SPLITTERS, JUNCTION AND PULL BOXES, CABINETS
26 05 33 - CONDUITS, FASTENINGS AND FITTINGS
26 05 35 - OUTLET BOXES, CONDUIT BOXES AND FITTINGS
26 08 19 - PROJECT CLOSE-OUT ELECTRICAL
26 27 26 - WIRING DEVICES
26 27 27 - OCCUPANCY SENSOR SWITCHES
26 27 28 - WIRE AND BOX CONNECTORS 0-1000 V
26 28 16 - MOULDED CASE CIRCUIT BREAKERS
26 51 13 - LIGHTING

DIVISION 28

28 08 15 - 3RD PARTY FIRE ALARM VERIFICATION
28 31 13 - FIRE ALARM SYSTEM

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 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.
- .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 gasketed 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*
 - o Zurn Industries Canada Ltd. - Inspectors
 - o LeHage Industries Ltd.
 - o A. G. Baird Limited - ABCO
 - o 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 (1/8") 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 (c") 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 (c") high
4	20 x 90 mm (1" x 4")	1 line	8 mm (d") 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 lamicon plate designating panel name.
- .11 Typical Identification Standards
 - .1 Lighting, Receptacle and Power panels to each be identified with an engraved lamicon 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

- o W. M. Brady Co. of Canada Limited - B350
- o 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 (1/8") 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 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.

6.16 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.

6.17 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.

6.18 **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.

6.19 **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.

6.20 **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.

6.21 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.

6.22 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

6.23 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.

6.24 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.

6.25 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 Allpriser 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) calendar 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 Coordinator, 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.



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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) Profirestop (Tel: 416-293-0993)
- (d) RILI Firestopping (Tel: 905-349-3779)
- (e) 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 on 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

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.

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.

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 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.

3.3 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

3.4 **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 EI 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 be 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.

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. 56 Flexible Metal and Liquid-Tight Flexible Metal Conduit
- .3 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 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.
- .3 Use EMT conduit for branch circuit and signal wiring in ceilings, furred spaces, and in hollow walls and partitions.
- .4 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]
- .5 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.]
- .6 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.
- .7 Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.
- .8 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.
- .9 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 Flexible metal conduit and liquid-tight flexible metal conduit.
- .3 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 Raintight insulated throat steel compression connectors and couplings for EMT.
- .4 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

2.5 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 liquid tight flexible metal conduit for connection to motors or vibrating equipment
- .5 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .6 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.
- .7 Install wiring in conduit unless otherwise specified.
- .8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 19mm (3/4") dia.
- .10 Install fish cord in empty conduits.
- .11 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .12 Dry conduits out before installing wire.
- .13 Conduit manufacturer's touch up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.
- .14 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.
- .15 Where EMT is used, run green insulated ground wire in conduit, with minimum one ground conductor per three ungrounded conductors.
- .16 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints.

- .17 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 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.

2.5 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

SPECIAL HOSPITAL WIRING

26 07 05

PART - 1 GENERAL

1.1 DESCRIPTION

- .1 Patient care areas are as follows:
 - .1 Intermediate Patient Care Areas
 - .2 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 minimum ¼" (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 minimum ¼" (6 mm) high and shall be white letter on black lamacoid

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 Intermediate and 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°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 Other Isolated Power Centres as shown
 - .2 receptacles,
 - .3 cover plates,
 - .4 conduits,
 - .5 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

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 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 Z32-21 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-Z32-21 "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 Intermediate Care Areas; and
 - .2 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 Z32-21.

- .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

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:	<input type="checkbox"/> Reviewed <input type="checkbox"/> <u>Incomplete or deficient - resubmit</u>
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:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

END OF SECTION

WIRING DEVICES 26 27 26

GENERAL

REFERENCES

CSA C22.2 No. 111-M1986 Switches.

PART - 1 CSA C22.2 No. 42-M1984 Receptacles.

1.1 Section 26 28 19 - Ground Fault Circuit Interrupters.

.1

.2

.3

1.2

.1

1.3

.1

SHOP DRAWINGS AND PRODUCT DATA

Submit shop drawings and product data in accordance with 26 05 01 Electrical General Requirements.

IDENTIFICATION

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.

PRODUCTS

PART - 2

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

.1 Manually-operated general purpose ac switches with following features:

.2

Terminal holes approved for No. 10 AWG wire.

.3

Silver alloy contacts.

.4

.5

Urea or melamine moulding for parts subject to carbon tracking.

.3

Suitable for back and side wiring.

.4

White coloured "rocker" toggle.

.5

Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

Switches of one manufacturer throughout project.

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

Combination switches shall have neon pilot light and jewel on stainless steel plate

Standard of Acceptance

- Pass & Seymour
- Harvey Hubbell of Canada Ltd.
- Bryant Electric
- Cooper Wiring Devices
- Leviton

DIMMER SWITCHES

Dimmers for use on LED Luminaires shall be equal to Lutron, "Nova Series", LED compatible as noted and white cover plates.

Matching switches shall be used adjacent to dimmers.

Where more than one dimmer is shown in the same location, mount dimmers in individual backboxes. Provide matching switches where shown adjacent to dimmers.

RECEPTACLES

Receptacles shall be decorator style to be complete with following features:

- urea moulded housing.
- Suitable for no. 10 AWG for back and side wiring
- Break-off links for use as split receptacles.
- Eight back wired entrances, four side wiring screws.
- Triple wipe contacts and rivetted grounding contacts.
- receptacles to be Heavy duty Hospital grade type

Receptacles of one manufacturer throughout project.

Receptacles shall be colour coded as follows:

- Normal power: white
- Emergency power: red

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

The receptacles listed below represent the most common configurations available and are not necessarily used on this project. Refer to drawings for types used.

Duplex receptacle: 15 ampere, 120 volt, grounded CSA Configuration 5-15R:

.1 *Standard of Acceptance*

.2

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
.4 gasketed cast plate and hinged covers, equal to Leviton No. 4926 (vertical).

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

2.4

.1

COVER PLATES

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.

Cover Plates shall be finished as follows:

Light Switches: White

Receptacles, Normal power: gray

Receptacles, Emergency power: red

.2

.1 Cover plates for wiring devices. Cover plates from one manufacturer throughout project.

.2 Stainless steel 18-8 chrome metal alloy, Type 302, vertically brushed, 1 mm (1/32")
.3 thick cover plates for wiring devices mounted in flush-mounted outlet box.

.3

Cast cover plates for wiring devices mounted in surface-mounted FS or FD type
conduit boxes.

.1

Weatherproof double lift spring-loaded cast aluminum cover plates, complete with
gaskets for duplex receptacles as indicated.

.2

.3

Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for
single receptacles or switches.

.4

Letters shall be 6 mm (1/4") high filled with red paint where engraving is indicated.
Engraving shall be parallel to finished floor level.

.5

Standard of Acceptance

- Pass & Seymour #93000 Series
- Harvey Hubbell of Canada Ltd. #93000 Series
- Bryant Electric #S600 Series
- Leviton #84000 Series
- Cooper #93000 Series

2.5

GROUND FAULT CIRCUIT INTERRUPTERS

.1

.2

Units shall be CSA approved Type A.

.3

Ground fault circuit interrupters (GFCI) shall be complete with receptacle, test feature and
reset switch.

.4

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.

.5

.6

Units in Hospitals to be hospital grade.

Unless noted otherwise, unit shall trip at 6 mA.

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

EXECUTION

INSTALLATION

Switches

Install single throw switches with handle in "UP" position when switch closed.

PART - 3

3.1

Install switches in gang type outlet box when more than one switch is required in one location.

.1

Mount toggle switches at height specified in Section 26 05 01 - Electrical General Requirements or as indicated.

.1

.2

Receptacles

.3

Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2

.1

Mount receptacles at height specified in Section 26 05 01 - Electrical General Requirements or as indicated.

.2

Connect receptacle grounding terminal to the outlet box with an insulated green ground strap.

.3

Exact position of service fittings shall be verified to suit furniture layout.

.4

Do not mount receptacles directly on a column, unless column has been appropriately furred, to avoid breaking fire barrier.

.5

.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

.4

Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.1

Ground fault circuit interrupters:

Mount receptacles at height indicated in Section 26 05 01 - Electrical General requirements or as indicated.

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

ISOLATED POWER SYSTEMS

26 26 27 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.
- .2 **There are two Isolated Power systems involved in this Project as follows:**
 - **IPC – OR3 which is a 5kVA, 208 volt to 120 volt, single Phase and to be installed flush mounted**
 - **IPC – OR4 which is a 5kVA, 208 volt to 120 volt, single Phase and to be installed flush mounted**

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

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: not exceeding 25 Micro Amps
- .9 Ratings:
 - .1 208/120 volts or 208/208 volts as noted, 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/ 20 Ampere rating, 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.

Standard of Acceptance

Bender (contact is Hinad Ahmed, Sales Application Engineer | Sales Department
Tel: +1 (647) 616-8030 | E-Mail: hinad.ahmed@bender-ca.com)

PART 3 - EXECUTION

1.13 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 built-in 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 laser receptacles where indicated.
- .6 Flush mount IPC's, alarm indicators and receptacles, unless indicated otherwise.
- .7 Provide wiring from each I.P.C. to receptacles and outlets shown.
- .8 Provide wiring in accordance with Section 26 07 06 Wiring of Isolated Power Systems.
- .9 Connect the ground bus in each IPC to a corresponding ground bus in the up stream power panel with an insulated green ground wire, sized not less than required by code and run in the feeder conduit.
- .10 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

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 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 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.

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

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

PART - 3 EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Verify quantity of luminaires before placing orders.
- .3 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.
- .4 Co-operate with other trades to ensure proper installation of lighting luminaires.
- .5 Carefully align luminaires, shown in continuous lines or rows, so that rows appear as straight lines.
- .6 Mount luminaires perfectly level or plumb. Luminaires shall fit tightly to ceiling without showing a space or light leak between frame and ceiling.
- .7 Take down any improperly installed luminaires and re-install without expense to Owner.

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.

3.3 LUMINAIRE LIST

- .1 Luminaire manufacturers are listed in alphabetical order and not in order of preference.

LA	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
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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.

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 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")

- .7 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.
- .8 Interference shall be minimized by ensuring that, wherever possible, communications conductors cross sources of interference at right angles.
- .9 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

GENERAL

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

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 Scope to include:
 - .1 Installing all new Data Jacks and Cabling to the existing Hub Room
 - .2 Installing new Cat 6 Patch Panels in the existing Hub Room
 - .3 Supplying Patch Cables

Installations in existing Hospital Network Hub Rooms:

- .1 Access to Sunnybrook Hospital Network Rooms is severely restricted and Contractors will not be allowed to access these rooms un-escorted/ un-supervised. To complete this installation the following applies:
 - 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 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
 -
- .5 **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**
- .6 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.
- .7 **INSTALLATION STANDARDS**
- .1 The following are typical outlet types used on this project:
- typical Data/ VoIP outlet consisting of a single gang box with two 'RJ-45' data jacks and two '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
- .2 All Data 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 **CMF (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 Cables must have a orange coloured insert.
- .8 All **Data 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. .
- .9 All drop locations and quantities to be confirmed prior to the start of the installation.
- .10 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.
- .11 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.
- .12 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**.
- .13 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.
- .14 All Patch Cords shall be factory assembled and not site prepared.

8 INSTALLATION REQUIREMENTS, WORKSTATION

- .1 All Data 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.

9 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 defence costs and expenses in connection therewith.

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 manufacture the product used in this cabling system.

10 MANUFACTURER

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.

11 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.

12 COMMUNICATIONS CONTRACTOR

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.

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.

13 INSTALLATION GENERAL REQUIREMENTS

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 hangers, 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.

14 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, 10BASE-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:
 - .5 Maximum DC resistance 28.6 S/1,000 ft (9.38S/100m) Maximum DC resistance
 - .6 Unbalance: 5% Mutual Capacitance @1kHz: 14nF/1,000 f
 - .7 Mutual Capacitance Unbalance (pair to ground): 40OpF/1,000 ft (131.2 pF/100m)
 - .8 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
 - .9 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
 - .10 Pair to Pair Next (db) at 1,000 ft (305 m):

FREQUENCY		EIA STANDARD	90 TH PER
1.0 MHZ		62	68
4.0 MHZ		53	59
8.0 MHZ		48	54
10.0 MHZ		47	53
16.0 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

6. UL Listed

7. 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.

15 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 megohms.
 - 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:
- n. The modular cord assembly shall meet or exceed the short link NEXT requirements of 34 dB when tested with enhanced Category 5 connecting hardware.
 - o. The modular cord assembly shall meet the requirements per the latest issue of ANSI/TIA/EIA-568
 - p. The modular cord assembly shall meet the requirements per the latest issue of ISO/IEC 11801
 - q. The modular cord assembly shall be UL listed as a Communication Cable Assembly.
 - r. The modular cord assembly shall be CSA Certified as a Communication Cord Set.
 - s. 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.
 - t. 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.

16 COMMUNICATIONS CONNECTING CORDS, DEVICES AND ADAPTERS

- .1 Data Patch Cords
- .1 For each data drop installed provide one (1) patch cord at the patch panel end. Provide quantities as follows:
- .1 100% 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. .3 Provide quantities as follows:
- .1 100% 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.

4.6 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 lamicaid 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

17 COMMISSIONING OF COMMUNICATIONS

1.1 GENERAL

- i. Provide Commissioning Verification, Inspection and Certification.
- ii. Provide commissioning verification, inspection and certification of all communications cables installed.
- iii. 100% of all cables installed must be tested, and certified.

B. COPPER CABLE TEST REQUIREMENTS

- i. 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.
- ii. 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.
- iii. 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.
- iv. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests.
- v. The test equipment (tester) shall comply with the accuracy requirements for Level III field testers as defined in TIA-568-B.1
- vi. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
- vii. 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.
- viii. 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*.
- ix. 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.

- x. 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.
- xi. 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.

C. COPPER CABLE TEST STANDARDS

- i. Test all horizontal copper cable links to Category 6 standards.
- ii. 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.
- iii. 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.

D. TEST RESULT DOCUMENTATION

- i. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test.
- ii. 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.
- iii. 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.
- iv. 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.
- v. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information
- vi. The identification of the link in accordance with the naming convention defined in the overall system documentation.
- vii. For OTDR testing include all ray traces and graphical outputs.
- viii. The date and time the test results were saved in the memory of the tester. Ensure that the correct information has been entered.
- ix. Test results must be received by the Consultant for review within 2 weeks of completion of testing or they will be considered void.

E. CLEAN-UP

i. 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.

F. OCCUPANCY

i. 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.

18 EXECUTION

- .1 Data Cable Installation
- .1 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.
- .2 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.
- .3 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

**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

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

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 1/4 W, 1/2 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



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

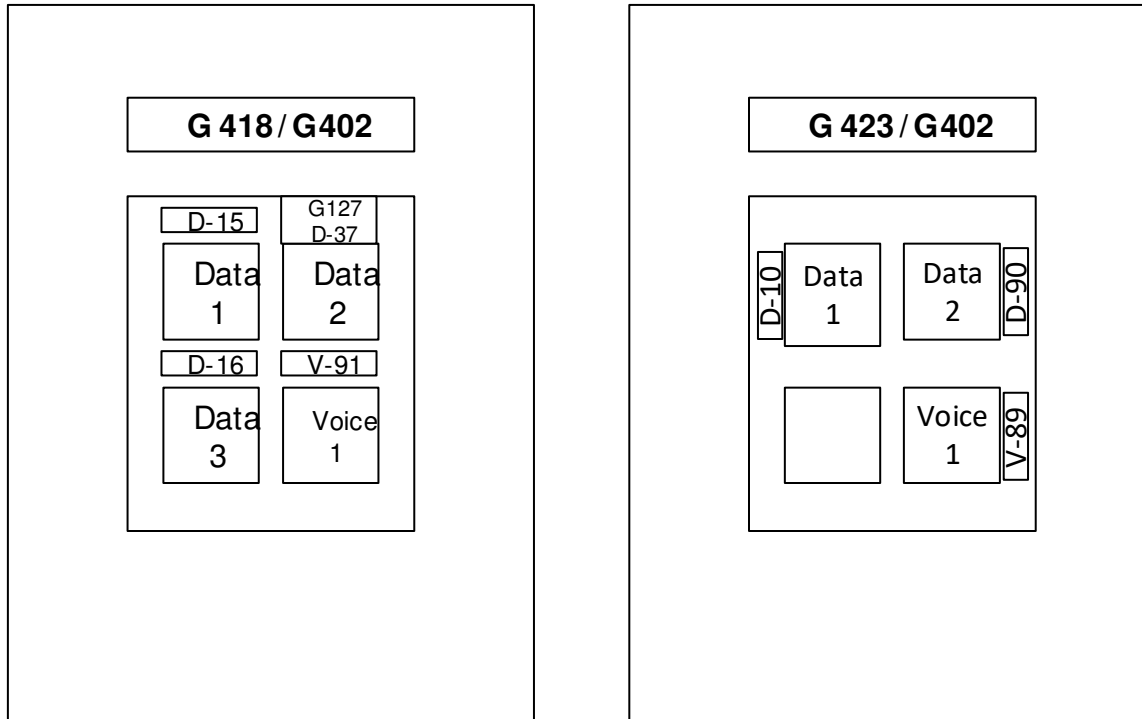
1. No ceiling space shall be accessed without a valid Ceiling Access Permit (CAP) received from the Occupational Health and Safety Coordinator and properly displayed.

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 V-91 D- 37

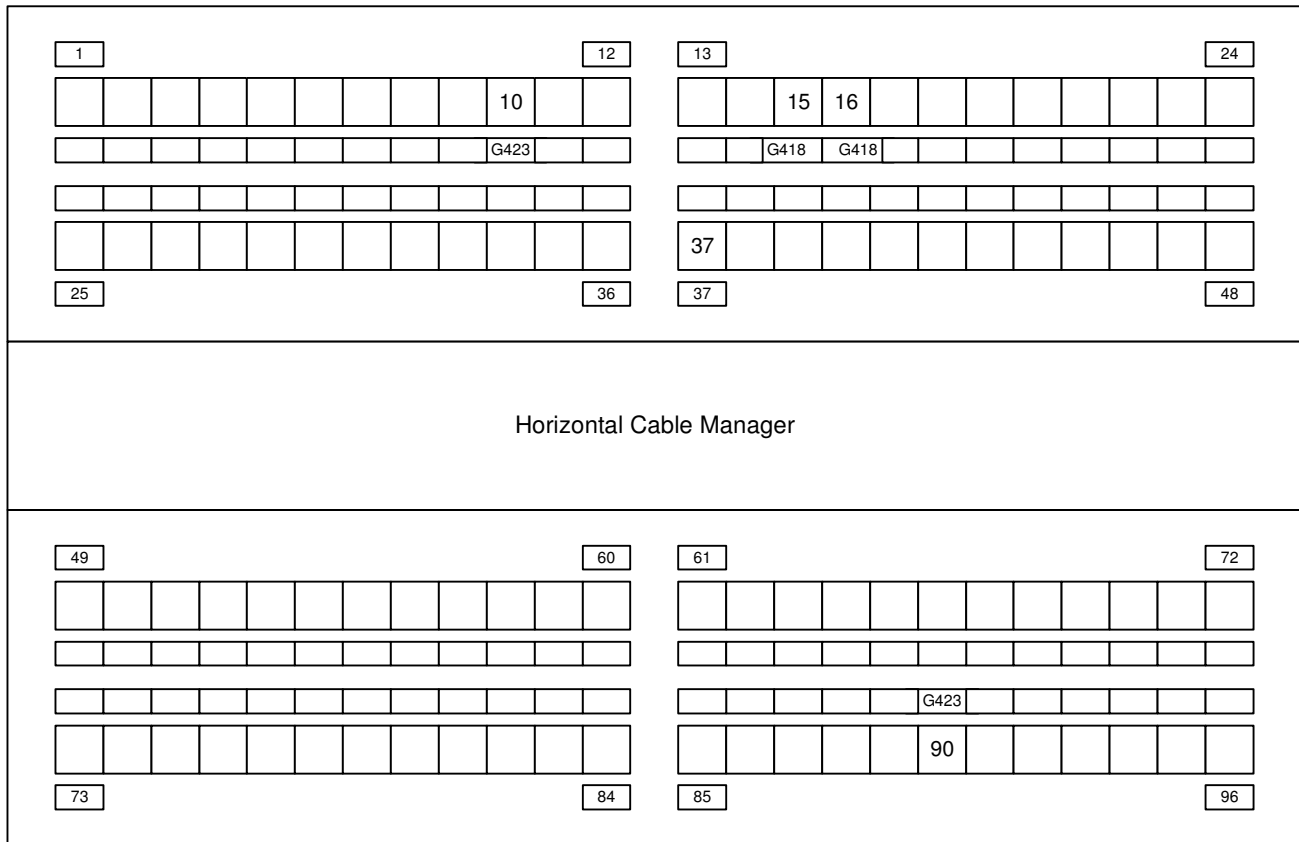
- where - 'D-15' is data cable terminating on patch panel port 15 in hub room G402
 - 'D-16' is data cable terminating on patch panel port 16 in hub room G402
 - 'G127 D-37' is data cable terminating on patch panel port 37 in hub room G127 (exception cable to a different hub room)

- 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

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 be 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.

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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 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 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.

OWNER'S RULES AND REGULATIONS

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 *OHS*A;
 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 (*OHS*A) 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 brought 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:

<u>Designated Substance</u>	<u>Location</u>
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



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)	03/10/2022
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](#) (IPAC-0006)

[Mould Management](#) (IPAC-0015)

[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 IP&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 contractors 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 B - Contractor Safety Checklist**

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Infection Control during Construction, Renovation and Maintenance

Sunnybrook Health Sciences Centre		Policy No:	IPAC-0006
Title	Infection Control during Construction, Renovation and Maintenance	Original: (mm/dd/yyyy)	01/01/2001
Category	Policies & Guidelines	Reviewed: (mm/dd/yyyy)	09/01/2007, 03/09/2010, 03/08/2012, 11/11/2013, 11/20/2017
Sub-Category	Infection Prevention & Control	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:

An air filter with an efficiency of 99.97% in the removal of airborne particles 0.3 μ 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:

1. Number, location and type of airborne infection isolation rooms
2. Air-handling and ventilation needs in special areas such as operating theatres, critical care units, laboratories, etc.
3. Water systems to limit exposure to opportunistic water-borne organisms
4. Minimum spacing requirements
5. Sink selection and placement (see [Sink Standards](#))
6. Finishes and surfaces
7. 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)
- 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 Manager 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 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.

4. Post-Construction Phase:

a. 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 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)

b. 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.

At the completion of construction, prior to containment barrier removal IP&C is to be notified to inspect.

Appendix II ([Click here to read / print Appendix II](#))

The image displays a grid of 24 pages from a Sunnysbrook High School textbook, organized into four columns and six rows. Each page features the school's logo and name at the top. The pages are numbered 1 through 24 in the top left corner. The content is divided into four main sections, each with a title and a list of activities or exercises.

- Section 1: Linear Functions** (Pages 1-4)
 - Page 1: Introduction to Linear Functions. Activities include: 1.1.1. Understanding the Slope of a Line, 1.1.2. Writing the Equation of a Line, 1.1.3. Graphing a Line.
 - Page 2: Linear Functions and the Real World. Activities include: 1.2.1. Understanding the Slope of a Line, 1.2.2. Writing the Equation of a Line, 1.2.3. Graphing a Line.
 - Page 3: Linear Functions and the Real World. Activities include: 1.3.1. Understanding the Slope of a Line, 1.3.2. Writing the Equation of a Line, 1.3.3. Graphing a Line.
 - Page 4: Linear Functions and the Real World. Activities include: 1.4.1. Understanding the Slope of a Line, 1.4.2. Writing the Equation of a Line, 1.4.3. Graphing a Line.
- Section 2: Quadratic Functions** (Pages 5-8)
 - Page 5: Introduction to Quadratic Functions. Activities include: 2.1.1. Understanding the Shape of a Parabola, 2.1.2. Writing the Equation of a Parabola, 2.1.3. Graphing a Parabola.
 - Page 6: Quadratic Functions and the Real World. Activities include: 2.2.1. Understanding the Shape of a Parabola, 2.2.2. Writing the Equation of a Parabola, 2.2.3. Graphing a Parabola.
 - Page 7: Quadratic Functions and the Real World. Activities include: 2.3.1. Understanding the Shape of a Parabola, 2.3.2. Writing the Equation of a Parabola, 2.3.3. Graphing a Parabola.
 - Page 8: Quadratic Functions and the Real World. Activities include: 2.4.1. Understanding the Shape of a Parabola, 2.4.2. Writing the Equation of a Parabola, 2.4.3. Graphing a Parabola.
- Section 3: Trigonometry** (Pages 9-12)
 - Page 9: Introduction to Trigonometry. Activities include: 3.1.1. Understanding the Sine Function, 3.1.2. Writing the Equation of a Sine Function, 3.1.3. Graphing a Sine Function.
 - Page 10: Trigonometry and the Real World. Activities include: 3.2.1. Understanding the Sine Function, 3.2.2. Writing the Equation of a Sine Function, 3.2.3. Graphing a Sine Function.
 - Page 11: Trigonometry and the Real World. Activities include: 3.3.1. Understanding the Sine Function, 3.3.2. Writing the Equation of a Sine Function, 3.3.3. Graphing a Sine Function.
 - Page 12: Trigonometry and the Real World. Activities include: 3.4.1. Understanding the Sine Function, 3.4.2. Writing the Equation of a Sine Function, 3.4.3. Graphing a Sine Function.
- Section 4: Probability and Statistics** (Pages 13-16)
 - Page 13: Introduction to Probability and Statistics. Activities include: 4.1.1. Understanding the Concepts of Probability and Statistics, 4.1.2. Writing the Equation of a Probability Distribution, 4.1.3. Graphing a Probability Distribution.
 - Page 14: Probability and Statistics and the Real World. Activities include: 4.2.1. Understanding the Concepts of Probability and Statistics, 4.2.2. Writing the Equation of a Probability Distribution, 4.2.3. Graphing a Probability Distribution.
 - Page 15: Probability and Statistics and the Real World. Activities include: 4.3.1. Understanding the Concepts of Probability and Statistics, 4.3.2. Writing the Equation of a Probability Distribution, 4.3.3. Graphing a Probability Distribution.
 - Page 16: Probability and Statistics and the Real World. Activities include: 4.4.1. Understanding the Concepts of Probability and Statistics, 4.4.2. Writing the Equation of a Probability Distribution, 4.4.3. Graphing a Probability Distribution.

Date: _____ Time: _____

Location: _____ Inspector: _____

Construction/Renovation/Repair site has been checked for:

ITEM	COMPLIANCE?		
	Y	N	N/A
1. Construction Barriers			
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.
Appendix III (Click here to read / print Appendix III) will be maintained by Infection Prevention and Control



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
	<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No		
	<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No		
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	<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No	<input type="radio"/> Yes <input type="radio"/> No		

(November 2017)

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: 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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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)	02/10/2022
Sub-Category	OccHealth & Safety	Revised: (mm/dd/yyyy)	Feb. 2007, Nov. 2009, Dec. 2011, Dec. 2012, Nov. 2015, Jan 2020
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, Health Care Regulation, O.Reg. 67/93, and Confined Space Regulation, O. Reg 632/05.

This policy applies to all employees and contractors engaged in confined space and restricted space entry (at all Sunnybrook campus).

The procedures in **Sections 1.0-15.0** of this document outline the requirements for:

1. **Identification of Restricted or Confined Spaces**
2. **Hazard Assessment**
3. **Entry Plan**
4. **Coordination Document**
5. **Entry Permits & Entering Confined/Restricted Spaces**
6. **Training**
7. **Emergency Response & Equipment**
8. **Isolation & Control of Material Movement**
9. **Atmospheric Testing**
10. **Ventilation & Purging**
11. **Explosives, Flammables or Combustibles**
12. **Warning Signs & Barricades**
13. **Equipment in Confined Spaces**
14. **Contractors**
15. **Records**

DEFINITION(S):

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/restricted 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 safely and properly.

Related Work

Work that is performed near a confined/restricted space in direct support of the work inside the confined/restricted 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.

ROLES AND RESPONSIBILITIES

Employer:

- Control access to and authorizing work in confined and restricted spaces.
- Ensure employees are informed of the existence, location of, and the danger within confined and restricted spaces by posting danger signs or by any other

equally effective means

Manager/Supervisor/Project Leader

- Ensure staff and/or contractors working under their supervision understand the general and specific procedures, and know how to conduct their confined/restricted space tasks safely
- Ensure staff and/or contractors conducting work related to confined/restricted spaces are adequately trained.
- Provide staff with all specified equipment required for entry in a confined or restricted space as outlined in this program, maintain the equipment, and ensure that employees use that equipment properly
- Inform contractors entering the space must be informed of all aspects of the hazard assessment, control plan and testing results.
- Provide plan-specific training, as required
- When contractors are used for confined/restricted space entry, verify that the contractors are adequately trained in confined/restricted space work and have appropriate personal protective equipment
- Prepare a coordination document if workers of more than one employer perform work in the same confined space or related work with respect to the same confined space and share this document to employer of each worker who performs work in the same confined space and JOHSC.
- Ensure a written entry plan and on-site rescue plan have been prepared specially for the space where confined/restricted space entry will be done.
- Maintain training records of their employees including the training provider and the type/date of the training, and share this record with Occupational Health and Safety.
- Complete confined space/restricted space entry permit and provide a copy of the permit to Occupational Health and Safety

Employees

- Will not enter any confined or restricted space unless specifically authorized by Sunnybrook after participating in the required training program
- Attend and complete any scheduled training required by their supervisor and this program
- When selected as an entrant or attendant, perform those duties as outlined in this program
- No employee shall enter a confined or restricted space without having a properly completed entry permit

Attendant:

- Know the hazards that may be faced during the entry, including the mode, signs or symptoms, and consequences of the exposure
- Remain outside the confined/restricted space during entry operations until relieved by another qualified attendant
- Attendant must not enter the restricted/restricted/confined space
- Attendant must be trained in first aid and CPR as well as in the rescue procedures and the use of the equipment.
- Be in constant communication with the entrant(s)
- Monitor activities inside and outside restricted/confined/restricted space to determine if safe for entrant to remain in space and orders evacuation when necessary.
- Summon rescue and emergency services when assistance for emergency exit from restricted/confined space if necessary.
- Perform no duties that might interfere with their primary duty to monitor and protect the authorized entrant
- Control activities at the entrance and keep unauthorized people away

Entrant:

- Be aware of all known and potential hazards of the space as well as be capable of performing the work.
- Properly use equipment as required
- Remain in constant communication with the attendant is required

- Exit the space immediately if so ordered by the attendant

Occupational Health and Safety.

- 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)
- Maintain inventory of all restricted/confined spaces on each campus

Joint Occupational Health and Safety Committee (JOHSC).

- A written confined/restricted space program must be maintained in consultation with the Joint Occupational Health and Safety Committee (JOHSC).

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).
- An inventory of confined and restricted spaces at each campus can be found on [Sunnynet](#). Where a space is not listed on the inventory and there are no signs posted, then a hazard assessment must be completed to determine if the space meets the requirements of a confined or restricted space.
- Even if a space does not meet the definition of a confined or restricted space, every precaution reasonable in the circumstances must be taken to protect workers entering the space

2. Hazard Assessment

- An assessment must be carried out **before any worker enters a confined space**. A competent person must complete and sign a written assessment of the hazards for a confined/restricted space with consideration for but not limited to potential atmospheric hazards, 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.
- Where two or more confined spaces are similar in construction and present the same hazards, the assessment for each specific confined space may be recorded in a single document. The specific confined space(s) to which each assessment applies must be clearly identified in the assessment.
- The assessment must be reviewed as often as necessary to ensure the plan remains adequate.

3. Entry plan

- Before any worker enters a restricted/confined space, the project leader shall ensure that a competent person completes a written entry plan and onsite rescue plan have been prepared specifically for that space and the work to be done in it. The entry plan is a set of measures and procedures to control all hazards identified by the assessment for that restricted/confined space to allow workers to enter and work safely. Individual departments are responsible for developing these specific procedures that relate to their work
- The plan shall include the following:
 - Duties of workers
 - On-site rescue procedures rescue equipment
 - Isolation of energy & control of materials movement
 - Atmospheric testing
 - Adequate procedures for working with explosive or flammable substances
 - Methods of communication
 - Inspection of equipment personal protective devices equipment, or clothing

- Adequate means of entering & exiting
 - Ventilation & purging attendants
 - Coordination document (where applicable)
- The information will be documented on the entry permit.
- The control plan must be reviewed as often as necessary to ensure it remains adequate.

4. Coordination Document

- If workers from more than one employer (e.g. Sunnybrook staff and a contractor) are working in the same confined/restricted space or doing related work with respect to the same restricted/confined space, then the project leader 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.

5. Entry Permits & Entering Confined/Restricted Spaces

- The Project Leader must ensure the confined/restricted space entry permit is complete prior to anyone entering the space. The 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 ace
 - A description of the work being performed
 - The time period for which the entry permit applies
 - 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
- Before each shift, a competent person shall verify that the entry permit complies with the relevant plan
- 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.
- Each restricted/confined space must have its own, separate entry permit

6. 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.
- Managers/supervisors are responsible for identifying employees who require training
- 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.
- The records may be incorporated into an entry permit

7. Emergency Response & Equipment

- The Project Leader must ensure 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 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.

8. Isolation and Control of Material Movement

- Prior to each restricted/confined space entry, there must be adequate protection against:
- Contact with moving equipment parts inside the restricted/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.
- LOTO & only those trained to perform LOTO shall install locks/tags

9. Atmospheric Testing

- Workers are not permitted to enter the work space 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 restricted/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 restricted/confined space entry permit.

10. 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.
- To ensure adequate ventilation, the points of air supply and exhaust should be separated as far as possible. Openings must be provided for the entry of clean replacement air and/or to allow air to be exhausted. Pure oxygen must not be used to ventilate a 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.
- Any respiratory equipment used by workers in a confined space must be inspected by a qualified person and be in good working order.

11. Explosives, 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 explosion 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.

12. Warning Signs & Barricades

- During restricted/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 restricted/confined and restricted spaces.

13. 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 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 (24th 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.

14. Contractors

- Project Leader shall ensure 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

15. Records

- All records including permits, hazard assessments, control plans, and training records, must be kept by the Project Leader 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. Ontario Ministry of Labour. Occupational Health and Safety Act, ONTARIO REGULATION 67/93, HEALTHCARE AND RESIDENTIAL FACILITIES
3. [List of confined/restricted spaces](#)
4. [Restricted/Confined Space Permit](#)

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Falls Prevention

Sunnybrook Health Sciences Centre		Policy No:	HR-0095
Title	Falls Prevention	Original: (mm/dd/yyyy)	12/01/2007
Category	Human Resources	Reviewed: (mm/dd/yyyy)	10/13/2022
Sub-Category	OccHealth & Safety	Revised: (mm/dd/yyyy)	10/10/2017
Issued By:	Human Resources		
Approved By:	Joint Health & Safety Comm.		

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 precautions are in place to minimize the risk of slips, trips and falls (both same level and from heights) within the hospital and on the grounds. This policy includes requirements for ladders, step stools and guardrails. The hospital recognizes the importance of a safe environment for employees, physicians, volunteers, students, patients and visitors.

POLICY:

The following practices will reduce the risk of falls

1.0 Environmental Services will:

Within Hospital Buildings

- Check that rugs and carpeting are in good condition (e.g. free of bulges, rips), and securely attached to the floor.
- Place warning signs/barriers when cleaning floors. Care must be taken to remove water and/or floor products after cleaning.
- Wash half of the hallway at a time so that there is a dry area for walking.
- Provide regular removal of garbage, linen, discarded equipment etc. to keep rooms and corridors clear.
- Provide timely response to spills or leaks to remove any slip hazard.

Exterior Grounds

- Remove snow/ice promptly from pedestrian routes, parking lots/garages, and bus stop areas and/or provide salt/sand.
- Maintain landscaped areas on hospital property.

2.0 Maintenance will:

Within Hospital Buildings

- Fix damage to stairwell treads, risers and handrails.
- Replace/repair lighting in corridors, rooms and stairwells.
- Address plumbing leaks.
- Unclog floor drains to remove water from shower and washroom areas.

Exterior Grounds

- Complete semi-annual inspections of roads, sidewalks and parking areas.
- Make repairs on items identified during inspections or forward items to appropriate department for follow-up e.g. Environmental Services, Parking and Transportation, Corporate Planning, external contractors.
- Use anti-slip surface finishes in parking garages and on stairs.

3.0 Parking & Transportation will:

Exterior Grounds

- Address damaged walking surfaces in parking lots and structures.
- Ensure any vehicle fluid leaks that occur in parking areas are addressed appropriately.

4.0 Corporate Planning/Contractors:

Within Hospital Buildings

- Ensure corridors, stairwells in or around construction or renovation projects are safe for use by keeping areas free from debris or clutter.
- Provide appropriate signage to direct employees/visitors towards alternate routes if construction projects will impact passageways.
- Ensure secure construction areas are secured and that there is signage indicating that only authorized personnel can access construction areas.
- Employees authorized to go into construction areas must wear appropriate protective footwear as per the [Footwear Policy](#).

Exterior Grounds

- Ensure signage and barriers are in place to keep pedestrians away from construction areas.
- If construction projects will impact pedestrian areas, project managers must ensure a safe alternative e.g. temporary sidewalk, cordoned off area, or flag person as appropriate. Project Manager must ensure temporary or new sidewalks are accessible for wheelchairs and scooters.

5.0 Safe Work Practices for All Employees

- Wear appropriate footwear for the weather conditions, work tasks and work areas. Refer to the [Footwear Policy](#) for specific guidelines.
- Promptly report lighting problems or damage to carpet, floors, stairs, handrails etc. by submitting an online maintenance request.
- Report grounds maintenance concerns e.g. damage to sidewalks, damaged street lights to maintenance.
- Report snow/ice removal concerns to Environmental Services (ext. 4555).
- Immediately clean up small spills (e.g. coffee) or block area and contact Environmental Services (ext. 4555).
- Follow Environmental Service signage, barriers and instructions on safe areas to walk following a spill or during floor cleaning.
- Keep work areas and corridors free from clutter.
- Never carry a load that blocks vision or is difficult to balance. Carry smaller loads or use a cart.
- Minimize trip hazards due to cords by using ties to bundle computer/telephone cords, keeping cords away from walking surfaces or taping down/covering cords. Information Services will secure cords, contact by emailing sbiscallcentre@sunnybrook.ca. **The use of cordless devices is also encouraged.**
- Use established pedestrian routes rather than shortcuts.

- Exercise caution on stairs, use the handrails and slow down. If you are carrying an item with both hands, use the elevator rather than the stairs.
- Only use proper ladders or step stools; do not stand on chairs or other equipment, see Section 7.0.
- Avoid distracted walking by not using cellphones, tablets etc. while walking.

6.0 Joint Health Occupational & Safety Committee (JOHSC) & Department Safety Committees will:

- Complete regular inspections including checking for slip or trip hazards such as cords, damaged flooring, loose handrails, corridor or room clutter, damaged ladders or ladders that are not stored securely e.g. on hooks or chained to a surface.
- Inspect the exterior grounds as part of the annual JOHSC inspections.

7.0 Ladder/Step Stool Safety (also see Appendix 1)

- Follow any manufacturer's instructions or department procedures for the specific equipment.
- Step stools must have non-slip feet, be stable and in good condition.
- Inspect ladder prior to each use (see Appendix 1) and remove defective ladders from service until repaired.
- Ladder must have appropriate load capacity and be either an industrial or trade ladders (based on CSA rating). Household ladders are **not** to be used.
- Select proper ladder length and material type for the job and location.
- All ladders must have non-slip feet.
- Place ladder on solid and level base and for straight ladders ensure support surface is stable, and secure against slipping.
- If ladder will be used in a doorway or passageway, a second person must be stationed to direct traffic or a barrier/warning signs or tape must be in place.
- Ensure step ladder spreaders are locked into place.
- Ensure footwear is clean, dry and in good condition before climbing a ladder.
- Face ladder and do not overreach from the ladder, maintain 3 points of contact at all times (e.g. 2 feet and 1 hand) and keep centre of body/belt buckle within the ladder rails. If not aligned with work area, step down from ladder, move ladder to proper location, secure it and then step back onto ladder.
- For step ladders, don't stand on top 2 rungs, for straight ladders, don't stand on top 3 rungs.
- Instead of carrying objects in your hands, use a tool belt, hoist or have the items handed up.
- Only one person can use a ladder at a time.
- Ladders that are not in use, must be stored securely (e.g. on wall hooks or chained to surface).
- For outdoor use, take extra precautions if windy (secure ladder) and ensure rungs are dry and free from snow or ice.

8.0 Guardrails

• A guardrail is required:

- around the perimeter of uncovered openings in the floor, roof or other surface
- at the open side of a raised floor, mezzanine, balcony, gallery, landing, platform, walkway, stile, ramp or other surface
- at the open side of a vat, bin, or tank the top of which is less than 107 cm above the floor, platform, ground or surface
- around a machine, electrical installation, place or thing that is likely to endanger the safety of a worker

Guardrails are **not** required for loading docks, pit for vehicle maintenance, roof accessed for maintenance only, swimming pool/therapy pool or an auditorium/lecture theatre stage.

- A guardrail must meet requirements of Parts 3 & 4 of the Ontario Building code or must:
 - have horizontal top rail between 91 – 107cm above surface
 - have an intermediate rail midway between the top rail and surface

- have a toe board extending at least 125 mm, if tools or other objects may fall on a worker
- be free of splinters or other hazardous protrusions

APPENDICES AND REFERENCES:

APPENDIX 1: Ladders: Inspection and Securing

Prior to each use, inspect to ensure:

- Rungs, rails, steps and pail shelf are in good repair (no cracks or splinters, not bent or loose, not slippery, no missing parts)
- Spreaders are sturdy, tight, open fully and lock into place securely
- Nuts, bolts, rivets etc. are in place, in good condition and tight
- Ladder is clean and no signs of corrosion
- Anti-slip feet are in place and in good condition
- No sharp edges on rungs or rails
- For extension ladders, ropes and pulley are in good repair (not frayed or worn) and lubricated

Securing ladders and inclines:

- If the ladder is between 6-9 metres in length, it must be securely fastened or held in place by one or more co-workers
- For ladders beyond 9 metres in length, it must be securely fastened or stabilized to prevent tipping or falling.
- The top of a straight ladder must extend at least 0.9 metres above landing or support surface
- If ladder is not securely fastened, it must be inclined so that the horizontal distance from the top support to the foot of the ladder is between $\frac{1}{4}$ and $\frac{1}{3}$ the length of the ladder.

REFERENCES:

1. Ontario Ministry of Labour. Occupational Health and Safety Act and Regulations for Industrial Establishments. 1990.

RELATED POLICIES:

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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)	03/10/2022
Sub-Category	OccHealth & Safety	Revised: (mm/dd/yyyy)	Dec. 2006, Jun. 2009, Oct. 2010, Nov. 2011, Sept. 2013, Mar. 2017, Mar 2021
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 Sunnybrook Health Sciences Centre's (Sunnybrook) policy to adhere to all necessary measures and procedures by means of engineering controls, work practices, hygiene practices and facilities to ensure 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 fibers per cubic centimeter of air. Sunnybrook shall establish an Asbestos Management Program (AMP) as outlined under the Ontario Regulation 278/05: Designated Substance Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations, made under the Occupational Health and Safety Act.

This policy applies to every building owned or operated by Sunnybrook at all campuses and other locations (i.e. Pine Villa). This policy applies to every project owner, constructor, employer and worker who engages in the repair, alteration or maintenance of asbestos-containing material (ACM) where ACM is likely to be handled, dealt with, disturbed or removed.

The following sections outline the components of the Asbestos Management Program.

ROLES AND RESPONSIBILITIES

Managers and Supervisors shall:

- Ensure their staff adhere to the contents of this program
- Ensure their staff are familiar with the presence of asbestos-containing materials in their work area
- Ensure their staff do not disturb asbestos-containing materials
- Ensure occupants are notified of scheduled asbestos-related work in the work area
- Report damaged materials suspected to contain asbestos to OHS (Occupational Health & Safety).

Employees shall:

- Be aware of the present of ACMs in their work area ([Asbestos at Sunnybrook](#))

- Adhere to the contents of this program
- Report damaged materials suspected to contain asbestos to their supervisor
- Refrain from disturbing building materials containing or suspected to contain asbestos

Project Leader shall:

- Consult with the OHS, to jointly classify and plan all asbestos remediation activities.
- Ensure that a pre-job review of all maintenance, repair, and renovation or construction activity is conducted to verify that asbestos-containing materials will not be disturbed by such activities. In the case where asbestos-containing materials will be disturbed by maintenance, repair, renovation or construction activity, a [Construction, Renovation and Maintenance Permit](#) shall be completed.
- Communicate asbestos-related work to occupants of the affected area
- Ensure all contractors under their supervision are provided with a copy of the most recent Asbestos Inventory.
- Ensure all contractors under their supervision to conduct Type 3 asbestos work have appropriate training.
- Notify OHS and JOHSC in advance of any sampling or testing to be performed.
- Arrange for appropriate inspection and air monitoring of asbestos operations
- Forward asbestos-related documentation to OHS\

Occupational Health and Safety (OHS) shall:

- Ensure the asbestos inventory is available and kept up to date
- Provided the Project Leader, Plant Operations & Maintenance (POM) and/or Environmental Services (EVS) with a copy of the most recent asbestos survey as requested
- Notify the JOHSC of any sampling or testing
- Review and approve the CRMP, providing the recommended asbestos precautions as required.
- Administer medical surveillance requirements of the Asbestos Management Programs
- Respond to reports of asbestos disturbance or the discovery of previously undocumented locations of asbestos-containing material and ensure appropriate remediation and documentation procedures are followed
- Monitor compliance with the Asbestos Management Program

Joint Occupational Health and Safety Committee (JOHSC) shall:

- Be consulted prior to any asbestos sampling or inspections which may be required, and shall be given the opportunity to attend at the start of such activities
- Receive copies of all reports, sampling results and general information regarding any asbestos related activity

INVENTORY

A survey of the location of asbestos-containing materials (ACM) shall be completed and maintained. The survey shall contain the following information:

- Location of asbestos containing material
- For each material indicate whether the material is friable or non-friable
- An indication as to whether the material has been sampled to determine if it contains asbestos or whether it is assumed to contain asbestos
- If known to be asbestos, type of asbestos

The survey shall be updated every 12 months or as required to reflect any changes caused by construction, renovations or abatement.

OHS shall maintain copies of the survey. A copy of the survey is available upon request.

A summary of ACM is available on [Sunnynet](#).

INSPECTIONS AND HAZARD ASSESSMENT:

Period Inspections:

Inspection of the condition of ACM shall be conducted by a qualified consultant at reasonable intervals, at a minimum rate of once every year. The consultant shall determine identify locations and quantities of deteriorating ACM and generate a list of corrective actions.

Condition of ACM shall be classified as either good, fair, or poor. Fair and poor condition ACM shall be control either through repair, sealing, encapsulation or removal following appropriate asbestos precautions in accordance with O. Reg.278/05. OHS shall maintain documentation of these inspections in the form of a report issued by the consultant.

- POM will be responsible for all non-flooring corrective actions
- EVS 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 OHS.

Hazard Reporting:

Damaged asbestos-containing material identified by employees during the course of their normal day-to-day activities shall be reported to the OHS who will ensure that appropriate remediation steps are taken.

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.

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 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.

NOTIFICATIONS

Sunnybrook shall notify employees of the location of ACM through the Asbestos Management page on [Sunnynet](#). A copy of details reports can be provided as requested.

The project leader shall inform their employees and/or contractors when the work performed may bring them into contact or close proximity to ACM and they may disturb it.

TRAINING AND EDUCATION

Employees who work around and who may disturb asbestos containing material or who are responsible for managing, overseeing or coordinating such activities shall receive asbestos awareness training. Training will include

- Asbestos hazards
- Personal hygiene and appropriate work practices
- Use, care and disposal of respirators and protective equipment, including limitations, inspection and maintenance, proper fitting, respirator cleaning and disinfection.

Retraining is completed on a routine and as-needed basis

Employees involved in Asbestos Operations shall complete appropriate respirator fit testing as per Respiratory Protection Program. As such, the records of respirator fit tests will be maintained by the department.

Medical surveillance

To permit earlier detection of such diseases, O. Reg. 278/05 prescribes medical examinations for workers who work in Type 2 or Type 3 operations

BUILDING OPERATIONS

Classification of Asbestos:

Asbestos operations are as classified as Type 1, 2 or 3 as specified in O. Reg. 278/05. Refer to Appendix 1 for details outlining each type of operation.

Employees may engage in Type 1 or 2 asbestos operations provided they have completed the appropriate training. All 3 work must be contracted to fully qualified contractor

Routine Operations:

Prior to any planned maintenance or construction activity, the supervisor and/or project leader shall review the appropriate ACM Inventory, assess the probability that the work activity will, or will likely, disturb ACMs and determine the appropriate control measures (i.e. Type 1, 2, or 3).

If the activity will, or will, likely to disturb ACMs, the supervisor/project leader shall complete a [Construction, Renovation and Maintenance Permit](#). IPAC and OHS shall review and approve the permit.

If it is determined that ACM is present and will be disturbed by the work an inspection by OHS and/or IPAC is required.

- 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.
- If, in the course of work, material is discovered which was not identified in the asbestos assessment and report but which may be asbestos-containing material, work is stopped and the material is analyzed for asbestos content
- Project managers who oversee the work of asbestos abatement contractors are appropriately trained and competent

Infection Prevention and Control (IP&C)

In addition to asbestos precautions, IPAC controls as described in the Infection Control during [Construction, Renovation and Maintenance Policy \(IPAC-0006\)](#) shall be implemented to minimize the risk of nosocomial infection by containments and prevention of particulates from the construction area migrating into the high risk patient area(s).

Inspection and Air Monitoring of Asbestos Work

Visual clearance and clearance air testing shall be conducted for all Type 3 work areas.

Type 3 asbestos abatement shall be supervised by a qualified constant who shall:

- Inspect of the contaminant area prior to commencement of work to ensure it meets or exceeds the requirements under O. Reg. 278/05 prior to commencement
- 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.
- Complete final inspection of the containment area.

- Collect air samplings following forced air clearance testing. Air sample results <0.01fibers/cc are deemed acceptable.
- 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
 - The number of air samples collected shall be in accordance with Table 3 of O. Reg. 278/05
- Provide a copy of the clearance air testing results to OHS.

Within 24 hours after the clearance air testing results are received:

- a copy of the results shall be placed in conspicuous place
- a copy shall be provide to the JOHSC

Emergency Procedures:

In the event that an employee or contractors determines that there has been unintentionally disturbance to ACM (ex. Accidental damage or uncovered during demolition/construction work), immediately notify the Project Manager, Maintenance and the OHS department and relay the location and the extent of the damage.

All activities in the area must immediately stop in order to minimise potential exposure of the individuals or other building occupants to airborne asbestos fibres.

Minor Release:

A minor release occurs when there is less than 9ft2 of ACM (or 21 linear ft. of 1.6 in.) pipe or equivalent) is disturbed.

- *Immediately notify the Project Manager and/or POM and the on-call Safety Pager (ext. 4737)*
- Following the direction of the Project Manager, Maintenance and OHS, isolate the affected area by way of physical barriers such as doors or plastic sheeting and the shutdown of the HVAC system.
- At minimum, follow Type 2 procedures to remediate the release
- The Project Manager and/or POM shall complete a Fibre Release Episode Report form Appendix 2 and submit a copy to OHS.

Major Release:

A major release occurs when greater than 9ft2 of ACM (or 21 linear ft. of 1.6 in. pipe) or equivalent is disturbed.

- *Immediately notify the Project Manager and/or POM and the on-call Safety Pager (ext. 4737)*
- Any major release episode shall require the immediate isolation of all affected areas and the involvement of a consultant and a removal contractor. At minimum, Type 2 procedures shall be followed to remediate the release.
- 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. Depending on the circumstances, remediate may be elevated to Type 3 status at the discretion of the Project Manager, Maintenance, OHS, Risk Management and Infection Prevention & Control.
- The Project Manager and/or POM shall complete a Fibre Release Episode Report form and submit a copy to OHS.

APPENDICES AND REFERENCES:

Related Policies

1. Infection Control during Construction, Renovation and Maintenance - IPAC-0006
2. Air Purifying Respirator Policy - HR-107

References:

- 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.
- 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.
- 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
- Ontario Ministry of Labour. Occupational Health and Safety Act and Regulations for Industrial Establishments, 1990.
- Canadian Standards Association (CSA). Z94.4-02 Selection, Use, and Care of Respirators, 2018
- Canadian Standards Association (CSA). Z317.13-12. Infection Control during Construction or Renovation of Health Care Facilities, 2012

Appendices

[Appendix 1 – Classification of Asbestos Operations and Precautions](#)

[Appendix 2 – Fibre Release Episode Report](#)

[Appendix 3 – Definitions](#)

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Mould Response Policy (IP&C and OHS)

Sunnybrook Health Sciences Centre		Policy No:	IPAC-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:

1. For an affected area greater than 10 ft², 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 ft²**, 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 ft²**, 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:

[IPAC-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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Recommended Sink Standards for New Construction and Renovation

Sunnybrook Health Sciences Centre		Policy No:	IPAC-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, 11/11/2013, 11/10/2017
Sub-Category	Construction & Renovation	Revised: (mm/dd/yyyy)	11/11/2013
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 (IP&C) 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 shall be consulted for review and approval of all sink specifications and placement within the facility, as required for new construction and renovation of existing spaces.

For manufacturer fixture specifications, refer to Corporate Planning & Development's Master Specifications.

DEFINITIONS:

Hand hygiene sink:

A sink dedicated for hand hygiene (HH).

Scrub Sink:

A sink equipped to enable medical personnel to scrub their hands prior to a surgical procedure. The water supply is activated by a knee-action mixing valve or by foot control.

Utility Sink:

A sink used to clean instruments/articles, or to be used for general purposes by staff in routine unit cleaning. This sink is not to be used for hand hygiene. Frequently located in soiled rooms and/or utility rooms.

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 Hand Hygiene sinks and mechanical washing (dishwashers).

Backsplash:

Impermeable material mounted behind sink area to prevent rotting and deterioration of the wall from water/chemicals splashing behind the sink causing mould and bacterial contamination.

Hand Hygiene Sink Design Specifications:

Hand hygiene sinks design shall reflect the following criteria:

1. The sink material shall be non-porous (i.e. porcelain, enamel) or 18 gauge (or thicker) stainless steel.
2. The size shall minimize recontamination from splashing during use. Minimum inside dimension should be 350 x 250mm and a minimum depth of 225mm.
3. HH sinks shall be wall-mounted, free standing and not inserted into or immediately adjacent to a counter.
 - Sinks shall be at least 1m from any fixed surface, patient care equipment, storage unit. If not possible then consult with IP&C to determine if a splash guard barrier is appropriate.
 - There must be no space between the back of the sink and the wall.
 - The sink shall be installed at least 865mm above the floor.
 - There is to be no storage/cabinet/shelving beneath the HH sink.
4. Taps and controllers must be hands free, electronic eye or foot pedal may be used.
 - Electronic eye technology shall be hard wired to the emergency power system to allow for use in times of power outage and shall have a means for users to adjust water temperature adjacent to sink.
5. HH sinks shall be shaped to prevent splashing and with a collar directing runoff into the sink basin.
 - The faucet shall not direct water directly into drain but should hit basin surface in front of the drain.
 - Faucets shall be free of aerators/modulators/rose sprays and shall not swivel.
 - Traps shall be metal and 40mm diameter, gaskets shall at skin/drain connection shall be plastic or neoprene.
 - Sink overflows shall not be used.
6. Adjacent wall surfaces shall be protected from splashes by installing an impermeable back/side splash (i.e. Acrovyn).
 - Backsplashes shall be seam free and all edges shall be sealed with a waterproof barrier.
 - Backsplashes shall extend a minimum of 600mm above sink level and 250mm below sink level.
7. Single paper towels shall be provided, no knobs or levers.
8. Liquid dispensers (lotion or soap) to be in non-refillable bottles and placed so as to prevent splash-up contamination, minimize dripping and be easily accessible when at the sink.

Hand Hygiene Sink Placement Recommendations:

A hand hygiene sink shall be placed in the following locations for all renovations/new construction:

- In each soiled utility/dirty room (in addition to hopper/slop sink/deep sink used for cleaning purposes).
- Inside each inpatient bedroom, close to the exit.
- In any space where treatment is provided or procedures or physical exams are performed, as follows:
 - i. in a location designed for one patient to be present at a time: one sink; or
 - ii. in a location designed to accommodate three or more patients at a time: a minimum of one sink for every three patients, with no more than 6 m distance between any patient station and the nearest sink;
 - iii. inside or adjacent to each diagnostic MRI room.

- In any room in which food or patient care items (e.g., tray) are prepared.
- Inside each nursing station or within 6 m of the station.
- Inside each staff lounge or within 6 m of the lounge.
- Within 6 m of each laboratory workstation and within each work room.
- In each room in which medication is prepared (including in pharmacies).
- In each area where unbagged soiled linen is handled .
- In other areas where there is potential to contaminate hands including goods receiving areas, waste storage, and disposal.

Note: The above list highlights key areas for HH sink placement and is not inclusive of all areas within the facility. For all construction/renovation the location and design of hand hygiene facilities shall be developed in consultation with infection prevention and control personnel. This will ensure an Infection Control Risk Assessment is completed for each area where a handwash sink will be place and that the following items will be addressed:

- Addition of hand hygiene sinks in new construction/renovation projects.
- Placement and design specification of the sink(s).
- Use of the sink for hand hygiene only.
- Location of waterless hand hygiene stations.

APPENDICES AND REFERENCES:

REFERENCES:

1. FGI. *Guidelines for Design and Construction of Hospital and Health Care Facilities, 2014 Edition*. The Facility Guidelines Institute, 2014 (7).
2. CSA Z8000-11, Canadian Health Care Facilities, Canadian Standards Association, 2016.

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Footwear

Sunnybrook Health Sciences Centre		Policy No:	HR-0096
Title	Footwear	Original: (mm/dd/yyyy)	06/01/2001
Category	Human Resources	Reviewed: (mm/dd/yyyy)	06/09/2022
Sub-Category	OccHealth & Safety	Revised: (mm/dd/yyyy)	12/01/2015
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 prevent foot injuries, exposures as well as injuries related to slips or trips by taking all reasonable precautions and ensuring employees wear footwear appropriate for the type of work and environment, as per the Occupational Health and Safety Act, S. 25.

This includes requirements for protective footwear as well as for recommended safe footwear, see definitions below.

DEFINITION(S):

Protective Footwear:

A boot or shoe that provides a degree of protection against injury to the wearer as defined in Canadian Standards Association, CSA, Z195-09. e.g. shoes or boots with steel toe, puncture resistant or electrical resistant soles.

Safe Footwear:

A boot or shoe that minimizes the risk of slips, trips or fall as well as foot injury. Safe footwear would have the following features:

- Closed toe and secured heel,
- non-slip sole,
- low or flat heel e.g. walking shoe

POLICY:

1. Selecting & Obtaining Footwear

- Supervisors must assess the foot and slip/trip hazards in their areas and then in consultation with the department safety committee or employees determine and communicate the department footwear based on the guidelines in Section 2.0. Occupational Health can assist with the hazard assessment if required.
- Employees are to follow the footwear standards for their department/role.
- Employees who are required by the Hospital to wear safety footwear during the course of their duties, will be directed by their manager to purchase safety footwear. The manager will administer payment for the

safety footwear in accordance with the collective agreements and administrative policies

- o Signage must be posted in areas that require protective footwear. For areas that don't require protective footwear, but have established department general footwear requirements, staff must be educated on the policy requirements and signs should be posted.

Supervisors and employees must be aware that not following recommended footwear can result in injury or fines from enforcement bodies.

2. Guidelines for Appropriate Footwear

The following guidelines from CSA Z195.1-09 are to be used in determining appropriate footwear:

Hazard	Examples of Departments	Footwear
Wet Floors e.g. water, cleaning solutions, body fluids	Environmental Services, Food Services, Patient Care Units, Operating Rooms, Labs, Patient Transport Department	Safe Footwear <ul style="list-style-type: none"> • Closed toe and secured heel, • non-slip sole, • low or flat heel recommended e.g. walking shoe • fluid resistant, • covers top of the foot
<ul style="list-style-type: none"> • Heavy Lifting >5kg • Mechanical Work • Transport Vehicles e.g. Tow Motors or Hand Trucks 	Shipping/Receiving, Stores, Tow-Motor Operators, Maintenance, Groundskeeping *	Protective Footwear (Required) <ul style="list-style-type: none"> • Steel toe • Green Patch
Possible Electrical Shock e.g. work on Electrical equipment	Facilities Services	Protective Footwear (Required) <ul style="list-style-type: none"> • Steel toe/Electrical Insulation • Green Patch/Omega W
Dropped small items e.g. glass items, minor spills	Labs, Patient Care Units	Safe Footwear <ul style="list-style-type: none"> • Closed toe and secured heel, • non-slip sole, • low or flat heel recommended e.g. walking shoe
Patient Transport	Porters, Medical Imaging, Patient Care Units	Safe Footwear <ul style="list-style-type: none"> • Closed toe and secured heel, • non-slip sole, • low or flat heel recommended e.g.

walking shoe

All Staff

****Walking** (includes walking on grounds

e.g. from car/TTC stop to building entrance

Safe Footwear

- Closed toe and secured heel,
- non-slip sole,
- low or flat heel recommended e.g. walking shoe

* If Groundskeepers are doing chainsaw work, their protective footwear must have chainsaw protection.

** All staff are reminded that Sunnybrook campus and buildings cover a large area and may require walking significant distances including stairs, ramps, hills, crosswalks, high traffic and wet areas. In addition, many staff are required to respond to emergency situations. It is recommended that all staff wear safe footwear while walking significant distances or when they will encounter any of the aforementioned conditions.

APPENDICES AND REFERENCES:**REFERENCES:**

1. Ontario Ministry of Labour. Occupational Health and Safety Act and Regulations for Industrial Establishments. 1990.
2. Canadian Standards Association. Z195.1-09, Guidelines on Selection, Care and Use of Protection Footwear. 2009.

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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 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 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

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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.0	Sign-in procedure and location	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.0	All applicable policies and procedures have been provided to contractor staff working at SHSC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.1	<i>Emergency Codes (Quick Guide)</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.2	<i>Copy Respect Program (Corporate Code of Conduct) provided</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.3	<i>Asbestos Management</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4	<i>Mould Response/Management</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5	<i>Restricted and Confined Space</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.6	<i>Infection Control during Construction, Renovation and Maintenance</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

		YES	NO	NA	Comments
4.0	<i>Smoke-Free Environment</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5.0	Fire alarm bypass required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6.0	Aware of incident/accident reporting procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7.0	Contractor aware of required permits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7.1	<i>Construction Renovation and Maintenance Permit</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7.2	<i>Hot Work Permit</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7.3	<i>Restricted and Confined Space Permit</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8.0	Record of training required? (i.e. Type 3 work as per O.Reg. 278/05)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.0	MRI/Radiation Safety required (working in AG, SG, TB, M3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10	Contractor has been made aware of all Designated Substances and other hazards within work area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Contractor (Signature)

Name (Please Print)

Date

SHSC Project Manager (Name)

Contact Number

Date

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 or 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.

[illegible]

