Smith + Andersen
100 Sheppard Ave East, Suite 1100 Toronto Ontario M2N 6N5
416 4878151 f 416 487 9104 smithandandersen.com

MECHANICAL SPECIFICATION

FOR

UOFT SCARBOROUGH

ARC LIBRARY AND IITS RENOVATION – PHASE 1

1265 MILITARY TRAIL, SCARBOROUGH

THIS SPECIFICATION SHALL BE READ IN CONJUNCTION WITH DRAWINGS:

REFER TO DRAWING LIST ON DRAWING TM-0.1

OUR PROJECT NUMBER:

03118.008.M.001

DATE:

2021-10-20

ISSUED FOR:

CONSTRUCTION

20 00 00.00 Index

END OF SECTION

20 05 00.00 General Instructions for Mechanical Sections

1. General

1.1. WORK INCLUDED

1.1.1. Conform to the requirements of Division 1, which applies to and forms part of all sections of the work.

1.1.2. The Specification is divided into Sections which are not intended to identify contractual limits between Subcontractors nor between the Contractor and their Subcontractors. The requirements of any one Section apply to all Sections. Refer to other Divisions and Sections to ensure a complete and operational system.

1.1.3. Provide mechanical components and accessories which may not be specifically shown on the Drawings or stipulated in the Specifications, but are required to ensure complete and operational systems.

1.2. INTENT

1.2.1. Mention in the Specifications or indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.

1.2.2. The Specifications are an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.

1.2.3. Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective material, equipment and part of equipment and repair related damages.

1.3. SECTIONS AFFECTED

1.3.1. These instructions apply to and form a part of all Division 20, 21, 22, and 23 Sections referred herein as Mechanical.

1.4. REGULATIONS

1.4.1. Work shall be performed in accordance with codes, rules, regulations, by-laws and requirements of the authorities having jurisdiction.

1.4.2. The plumbing and drainage systems shall comply with regulations respecting plumbing made under the following legislation except as modified by rules, regulations and by-laws of authorities having jurisdiction:

.1 Ontario Water Resources Act.

.2 Ontario Plumbing Code.

1.4.3. These Specifications are supplementary to the requirements above.

1.4.4. Drawings and specifications should not conflict with the above regulations but where there are apparent discrepancies the Contractor shall notify the Engineer’s Representative.

1.5. PERMITS, FEES INSPECTION

1.5.1. Obtain all permits, make submissions, pay all fees and arrange for all inspections required for the work of this Division.

1.6. EXAMINATION OF SITE

1.6.1. Before submitting Bids, each trade shall examine the site to determine the conditions which may affect the proposed work. No claims for extra payment will be considered because of failure to fulfil this condition.

1.7. DRAWINGS, CHANGES AND INSTALLATION

1.7.1. The Drawings shall be considered to show the general character and scope of the work and not the exact details of the installation. The installation shall be complete with all accessories required for a complete and operational installation.

1.7.2. The location, arrangement and connection of equipment and material as shown on the Drawings represents a close approximation to the intent and requirements of the work. The right is reserved by the Engineer's Representative to make reasonable changes required to accommodate conditions arising during the progress of the work, at no additional cost.

1.7.3. In order to show more clearly the arrangement of the work, plans and sections do not show every valve, thermometer, pressure gauge or other system accessory. Refer to the Mechanical Standard Details and to the Specifications to determine the requirements.

1.7.4. Equipment installed by this Division shall installed in accordance with the manufacturer's installation requirements. In the event of conflicts between the Drawings or Specifications and the manufacturer's installation requirements, the Contractor shall notify the Engineer's Representative.

1.7.5. Certain Details indicated on the Drawings are general in nature and specific labelled detail references to each and every occurrence of use are not indicated, however, such details shall be applicable to every occurrence.

1.7.6. All piping and ductwork in finished areas shall be concealed in ceiling spaces and shafts or furred into walls. No exposed piping or ductwork shall be installed in such areas unless specifically reviewed and accepted by the Engineer's Representative. No piping shall be concealed in outside walls.

1.7.7. The location and size of existing services shown on the Drawings are based on the best available information. The Contractor shall site verify the actual location of existing services before work is commenced. Particular attention shall be paid to underground services.

1.7.8. Changes and modifications necessary to ensure co-ordination and to avoid interference and conflicts with other Trades, or to accommodate existing conditions, shall be made at no additional cost.

1.7.9. Leave areas clear of piping and ducts where space is indicated as reserved for future equipment and equipment for other Trades.

1.7.10. Adequate space and provisions shall be left for removal of coils and servicing of equipment, with minimum inconvenience to the operation of systems.

1.7.11. Where equipment is shown to be 'roughed-in only' obtain accurate information from the Engineer's Representative before proceeding with the work.

1.7.12. Before fabricating ductwork or piping for installation, make certain that such items can be installed as shown on the Drawings without interfering with the structure or the work of other Trades. Any problems that cannot be solved in agreement with the other Trades affected, shall be submitted for decision. If ductwork or piping is prefabricated prior to the investigation and reaching of a solution to possible interference problems, necessary changes in such prefabricated items shall be made at no additional cost.

1.7.13. Location of diffusers, grilles registers, thermostats, sprinklers and all other equipment shown on plans is diagrammatic. Layout of each device in finished areas is critical in terms of symmetry and location. Refer to Architectural Drawings and to site instructions in all regards. Any work not installed in the correct location (at the sole discretion of the Engineer's Representative) shall be remedied by this Contractor at their expense. This Contractor is responsible for mark-out of their work, fully co-ordinated with all other trades, in sufficient time for review by Engineer's Representative prior to rough-in. All mechanical and sprinkler services shall be located precisely.

1.7.14. Prepare dimensioned layouts of each room prior to rough-in for review by the Architectural Consultant. Do not proceed with any work until the Engineer's Representative has reviewed the layout.

1.8. BID FORM AND SUBMISSIONS OF BIDS

1.8.1. Any alternative and/or substitute equipment listed shall be equal in performance and quality to that specified. If space, power, structural or any other requirements are different from the equipment specified, the cost of any changes shall be included for in the price shown on the Bid Form.

1.8.2. The Owner reserves the right to accept or reject any substitution without question.

1.8.3. Include the cost of premium time in the Tender Price for work provided during nights, weekends or other times outside normal working hours, necessary to maintain all mechanical services in operation and to meet the project schedule.

1.9. MATERIALS

1.9.1. Make and quality of materials used in the construction of this work shall be subject to the approval of the Engineer's Representative.

1.9.2. Materials and equipment supplied by this Division shall be new and free from defects and shall be as specified by the manufacturer's name and catalogue reference.

1.9.3. Where a manufacturer's equipment has been specified by name and/or model number, the Contractor shall be responsible to ensure that the performance and quality of equipment provided by an acceptable manufacturer, meets the specified equipment performance, is inclusive of all standard and specified optional features, and can be installed in the planned location with access and maintenance clearances in accordance with the manufacturer's recommended installation. This Contractor shall also confirm all required piping, duct and electrical connections are provided at no additional cost.

1.10. CO-OPERATION WITH OTHER DIVISIONS

1.10.1. Particular attention must be paid to the proximity of electrical conduit and cable to mechanical piping and equipment.

1.10.2. Pipes transporting hot fluids shall be installed at least 150 mm (6 in.) away from pipes carrying cold fluids, unless approval from the Engineer's Representative is obtained to install services closer than 150 mm (6 in.).

1.10.3. Electrical conduits shall not touch or be supported from piping or ductwork.

1.10.4. Each Section shall confine itself to installing all materials in the spaces shown without encroaching upon space for materials installed under other Sections or Divisions. Where the space allocated to another Section or Division is encroached upon, the materials shall be relocated to their proper space allocation in such a manner to complete the work using space allocated to the various Sections and Divisions. Relocation of materials and work involved shall be paid for by the Section responsible for the encroachment at no additional cost.

1.10.5. Supply all items to be built in ample time for rapid progress of the work. Schedule and proceed with work as required to satisfy the construction schedule.

1.10.6. The Contractor shall confirm the available voltage for all single phase and three phase motors or other similar electrically driven equipment with the Electrical Division prior to ordering the equipment. Any discrepancy between the requirements identified within the Contract Documents and those of the Electrical Division shall be reported to the Engineer's Representative and the equipment shall be adjusted to suit the appropriate power requirements. Failure to perform this coordination prior to ordering of the motors or equipment shall result in correction at no additional cost.

1.11. TEMPORARY USE OF EQUIPMENT

1.11.1. Where systems, or a part thereof, are operated during construction, the Contractor shall maintain the system and equipment in proper operating condition.

1.11.2. Prior to application for substantial performance of the work as certified by the Engineer's Representative, the systems and/or equipment shall be returned to new condition by replacing all consumables such as air or water filters, belts in belt driven equipment, etc. with new components. This Contractor shall clean the air side of all coils in the air handling systems, lubricating all bearings according to manufacturer's factory standards and adjust the thermostatic control system according to Specifications. This Contractor shall clean all duct systems to NADCA Standards.

1.12. EXISTING SERVICES AND EQUIPMENT

1.12.1. Provide temporary filters, 1 in. thick disposable media type, over all return air openings in the base building HVAC. systems that remain in operation during construction. Maintain and replace the temporary filter media as required to prevent construction dust from fouling the base building equipment. Remove same at the completion of construction. Filters in all base building air handling equipment i.e., Air Handling Units, Induction Units, Fan Coil Units, etc., shall be replaced after construction is completed

1.12.2. Reuse existing materials and equipment wherever possible. Provide new materials and equipment as required to ensure a complete installation. All existing equipment, materials and associated controls not used in this contract shall be packaged and turned-over to the Landlord. Include in the tender for all shipping and placement in a designated on-site storage location. Remove any equipment or material not wanted by the Landlord from the site.

1.12.3. All changes and connections to existing services shall be made only in a manner and at a time approved by the Engineer's Representative so as to avoid any interruption of such services during normal working hours. If necessary, changes and connections to existing services shall be made outside of normal working hours, without addtional cost.

1.12.4. Prior to operating any existing or new equipment during any stage of construction, approval from the Landlord and Engineer's Representative must be received in writing

1.12.5. Whenever existing services or equipment are to be removed, all piping and ducts for such services or equipment shall be removed back to the main, nearest pipe or duct and any open ends securely capped or plugged in an approved manner. If necessary to facilitate installation of new work, any existing services and equipment shall be removed and then replaced by this Contractor without additional cost.

1.12.6. Whenever it becomes necessary to relocate existing piping, ducts or equipment to make possible installation of the work under this Contract, such relocation shall be done by this Contractor without additional cost.

1.12.7. Where connections are made to existing services, existing insulation shall be made good under this Division.

1.13. INTERRUPTION OF SERVICES

1.1.2. All shutdown, draining, filling and chemical treatment for any portion of the existing base building systems shall be performed to the satisfaction of the Landlord's building operations staff and shall be co-ordinated with the Landlord for time and duration of interruptions. Comply with all of the Landlord's instructions and include for all costs of this work, including work performed by the Landlord's chemical treatment supplier, in the tender price.

1.1.3. Any interruption of the mechanical services to any part of the building shall come at a time agreeable to the Landlord. Make all necessary arrangements with those concerned and include for any overtime required to ensure that the interruption is held to a minimum.

1.13.1. Testing and operation of major equipment shall be approved by the Engineer’s Representative to avoid excessive utility charges. Such testing is to be generally carried out after normal working hours or on weekends.

1.13.2. All such overtime work shall be carried out without additional cost.

1.14. STATEMENT OF PRICES

1.14.1. For the purpose of progress applications the Contractor shall submit a summary statement of their estimated prices for the various portions of the work, including labour, materials and equipment shown separately. The total price of all portions of the work shall equal the total price of the work covered under Divisions 20, 21, 22, and 23.

1.14.2. The Contractor shall submit the summary of work for this Contract to the Engineer’s Representative for review and approval. The summary shall be in sufficient detail to enable the Engineer’s Representative to evaluate the progress of work and shall identify all major equipment, components and sub trades.

1.14.3. Particular care shall be taken with imperial versus S.I. metric conversions. This applies to all services including, but not limited to, equipment, pipes, ductwork and site services in both new and existing installations.

1.14.4. Conform to the Canadian Metric Practice Guide CSA-CAN3-2234-1-89.

1.15. ALTERNATIVE, SEPARATE AND IDENTIFIED PRICES

1.15.1. If alternative, separate and unit prices have been requested, these shall be completed and identified on the Bid Form. Prices not on the Bid Form at time of submission will not be accepted. Refer to the Specifications and the Drawings for details.

1.16. DEMOLITION

1.16.1. The Drawings show the general scope of the demolition and not exact details or total extent. For exact details and total extent each service must be carefully checked on site. Before removing services follow the service through to ensure other areas of the building are not affected. Open shafts, walls and ceilings as required to examine the services.

1.16.2. If there are no isolating valves readily available to isolate sections of pipe that requires removal, add valves as required. The cost of these valves will be paid for from the Cash Allowance Section. Co-ordinate with the Engineer’s Representative to shut-down the system. Install caps on all services. Add cap to all valves at the termination point of existing services.

1.16.3. Where valves are removed, remove valve tags, revise existing charts and hand tags over to Owner.

1.17. SCHEDULE, ACCESS, PROTECTION AND CLEAN-UP

1.17.1. The construction schedule places restrictions on the duration of construction within areas and the duration of shut-down of equipment. Refer to the General Conditions for all requirements.

1.17.2. Access to the site is limited to location and time of day. Access to areas of the building is limited to location and time of day. Refer to the General Conditions and conform to all requirements.

1.17.3. Refer to the security and protection requirements in the General Conditions and conform to all requirements. In particular no open flames shall be used without prior written approval of the Owner. There shall be no smoking, and the site shall be kept clean at all times.

1.18. MECHANICAL DIVISIONASHRAE 90.1

1.18.1. All mechanical equipment shall comply with the minimum efficiency standards set out in ASHRAE 90.1 and the National Energy Code of Canada for Buildings. Submit all necessary information to substantiate conformance.

1.19. INTELLECTUAL PROPERTY

1.19.1. The Contractor acknowledges, represents, warrants and agrees that the Owner, its Consultants, and the Engineer's Representative are not responsible, and hereby indemnified against any action as a result of patent infringement made through the review, acceptance, or receipt of materials, equipment, work, etc. provided by the Contractor or any of their suppliers or manufacturers in the execution of this Contract.

2. Products

2.1. NOT USED

3. Execution

3.1. NOT USED

END OF SECTION

20 05 02.00 Record and As-built Drawings

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Refer to Record and/or As-built Drawings in Section 01 70 00.00 (01 72 29.00) - CLOSEOUT SUBMITTALS.

1.3. RECORD OF REVISIONS ON SITE

1.3.1. Print and maintain two complete sets of white prints to mark the project progress, changes and deviations.

1.3.2. Maintain an updated copy of plans and schematics in the digital format for which the project is provided (i.e. AutoCAD or Autodesk Revit MEP) and be capable to produce documents in Adobe PDF upon request.

2. Products

2.1. NOT USED

3. Execution

3.1. DOCUMENTATION REQUIREMENTS

3.1.1. As the project progresses record all changes and deviations..

3.1.2. Maintain an accurate dimensional record of revisions. Specifically record:

.1 Above ground piping revisions

.2 Duct revisions

.3 Equipment revisions

.4 Locations of access doors and panels. Identify the equipment and components they serve.

.5 Locations of valves

3.1.3. Keep revisions up-to-date during construction including change orders, change directives, and site instructions. Documentation shall be available for review at all times.

3.2. FINAL AS-BUILT DOCUMENTS SHALL NOT CONTAIN MARKINGS OR CORRECTIONS ELECTRONICALLY OR BY HAND (I.E. MARKER, PEN, PENCIL, ETC.). DRAWINGS SUBMITTED THAT CONTAIN MARK-UPS WILL NOT BE ACCEPTED.

3.3. SUBMISSION REQUIREMENTS

3.3.1. On completion of the Work, submit the draft documentation indicating all such changes and deviations for review by the Engineer's Representative. Submit all documents in PDF format.

3.3.2. Upon return of the "Reviewed" draft submittal, transfer "As-Built" information and any additional submittal comments to the final software submission requirement (i.e. Autodesk AutoCAD or Autodesk Revit MEP).

.1 Request the acceptable version(s) of the sofware that may be used. Owner shall confirm the acceptable software version upon receipt of request. If the Owner has no preference, the latest published version shall apply.

.2 Conform to the Owner/Engineer's Representative's standards.

.3 The Mechanical Contractor may request from the Engineer's Representative the most current electronic documentation in AutoCAD Documents to be forwarded via a secure file transfer (at a nominal charge of $500.00).

.4 Clearly label electronic files with Engineer's Representative and Owner, Contract number, file names and the Drawing number.

3.3.3. Submit the documents in PDF along with the submission of the completed electronic source software documentation on an approved electronic storage device for review by the Engineer's Representative.

3.3.4. The project will remain incomplete and monies retained until a satisfactory as-built submission is provided.

3.4. AUTOCAD SPECIFIC SUBMISSION REQUIREMENTS

3.4.1. Make special effort to ensure that drafting is accurate, i.e. appropriate lines are indeed horizontal and vertical; lines that should intersect do but not over-intersect and that entities are placed on correct layers.

3.4.2. Use the standard fonts available in the software. Do not use custom fonts, shape files, etc.,.

3.4.3. Provide all drawings in the same scale of measurement and units as issued on Bid Documents.

END OF SECTION

20 05 03.00 Shop Drawings

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. SHOP DRAWINGS

2.1.1. Submit shop drawings organized by Specification Section. Do not combine more than one Section into one submission. Incorrect submissions will be returned without review.

2.1.2. Submit shop drawings electronically, by email, in PDF format. Submissions that are not electronic without prior approval from the Engineer's Representative shall be returned as not reviewed. Provide the following information in the email submission:

.1 S+A project number and Contractor Shop Drawing Identifier in Subject Line

.2 Attachments shall be limited to 20MB

.3 Provide FTP hyperlink for all attachments in excess of 20MB with appropriate information for downloading the file (as required)

2.1.3. Each Shop Drawing for non-catalogue items shall be prepared specifically for this project. Shop Drawings and brochures for catalogue items shall be marked clearly to show the items being supplied.

2.1.4. When requested, Shop Drawings shall be supplemented by data explaining the theory of operation. The Engineer's Representative may also request that this information be added to the maintenance and operating manual.

2.1.5. Provide a cover sheet with the project name, issue date, issue number, Specification section number, title of section and with space for Shop Drawing review stamps for the Contractor and Engineer's Representative.

3. Execution

3.1. SUBMISSIONS

3.1.1. Each Shop Drawing or catalogue sheet shall be in original PDF format stamped and signed by the Contractor to indicate that they have checked the submission for conformance with all requirements of the Drawings and Specifications, that they have co-ordinated this equipment with other equipment to which it is attached and/or connected and that they have verified all dimensions to ensure the proper installation of equipment within the available space and without interference with the work of other trades. Ensure that electrical co-ordination is complete before submitting drawings for review.

3.1.2. Installation of equipment or connecting services shall not start until after final review of Shop Drawings by the Engineer's Representative has been completed.

END OF SECTION

20 05 29.00 Hangers and Supports

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. Piping and equipment provided under the Mechanical Division shall be complete with all necessary supports and hangers required for a safe and workmanlike installation.

2. Products

2.1. MATERIALS

2.1.1. Provide hangers and supports manufactured by Anvil International, Taylor Pipe Supports, or E. Myatt & Co.

2.1.2. All pipe hangers and supports shall be manufactured to the latest requirements of MSS-SP-58. Where applicable, design and manufacture of hangers and supports shall also conform to ANSI/ASME Code for Pressure Piping B31.1.

3. Execution

3.1. INSTALLATION

3.1.1. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent undue stress to building structural components.

3.1.2. Piping shall be supported from walls, beams, columns, and slabs using approved structural attachments. In situations where approved attachments cannot be used, alternative attachments or substructure assemblies shall receive approval prior to installation. Prior approval shall be given for any cutting or drilling of building structural steel. Damage or modification to the structure through welding, cutting, or drilling shall not be permitted if it reduces the integrity of the building structure as deemed by the Structural Engineer's Representative. It shall be the responsibility of the Mechanical Division to supply anchor bolts and base diagrams for equipment and pipe supports showing exact location of attachments.

3.1.3. All drilling for hangers, rod inserts and work of similar nature shall be done by this Division.

3.1.4. Auxiliary structural members shall be provided under the Mechanical Section concerned where piping, ducts or equipment must be suspended between the joists or beams of the structure, or where required to replace individual hanger to allow for installation on new services. Auxiliary structural members shall be the same material and finish as the primary structure (i.e. prime painted, galvanized, etc.). Submit details for review as requested.

3.1.5. Depending on the type of structure, hangers shall be either clamped to steel beams or joists, or attached to approved concrete inserts. Submit proposed hanger details for review and acceptance by the Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division.

3.1.6. Suspension from metal deck shall not be allowed unless specifically accepted by the Engineer's Representative. Drawings of the proposed method of suspension must be submitted for review.

3.1.7. Hangers, hanger rods and inserts in all parking and ramp areas shall meet the requirements of CAN/CSA-S413 and shall be of corrosion-resistant material or have an effective, durable corrosion resistant coating. Submit samples for approval.

3.1.8. Hanger rods shall be subject to tensile loading only. Suspended piping shall be supported by adjustable hanger rods sized as follows:

Pipe Size	Hanger Rod Diameter
50mm (2 in.) and under	9mm (3/8 in.)

3.1.9. Unless otherwise specified or shown hanger spacing for all services shall be as follows:

Nominal Pipe Diameter	Maximum Span
Up to and including 38mm (1-1/2 in.)	2.1 m (7 ft.)
50mm (2 in.) to 125mm (5 in.)	3 m (10 ft.)

3.1.10. In addition, provide a hanger within 600mm (2 ft.) on each side of valves, fitting or tees on pipes 38mm (1½ in.) diameter and larger.

3.1.11. Hanger spacing for plumbing and drainage services shall be in accordance with the plumbing code or municipal by-laws as applicable.

3.1.12. Hanger spacing for fire protection services shall be in accordance with the NFPA codes.

3.1.13. All horizontal piping 50mm (2 in.) diameter and larger shall be supported by adjustable wrought iron clevis type hangers. Smaller piping shall be supported by adjustable split ring hangers or clevis type hangers.

3.1.14. Suspending one hanger from another shall not be permitted.

3.1.15. For hot water piping 38mm (1-1/2 in.) and smaller, use line size hangers.

3.1.16. For cold water services such as domestic cold water pipe 25mm (1 in.) and smaller, install a section of high density insulation complete with continuous vapour barrier between the pipe and the hanger. Refer to Section 20 07 00.00 - MECHANICAL INSULATION.

3.1.17. For cold water services such as domestic cold water pipe larger than 25mm (1 in.), use a galvanized steel shield between the insulation and the hanger. Between the shield and the pipe, install a section of high density insulation complete with continuous vapour barrier. Refer to Section 20 07 00.00 - MECHANICAL INSULATION.

3.1.18. The shield width shall be minimum 1/4 of the pipe circumference. The length and gauge shall be as follows:

.1 150mm (6 in.) long and 14 US gauge for pipe larger than 25mm (1in.) up to 50mm (2 in.) diameter

3.1.19. Hangers and riser clamps in contact with copper pipe shall be copper coated construction or plastic coated. Taped hangers and riser clamps shall not be accepted.

3.1.20. For special equipment supports refer to equipment sections. Where no support method is identified secure wall mounted equipment to metal framing or masonry, with steel toggle or expansion fasteners, machine screws or sheet metal screws as applicable. Plastic, fibre or soft metal inserts shall not be acceptable. Wall mounted equipment shall not exceed 45.5 Kg (100 lbs) in weight or 250mm (10 in.) in depth unless reviewed or detailed by the Engineer's Representative. Where framing does not permit direct attachment, provide metal strut sub-framing or minimum 19mm (3/4 in.) fire retardant treated plywood backboards, unpainted, attached to the framing. Provide attachments for backboards at 600mm (24 in.) on centres with no less than 4 attachments.

END OF SECTION

20 05 48.00 Vibration and Noise Control

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

1.3. PERFORMANCE REQUIREMENTS

1.3.1. Adequately isolate all equipment to maintain acceptable noise levels in the occupied area of the building as specified below. Take noise measurements over the complete audible frequency range in each of the occupied zones under, above and beside Mechanical Equipment Rooms, and where indicated by the Engineer's Representative. Noise levels due to mechanical equipment, ductwork, grilles, registers, terminal devices, diffusers, etc, shall not exceed sound pressure levels in all 8 octave bands corresponding to the NC levels per ASHRAE handbook as indicated.

2. Products

2.1. MATERIALS

2.1.1. All equipment provided for vibration isolation or noise control shall be new and manufactured specifically for the purpose intended.

2.1.2. All vibration isolation devices shall be Vibro-Acoustics, Kinetics Noise Control, VMC Amber Booth, or Mason Industries and shall be one manufacturer throughout the project.

2.1.3. All factory built silencers and acoustic plenums shall be Vibro Acoustics, Kinetics Noise Control/Vibron, VAW Systems or EH Price and shall be one manufacturer throughout the project.

2.1.4. Provide vibration isolation devices for all motorized or electrical equipment. Static deflection of isolators shall be as given in the Vibration Isolation Schedule and/or as specified below. The Vibration Isolation Schedule shall take precedence.

2.1.5. Provide silencers in accordance with the Silencer Schedule and/or as shown on Drawings to maintain acceptable noise levels.

2.2. VIBRATION ISOLATION

2.2.1. Type SPNH (Spring and Neoprene Hangers) - Vibro-Acoustics Model SHR, Kinetics Model SRH, Mason Industries Model 30N, or ISOTECH Model IHSE, IHAE or IHBE

.1 Type SPNH shall include the addition of a neoprene element in series with the spring. The neoprene element shall have a deflection of not less than 9mm with a strain not exceeding 15%. Unless otherwise specified, the static deflection of SPNH hangers under actual load conditions shall be 50 mm (2 in.).

2.2.2. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.

2.2.3. All vibration isolators shall have either known undeflected heights of calibration markings to that, after adjustment, verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to design.

2.3. INTERNAL ACOUSTIC DUCT INSULATION

2.3.1. Fiberglass duct liner shall be manufactured by Certainteed, Owens-Corning, Knauf Insulation, or Johns Manville.

2.3.2. Natural fibre duct liner shall be manufactured by Bonded Logic.

2.3.3. Acoustic duct insulation shall have a minimum density of 24 kg/m3 (1.5 lbs/ft3).

2.3.4. Acoustic duct insulation shall comply with the requirements of NFPA 90A and the “Duct Liner Materials Standard” of the Thermal Insulation Manufacturer’s Association.

2.3.5. Duct sizes shown on the Drawing are free area dimensions (after the installation of internal acoustic duct insulation). Internal acoustic duct insulation shall be a minimum of 25 mm (1 in.) unless shown otherwise.

2.3.6. All internal acoustic duct insulation shall incorporate means to prevent fiber entrainment in the air stream.

2.3.7. The following ductwork shall be internally insulated:

.1 All supply air ductwork of dual duct boxes.

.2 All transfer air ductwork.

.3 All ductwork specifically identified in Specifications and/or on the Drawings.

2.4. SILENCERS

2.4.1. Factory-Built Silencers shall be completely pre-fabricated of incombustible materials and shall have a minimum insertion loss and a maximum air pressure drop as shown in Silencer Schedule. Submitted silencer performance shall be according to ASTM E477-06a “Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers”

2.4.2. Media filled silencers shall contain acoustic media type as indicated on the Silencer Schedule, either acoustic quality, shot free glass fibre insulation with long, resilient fibres bonded with a thermosetting resin, or 100% natural cotton fibres treated with an EPA registered, non-toxic borate solution, “flash dried” to provide resistance to mould, mildew and fungi. Media shall not cause or accelerate corrosion of aluminum or steel. Glass fibre, and rockwool will not be permitted as a substitute for cotton fibre media.

2.4.3. Acoustic media in media filled silencers shall have density as required to provide specified performance, packed under 15 percent compression and protected from air erosion by perforated sheet metal, gauge as specified below.

2.4.4. Acoustic media filled silencers with internal air velocities above 22.9 m/s (4500 fpm) shall have acoustic media wrapped with glass fibre cloth for additional erosion protection.

2.4.5. Silencers shall have acoustic media wrapped in Tedlar film liner to help prevent shedding, erosion and impregnation of the acoustic media in the following areas:

.1 Where indicated on Silencer Schedules

2.4.6. Rectangular type elbow silencers shall have minimum Class 2 construction, 18 gauge (1.18 mm) Pittsburgh lock formed galvanized steel outer casing and 22 gauge (0.78 mm) galvanized perforated steel liner, unless indicated as Class 3 on the Silencer Schedule. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as necessary to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 1200 mm (48 in.) shall have at least two half splitters and one full splitter.

3. Execution

3.1. INSTALLATION

3.1.1. Obtain one copy of all Shop Drawings of equipment to be isolated showing weights, shaft centres and all dimensions.

3.1.2. On system start-up, inspect the complete installation and provide a report in writing.

3.1.3. Piping, ductwork, conduit or mechanical equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.

3.1.4. All wiring connections to mechanical equipment on isolators shall be made with a minimum long flexible conduit installed in a slack “U” shape.

3.1.5. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.

3.1.6. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

3.1.7. Fans shall be levelled with fans operating before the flexible connectors are attached.

3.1.8. All fan bases and isolators shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.

3.2. EQUIPMENT ISOLATION

3.2.1. Ceiling Suspended Centrifugal Fans, and axial flow fans shall be mounted on Type SPNH spring isolators. Static deflection of the isolators shall be 50 mm (2 in.) unless shown otherwise on the Vibration and Isolation Schedule. Fans shall be suspended from above only if expressly noted as such on the Drawings and Schedules. Thrust restraint shall be by pre-compressed springs.

.1 If the fan to be suspended is not furnished with integral structural frame and external mounting lugs of suitable strength and rigidity, install approved structural base with lugs in the field.

3.2.2. Fans suspended from overhead structure shall be hung on Type SPNH spring isolators. Unless otherwise specified in the Vibration and Isolation Schedule, the static deflection of the isolators shall be 50 mm (2 in.).

3.2.3. The first isolator both upstream and downstream of equipment on springs shall have a static deflection of 1.5 times the deflection of the vibration isolated equipment to a maximum of 50 mm (2 in.). All other piping supports shall have a static deflection of 25 mm (1 in.) minimum.

3.2.4. Flexible piping connectors shall be installed to connect piping of diameter 50 mm (2 in.) or greater to reciprocating or rotating equipment.

3.2.5. No rigid connections between equipment and the building structure shall be made that degrades the specified noise and vibration control system.

3.2.6. Any conflicts with other trades which result in rigid contact with the equipment or piping due to inadequate space or other unforeseen conditions should be brought to the Engineer's Representative's attention prior to installation. If not brought to the attention of the Engineer's Representative prior to installation corrective work necessitated by conflicts shall be at the Contractor's expense.

3.2.7. Locate isolation hangers with the housing a minimum of 50 mm (2 in.) below but as close as possible to the structure. Where isolator hangers would be concealed by a non-accessible acoustical sub-ceiling, install the hangers immediately below the sub-ceiling for access.

3.2.8. Ducts shall be connected to fans, fan casings and fan plenums by means of flexible connectors. Flexible connectors shall be installed to prevent metal-to-metal contact across flexible connection.

.1 Flexible connectors shall be in accordance with Section 23 31 13.00 - DUCTWORK AND SPECIALTIES.

3.3. SILENCERS

3.3.1. Where silencers are to be installed in stainless steel or aluminum ductwork, the silencer shall be all stainless steel or aluminum construction to match the ductwork.

3.3.2. Silencers shall be as scheduled in the Silencer Schedule. Refer to Drawings for specific number required. The Silencer Schedule only indicates type. Adjust silencers as required to match existing grille dimension. Adjust silencer as required to ensure insertion loss necessary to meet the room noise criteria.

3.3.3. Silencers shall have outside dimensions that match the connecting duct size unless indicated otherwise.

3.4. ACOUSTICAL LINING OF DUCTS

3.4.1. Ductwork shall be acoustically lined where shown on the Drawings and as Specified.

3.4.2. Acoustical duct lining shall be a minimum of 25 mm (1 in.) thick in all internally lined sheet metal ducts, unless otherwise specified or shown on the Drawings.

3.4.3. The acoustic liner shall be fixed to the duct with a minimum of 50% coverage of a fire-resistant adhesive. Where the duct width exceeds 300 mm (12 in.) or the height 600 mm (24 in.), the liner shall be additionally secured with mechanical fastening on maximum 450 mm (18 in.) centers on all sides. Mechanical fasteners that pierce the duct are unacceptable. Mechanical fasteners shall be in accordance with Section 20 07 00.00 - MECHANICAL INSULATION. All ends of the liner shall be coated with a fire resistant cementing material to prevent delamination, leakage or erosion. All joints shall be firmly butted and ends coated with an adhesive to ensure that the lining is smooth across all joints.

3.4.4. Where acoustical duct lining is installed, the dimensions of the sheet metal shall be increased to include the thickness of the lining material. Dimensions shown on the Mechanical Drawings are the clear internal dimensions after the liner has been installed.

END OF SECTION

20 05 53.00 Pipe and Ductwork Identification

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Field painting of non-colour coded piping and ductwork - under Division 9, Section 09 90 00.00 - PAINTING AND COATING.

2. Products

2.1. MATERIALS

2.1.1. Paint shall be compatible with the surface material to be painted.

2.1.2. Colour code shall conform to CAN/CGSB 24.3-92 and ANSI A131-1981.

2.1.3. Pipe covering shall be SMS, Brady, Primark Manufacturing Inc. and Seton equal to SMS Coil-Mark system pipe markers.

2.1.4. All identification shall incorporate direction of flow arrows, and the specified system designations and abbreviations. Designations and abbreviations shall be submitted for review prior to installation.

3. Execution

3.1. INSTALLATION

3.1.1. After completion of insulation and/or painting, all piping and ductwork shall be marked to show the service and direction of flow.

3.1.2. Marking shall be placed at each side of any wall, partition or floor, at 9.1 m (30 ft.) intervals (maximum) on all exposed piping and ductwork and at each access panel or door. Marking shall be located so as to be in full view and visible from the floor.

3.1.3. All pipe identification shall be installed in accordance with the manufacturer’s recommendations.

3.1.4. Pipe identification markers for insulated or non-insulated pipe sizes less than 150 mm (6 in.) circumference shall be pre-coiled and shall cover the pipe in its entirety and be joined using adhesive along the longitudinal joint. In addition to the adhesive the marking system shall be banded with clear plastic tie-wraps on each end.

3.1.5. Pipe identification markers for insulated or non-insulated pipe sizes equal to and greater than 150 mm (6 in.) circumference shall be strapped on with recommended tie-wraps.

3.1.6. Adhesive labels are not acceptable.

3.1.7. Gas piping shall be painted yellow for the entire length and identified with pipe identification markers. Banding is not permitted.

3.1.8. All electric traced piping shall have additional identification to show it is traced.

3.1.9. Identify ductwork with 50 mm (2 in.) stencils using black or white ink to contrast the surface being identified.

3.1.10. Identification location for ductwork shall conform to the guidelines for pipe and shall indicate flow medium, function, and direction.

3.1.11. Contractor shall ensure stenciling is performed in a neat, quality manner.

END OF SECTION

20 05 55.00 Valve Tags and Charts

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

1.2.1. Submit samples of charts and numbering system before installation.

2. Products

2.1. MATERIALS

2.1.1. Tags must be a minimum 2mm (3/32 in.) thick Micro Surface Impact Acrylic suitable for a service temperature up of -29°C through 80°C (-20°F through 175°F), with engraved numbers and/or letters as required. Tags shall be a minimum of 25 mm (1 in.) square and maximum to suit numbering system. Numbers shall be nominally 9 mm (3/8 in.) high. Letters shall be nominally 6 mm (1/4 in.) high.

2.1.2. Number and nameplates for standpipe and sprinkler system supervisory and main operating valves shall be minimum 2 mm (3/32 in.) thick laminated phenolic plastic and a minimum 125 mm (5 in.) long x 100 mm (4 in.) wide with red face and white centre. Lettering shall be a minimum 9 mm (3/8 in.) high with maximum to suit local authorities and shall be engraved through to the white lamination. Each nameplate shall contain the system name, service and valve number.

2.1.3. For all other valves on standpipe and sprinkler system not required to have laminated number and nameplates, provide plastic tags as specified above.

2.1.4. Abbreviations and colour code shall be as shown on Standard Details.

3. Execution

3.1. INSTALLATION

3.1.1. Tags and nameplates shall be attached to the valve body or handle with brass hooks or chains.

3.1.2. All valves shall be provided with tags, other than valves on convectors, induction units or other space heating, cooling units and valves on plumbing fixtures. Provide a chart or charts, indicating location, service and zone of each valve. This work shall be co-ordinated between the various Mechanical Sections to prevent overlapping of numbering systems.

3.1.3. Provide separate charts for all fire system nameplates and tags.

3.1.4. For extension and/or alterations to existing systems, provide new charts conforming in appearance to the existing charts.

3.1.5. Co-ordinate valve identification with pipe and ductwork identification.

3.1.6. Roof drains used for restricting or controlling the flow of water from the roof or acting as an overflow shall be affixed with an identification label “Control Flow Roof Drain - Do Not Remove Restriction Device”.

3.1.7. Electronically submit charts as PDF files along with As-Built drawings. Provide charts set in metal picture frames with a clear acrylic front and fastened securely where directed by Engineer's Representative.

3.1.8. All valve tag numbers for all systems shall be shown on the As-Built Drawings.

END OF SECTION

20 05 63.00 Access Doors and Accessibility

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. Submit Drawings showing size, type and location of all access doors, for review, before installation.

2. Products

2.1. MATERIALS

2.1.1. Access doors shall be Acudor, or Mifab Manufacturing Inc. Steel thickness (US Guage) indicated as minimum acceptable.

2.1.2. Doors in solid walls shall be with a 16 US gauge, prime painted steel door panel, rust resistant concealed hinges, flanged frame, and screwdriver operated lock. Acudor Model UF 5000 or Mifab Model UA.

2.1.3. Doors in drywall partitions or ceilings shall be 16 US gauge, prime painted steel recessed door panel for the acceptance of a drywall insert, concealed hinges, drywall bead frame, and screwdriver operated lock. Acudor model DW 5015 or Mifab Model CAD-DW.

2.1.4. Access doors in fire rated walls or ceilings shall be ULC labeled with insulated door panel, concealed hinge, self-closing, self-latching, flanged frame, and prime painted. Provide master key operated catch in areas accessible to the public. Acudor Model FW 5050 or Mifab MPFR.

2.1.5. Doors in tiled walls or ceilings shall be 16 US gauge, stainless steel, type 304 with #4 satin finish, concealed hinges, wall frame and screw driver operated lock. Acudor Model UF 5000 or Mifab Model UA-SS.

2.1.6. Doors for medium and high security applications in solid walls shall be 10 US gauge door with minimum 4 mm (3/16 in.) welded angle frame with heavy duty butt hinges welded to the door and frame with master keyed cylinder lock provided by the Owner. Acudor Model SD 6000 or Mifab Model MI-SADH.

2.1.7. Minimum size of doors shall be 350 mm x 350 mm (14 in. x 14 in.). Wherever possible 600 mm x 600 mm (24 in. x 24 in.) doors shall be used.

3. Execution

3.1. INSTALLATION

3.1.1. All parts of the installation requiring periodic maintenance shall be accessible. Wherever valves, dampers and other appurtenances are concealed by building construction, access doors shall be furnished by this Section and installed under the respective Trade Sections (i.e. masonry, plaster, drywall, tile, etc.) This Section is responsible for the proper location of the access doors.

3.1.2. Wherever possible, items requiring access shall be located in easily accessible areas (i.e. exposed or T-bar ceilings).

3.1.3. Group items in order to minimize the number of access doors required.

3.1.4. Each access door shall be installed to provide complete access to equipment for maintenance and servicing.

3.1.5. Make any changes to locations of access doors as directed by the Engineer's Representative.

3.1.6. The final installed locations of all access doors shall be shown on the As-Built Record Drawings.

END OF SECTION

20 05 83.00 Sleeves and Escutcheons

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Firestopping and smoke seals within mechanical assemblies (i.e. inside ducts, dampers, etc.) with the exception of sleeves shown for future use installed in fire or smoke rated partitions shall be the responsibility of Mechanical Division. All other firestopping and smoke seals of mechanical services are part of Mechanical Division.

2. Products

2.1. MATERIALS

2.1.1. Sleeves passing through stud partitions shall be 0.75 mm (0.0299 in. - 22 GSG) steel.

2.1.2. Sleeves passing through concrete or masonry partitions and floors shall be Schedule 40 steel pipe.

2.1.3. Sleeves passing through floors in finished areas and concealed spaces may be sheet metal where additional protection is provided to prevent water from passing freely (i.e. housekeeping pad).

2.1.4. Sleeves for pipes passing through exterior foundation walls shall be pre-manufactured molded non-metallic HDPE equal to PSI-Thunderline Model CS Century-Line. Each sleeve assembly shall have end caps manufactured of the same material as the sleeve and installed at each end to prevent deformation during the concrete pour.

.1 The annular space between the service pipe and the sleeve shall be a modular EPDM seal element, reinforced nylon polymer pressure plates, joined with ASTM B633 carbon steel bolts with zinc dichromate and corrosion inhibiting coating equal to PSI-Thunderline Link-Seal Model C wall seal.

.2 A reinforced concrete bridge shall be installed between the wall and the adjacent undisturbed soil.

2.1.5. Firestopping and smoke seal systems shall be in accordance with CAN4-S115 - Standard Method of Fire Tests for Firestop Systems, CAN/ULC-S101 - Standard Methods for Fire Endurance Tests of Building Construction and Materials, ASTM E119 - Standard Test Methods for Fire Tests of Building and Construction Materials, and ASTM E814 - Standard Test for Fire Tests of Through-Penetration Firestop Stops.

.1 Unless noted otherwise “F” and “T” ratings are required.

.2 Systems shall be asbestos free and maintain an effective barrier against flame, smoke, and gases in accordance with CAN4-S115 and shall not exceed opening sizes for which they are intended.

.3 Firestopping and smoke seals at openings around mechanical services shall be an elastomeric seal for sound and vibration control.

.4 Fire resistance rating of firestopping assembly shall not be less than the fire resistance rating of surrounding floor or wall assembly.

.5 Service penetration assemblies shall be ULC certified in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.

.6 Service penetration firestop components shall be ULC certified in accordance with CAN4-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15.

.7 Firestopping and smoke seals shall be by Hilti, Tremco/Royal Quickstop, STI Firestop or 3M.

.8 Firestop products shall be mold and mildew resistant

2.1.6. Escutcheons shall be satin finish stainless steel or satin finish chrome or nickel plated brass, with non-ferrous set screws. Do not use stamped steel split plates. Split cast plates with screw locks may be used. For escutcheons for plumbing fixtures refer to Section 22 42 00.00 - FIXTURES AND TRIM.

2.1.7. Provide adequate bracing for support of sleeves during concrete and masonry work. For floors and walls with a fire resistance rating, build fire damper assemblies into structure to attain fire rated construction, in a manner acceptable to the governing authorities.

2.1.8. Cover exposed duct sleeves in finished areas with 1.42 mm (0.0561 in. - 18 G.S.G.) galvanized sheet steel in the form of duct collars. Fix in position with non-ferrous metal screws.

2.1.9. Counter flashing for roof penetrations shall be commercial quality galvanized sheet steel to ASTM A653/A653M-02, 0.70 mm (0.0276 in. - 24 G.S.G.) minimum thickness, Z275 275 zinc coated by hot dip process.

3. Execution

3.1. INSTALLATION

3.1.1. Arrange for all chases and formed openings in walls and floors as required by the Mechanical Division for the mechanical services. These chases and openings shall not be larger than necessary to accommodate the equipment and services. Advise on these requirements well in advance, before the concrete is poured and the walls are built. All necessary sleeves and inserts shall be supplied by this Division.

3.1.2. Chases and openings not located in accordance with the above provisions shall be made at the expense of this Division. Cutting of structural members shall not be permitted without specified written acceptance of the Engineer’s Representative.

3.1.3. Provide sleeves for all service penetrations through walls, partitions, floor slabs, plenums and similar barriers.

3.1.4. Sleeves shall be sized to maintain insulation and vapour barrier around all pipes and ducts for all service penetrations. Coordinate thickness requirements with Section 20 07 00.00 - MECHANICAL INSULATION.

3.1.5. For sleeves through barriers without a fire resistance rating, for non-insulated pipe, fill the annular space between the service and the sleeve with insulation as specified in Section 20 07 00.00 - MECHANICAL INSULATION and caulk around the edges with sealant.

3.1.6. Firestopping and smoke seal material and components shall be installed in accordance with the ULC Listing and manufacturers instructions. Examine the sizes and conditions of the cavities to be filled to determine the correct thicknesses and installation of materials. All substrates and surfaces in contact with firestopping materials shall be dry and prepared in accordance with the Manufacturers instructions at appropriate ambient conditions.

3.1.7. Where holes are core drilled in existing structures, sleeves shall be provided as specified complete with a combination puddle/anchor flange bolted to the floor. Seal watertight between the flange and the floor.

3.1.8. Provide escutcheons at all penetrations of piping into finished areas, and at insulated pipes, make the escutcheons large enough to fit around the insulation.

3.1.9. Counter flash vertical duct penetrations through roof at intersection of roof curb and duct.

3.1.10. Extend sleeves a minimum of 50 mm (2 in) above floor and seal water tight to prevent seeping to the floor below. Sleeves passing through housekeeping pads are permitted to be flush with the top of the housekeeping pad.

END OF SECTION

20 07 00.00 Mechanical Insulation

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. Provide shop drawings with technical data on all types of insulation to be installed.

1.1.3. Provide two samples of each type of insulation indicating where each is to be used and a sample of a typical vapour barrier dam. Samples shall be mounted on boards. One shall be kept at the Contractor's site office and the other shall be turned over to the Engineer's Representative.

2. Products

2.1. MATERIALS

2.1.1. Fibreglass insulation shall be Owens-Corning, Certainteed, Manson, Johns Manville, Knauf or Fibrex.

.1 Duct insulation shall be rigid board vapour seal 48 kg/cu.m. (3 lbs/cu.ft.) density duct insulation with factory applied vapour barrier.

.2 Pipe insulation shall be preformed sectional fibreglass or mineral wool insulation with factory applied all service jacket.

2.1.2. Foamglass insulation shall be Pittsburgh-Corning.

2.1.3. Flexible elastomeric insulation shall be Armacell or K-Flex with adhesive applied to both surfaces to be joined. Flexible elastomeric insulation shall not be used on pipes that are electrically traced.

2.1.4. Corner beads and channels at floor line shall be 0.4 mm (28 ga.) galvanized sheet metal.

2.1.5. Fire retardant lagging coating shall be Chil-Seal CP-50 by Childers Products Company or Monsey Bakor equivalent.

2.1.6. Vapour barrier dam shall be Chil-perm CP30 with fibreglass cloth reinforcing.

2.1.7. All cements and adhesives shall be as recommended by the manufacturer of the insulation. Insulation, insulation jacket, canvas and adhesive shall be fire retardant with a flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50 when tested in accordance with CAN/ULC-S102-M.

2.1.8. Provide all insulation, adhesives, coatings, and jacket systems for indoor applications that are Certified under the GREENGUARD Environmental Institute (GEI) Certification Program for low chemical and particle emissions for indoors,

3. Execution

3.1. INSTALLATION

3.1.1. Install insulation in accordance with the manufacturer's printed installation instructions unless noted otherwise.

3.1.2. Insulation thicknesses and conductivities shall meet or exceed the minimum standards set out in ASHRAE 90.1 (refer to Table 1 following) and as specified herein for the services covered.

3.1.3. Apply insulation to clean, dry surfaces only while ambient temperature is at least 10 Deg. C. (50 Deg. F.).

3.1.4. Commence application of insulation following required testing of piping, ductwork, and apparatus where such items are to be covered.

3.1.5. Recover all insulation, where exposed to view and not concealed in ceiling spaces or pipe spaces with 6 oz. canvas pasted on. Apply two coats of fire retardant lagging finish.

3.1.6. Where vapour barrier dams are called for, terminate the insulation and seal the vapour barrier to the pipe or ductwork using a mesh embedded in a vapour barrier mastic. Provide dams at valves, fittings used for servicing, groups of other types of fittings, irregular shaped objects at floor and wall penetrations, and at 15 m (50 ft.) intervals of straight pipe or straight ductwork for the following services: water piping that is less than 80 deg. F., including but not limited to the following:

.1 Domestic cold water piping

3.1.7. Terminate insulation on pipes passing through fire rated walls or floors, and fit tight to the fire stop material.

3.1.8. Irregular shaped objects such as strainers, pipe system filters, cyclone separators, blowdown valves and other accessories requiring servicing, on insulated piping, shall be insulated with removable caps or sections. All edges shall be sealed between pipe and vapour barrier and held in place with stainless steel straps. Finish all insulation smooth, making the outline of pipe insulation a true circular and concentric shape. Shape the outline of fitted insulation to blend with adjacent covering.

3.1.9. On piping systems specified to be insulated, include insulation on valves, flanges, couplings and unions.

3.1.10. Do not use staples to secure joints of insulation jackets.

3.1.11. Hot Services

.1 Hot fluid such as heating water services shall have glass fibre preformed pipe insulation. Refer to Table 1 for required insulation thicknesses.

.2 On hot services, insulate valves, fittings, couplings, unions, flanges and all other appurtenances through which the fluid passes, using mitred sections of preformed insulation of a thickness equal to the adjoining pipe insulation, and securely wire in place. Over mitred section, apply one coat of field applied mesh reinforced mastic. Finish services with a vapour barrier using two full brush coats of vapour seal adhesive.

.3 Apply glass fibre preformed vapour barrier jacket pipe insulation to domestic hot water piping. Refer to Table 1 following for required insulation thickness. Apply with all joints butted firmly together, and bond securely, sealing flaps by pasting down to give a smooth finish.

.4 Recover with canvas. Provide removable sections at access doors/manholes and all components requiring servicing.

3.1.12. Insulate refrigerant suction piping in all locations and refrigerant liquid piping in the conditioned space served with preformed glassfibre insulation with continuous vapour barrier or flexible elastomeric pipe insulation. Cover exterior piping with field applied mesh reinforced mastic or weatherproof vapour barrier.

3.1.13. Cold Services

.1 Provide foamglass, Thermo-12 or calcium silicate insulation inserts the full length of shields at all hangers and supports.

.2 For domestic cold water piping less than 75 mm (3 in.) where hangers on cold water lines penetrate vapour barrier make sure the penetration is properly sealed with insulation and vapour barrier continued up hanger a further 75 mm (3 in.).

.3 Where sheet metal shields are used refer to Section 20 05 29.00 - HANGERS AND SUPPORTS.

.4 Apply 12 mm (1/2 in.) thick, preformed glass fibre pipe insulation with vapour barrier jacket or 12 mm (1/2 in.) thick flexible elastomeric insulation to all domestic cold water piping. Insulate the first 4500 mm (15 ft.) of the standpipe and/or sprinkler main.

.5 On cold water service valves, water meters, drain valves, vent connections, thermometer wells, pressure gauges and other irregular shaped objects, apply flexible elastomeric sheet insulation, thickness to suit service, cut and mitre as necessary, and attach with adhesive and stainless steel banding. Bond and seal edges of insulation to the adjacent surfaces and finish with field applied mesh reinforced mastic.

.6 Refer to the Table 1 for required insulation thicknesses.

.7 Piping in air conditioning units. Insulate with 25 mm (1 in.) thick flexible elastomeric insulation and cover with field applied mesh reinforced mastic.

.8 Insulate refrigerant liquid and suction lines with 12 mm (1/2 in.) flexible elastomeric insulation. Cover exterior piping with field applied mesh reinforced mastic.

3.1.14. Drainage Piping

.1 Cover cast iron drainage pipe 75 mm (3 in.) and smaller with 12 mm (1/2 in.) preformed glass fibre pipe insulation, and finish with vapour barrier jacket. Seal band to the fibreglass insulation. Apply 25 mm (1 in.) thick insulation for all larger pipes.

.2 Sanitary drainage piping to be insulated:

.1 Direct and indirect drains from drinking fountains

3.1.15. Ductwork and Equipment

.1 Ductwork and equipment internal to the building within conditioned spaces shall have 25 mm (1 in.) thick rigid glass fibre duct insulation with vapour barrier. In conditioned concealed spaces and on round duct smaller than 600 mm (24 in.) insulation may be 38mm (1-1/2 in.) flexible type with vapour barrier. Flexible duct connections do not require insulation except where a factory applied insulation has been specified with the flexible duct connection.

.2 Butt join insulation and attach with pins and speed washers, one per 0.186 sq.m. (2 sq.ft.), but not more than 450 mm (18 in.) apart in any direction. Apply fire resistive adhesive in 100 mm (4 in.) wide strips on 300 mm (12 in.) centres. Seal all joints with adhesive and apply vapour barrier tape. Install pins of suitable length for the thickness of insulation and clip flush after final installation of washers. Tack weld pins to sheet metal.

.3 On exposed insulation in mechanical rooms, increase thickness as necessary to give 12 mm (1/2 in.) thickness over flanges and angles. Provide corner beads to protect corners to a height of 2135 mm (84 in.) above floor and provide channels at floor line to finish off insulation on apparatus.

.4 Insulation Contractor shall coordinate with sheet metal contractor to ensure duct insulation is applied prior to ductwork being installed to underside of slabs, beams or other services or behind other duct risers and shafts.

3.1.16. Insulate the following ductwork and equipment:

.1 All supply ductwork from fans to VAV box for variable volume systems and all supply ductwork on constant volume systems

3.1.17. TABLE 1: MINIMUM PIPE INSULATION THICKNESS/PERFORMANCE (BASED ON ASHRAE 90.1 AND MODEL NATIONAL ENERGY CODE FOR BUILDINGS)

3.1.18. Minimum Pipe Insulation Thickness - mm (in.)

.1 Domestic and Service Hot Water Systems[c]

Fluid Design Operating Temp. range deg. C. (deg. F.)	Insulation Conductivity		Nominal Pipe Diameter - mm (in.)					
	Conductivity [W(m-K)] [h-cu.ft. - deg. F. (Btu-in.)]	Mean Rating Temp deg. C. (deg. F.)	Runouts [b] Up to 32 (1-1/4)	Less than 25 (1)	25-32 (1 to 1-1/4)	38-75 (1-1/2 to 3	100-150 (4-6)	200 (8) and up
41-60 (105 -140)	0.040 (0.28)	38 (100)	25 (1.0)	25 (1.0)	25 (1.0)	38 (1.5)	38 (1.5)	38 (1.5)

[a] Piping installed exterior to the building shall meet the minimum insulation requirements of Runouts for Heating Systems with a fluid design operating temperature above 177 Deg. C. (350 Deg. F.) or the thickness required by the fluid design operating temperature range, whichever is most stringent.

[b] Runouts to individual terminal units not exceeding 3.7 m (12 ft.) in length located within Partitions within Conditioned Spaces.

[c] Applies to recirculating sections of service or domestic hot water systems and first 2.4 m (8 ft.) from storage tank for non-recirculating systems.

END OF SECTION

20 08 02.00 Cleaning and Protection

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. NOT USED

3. Execution

3.1. INSTALLATION

3.1.1. Clean thoroughly all fixtures and equipment from grease, dirt, plaster or any other foreign material. Chrome-plated fittings, piping and trim shall be polished upon completion.

3.1.2. Fixtures and equipment shall be properly protected from damage during the construction period and shall be cleaned and polished in accordance with manufacturer's directions. Motors and equipment bearings shall be protected with plastic sheets, tied or taped in place. Aluminum fin heating or cooling elements shall be protected with cardboard covers.

3.1.3. Any dirt, rubbish, or grease on walls, floors or fixtures accumulated from the work of the Mechanical Division shall be removed promptly from the premises by this Division.

3.1.4. During construction protect all services and equipment from dirt and debris, by using temporary caps over the open ends of pipes ductwork and equipment connections.

3.1.5. All equipment installed or stored on site shall be maintained in accordance with manufacturers recommended instructions (i.e. rotate shafts on fans, pumps, etc).

3.1.6. Refinish and restore to the original condition and appearance all mechanical equipment which has sustained damage to the manufacturer's prime and finish coats of enamel or paint. Materials and workmanship shall be equal to the manufacturers original.

END OF SECTION

21 12 00.00 Standpipe and Fire Hose System

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. The standpipe system shall conform to applicable NFPA standards and to all local authorities requirements.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. All wiring to annunciator panel - under Electrical Division.

1.2.2. Wiring of alarms to the main alarm panel - under Electrical Division.

2. Products

2.1. MATERIALS

2.1.1. Pipe, valves and fittings less than 1380 kPa (200 psi) working pressure shall be as follows:

.1 Pipe, black steel, Schedule 40, ASTM A53

.2 Fittings for a minimum of 1206 kPa (175 psi) working pressure, 1035 kPa (150 psi) malleable iron ASME B16.3, 860 kPa (125 psi) cast iron ASME B16.4, butt welding schedule 40 ASME B16.25, or roll grooved Victaulic, Viking Anvil-Gruvlok or Tyco/JCI Grinnell.

.3 Provide ULC Listed and FM Approved valves of the same manufacturer for the entire system,

.4 Acceptable valve manufacturers:

.1 Viking Nibco

.2 Viking Gruvlok

.3 MA Stewart W Series

.4 Victaulic

.5 Tyco Grinnell

.5 Gate valves 65 mm (2½ in.) and larger iron body bronze mounted, O.S. & Y, flanged ends.

.6 Check valves 65 mm (2½ in.) and larger iron body, bronze mounted, flanged ends.

.7 Gate valves 65 mm (2½ in.) and larger iron body bronze mounted, O.S. & Y, flanged ends.

.8 Check valves 65 mm (2½ in.) and larger iron body, bronze mounted, fanged ends.

.9 All grooved products including couplings, fittings and valves shall be of one manufacturer.

2.1.2. Switches for supervised valves shall activate alarm when valve not fully open. Switch shall be complete with contacts for alarm and supervision. Switches shall be equal to Potter O.S. & Y -UA series. Plug-in type switches are not acceptable.

3. Execution

3.1. INSTALLATION

3.1.1. Installation shall conform to all applicable codes.

3.1.2. In all systems with fire pumps install low pressure alarm and wire to the building alarm panel.

END OF SECTION

21 12 26.00 Fire Hose Cabinets

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

1.2.1. Submit shop drawings and/or catalogue cuts of all items supplied in accordance with requirements of Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Fire hose cabinet equipment, hoses and racks shall be National Fire Equipment Ltd., Wilson & Cousins or Flag Fire, and shall be ULC listed and FM Approved.

2.1.2. Fire hose cabinets shall be National Fire Equipment Ltd., or Wilson & Cousins.

2.2. FIRE HOSE CABINETS Cabinet shown as Type "FHC-1" shall be recessed type flush mounted, 1.19 mm (0.0478 in. - 18 M.S.G.) thick steel tub with black enamel interior and maximum inside dimensions of 750 mm x 750 mm x 203 mm (30 in. x 30 in. x 8 in.) deep. Front shall be adjustable with black enamel trim, 1.2 mm (0.05 in. - 18USS Gauge) 304 stainless steel No. 4 vertical grain satin finish door. Glass shall be 5mm (3/16 in.) clear. Latch shall be concealed. National Fire Equipment Model CT300

2.2.2. Where indicated, cabinet tub shall have rear knock-out openings for hose connections.

2.3. General

2.3.1. Adjustable pressure regulating valves shall be ULC listed. Provide pressure regulating valves for 38mm (1-1/2 in.) hose connections where residual pressure will exceed 689 kPa (100 psi). Provide pressure regulating valves for 65mm (2-1/2 in.) hose connections where static pressure will exceed 1207 kPa (175 psi). For system static pressures up to 1207 kPa (175 psi) the valve shall be equal to National Fire Equipment Model A156 and for system static pressures above 1207 kPa (175 psi) the valve shall be equal to Elkhart Model UR-25. Valves shall limit the pressure to 689kPa(100psi) for 38mm (1-1/2”) hose connections and 1207 kPa (175 psi) for 65mm (2-1/2 in) hose connections.

3. Execution

3.1. INSTALLATION

3.1.1. Supply and install in each hose cabinet a ULC labelled fire extinguisher suitable for the distance and location served. Refer to Section 21 25 00.00 PORTABLE FIRE EXTINGUISHER Section.

3.1.2. Mount fire hose cabinets securely in concrete block walls, shimming the tub and mortaring tightly in place.

3.1.3. Where cabinets are mounted in stud partitions, provide 75 mm x 75 mm x 6 mm (3 in. x 3 in. x 1/4 in.) steel angle supports from floor below to floor above. Weld 75 mm x 225 mm x 6 mm (3 in. x 9 in. x 1/4 in.) plates top and bottom of angles and fasten each plate to structure with two 9 mm (3/8 in.) bolts.

3.1.4. For all free standing cabinets provide a steel angle support frame as specified for mounting in a stud partition.

END OF SECTION

21 13 00.00 Sprinkler Systems

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. Sprinkler system shall conform to applicable NFPAStandards and to all authorities' requirements.

1.2. DESCRIPTION OF SYSTEM

1.1.4. The sprinkler systems shall be wet type as shown, consisting of distribution and interconnecting piping, sprinkler heads, hangers and all necessary equipment to provide a complete sprinkler system ready for immediate operation.

1.3. DENSITY AND AREA REQUIREMENTS

1.3.1. The following minimum density and area requirements shall be the basis of the hydraulic design. Any request for modifying the density requirement shall be submitted by the Contractor for review by the Engineer's Representative.

Location Served	**Hazard**	**Density L/m/sq. m. (gpm/sq. ft)**	**Area Sq. m. (sq. ft)**	**Remarks**
Office Areas	Light	4.1 (0.10)	139.5 (1500)	Wet Type. Loop main shall have the capacity to serve 5 additional sprinkler heads at the most remote 139.5 sq.m. (1500 sq.ft.) area of application.

1.3.2. Where quick response sprinkler heads are used in the design, the area of protection shall not be reduced. Quick response heads shall be provided where required in accordance to NFPA 13.

1.1.5. Where systems are hydraulically designed obtain water flow data of street mains. Minimum street pressure shall be 207 kPa (30 psi) if no information is available at the time of bid.

1.4. SUBMITTALS

1.1.6. Shop Drawings: Submit sprinkler drawing layouts in accordance with Section 21 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS showing all component parts complete with Shop Drawings of all valves and accessories to I.A.O. (F.M.) and to the Engineer's Representative for review. These drawings shall be designed and bear the signed stamp of an engineer licensed to --practice in the appropriate discipline and in the Place of Work. The Contractor's design Engineer shall provide periodic review in accordance with all applicable requirements of their licence and shall sign and seal an occupancy letter indicating the installation is in conformance with their design.

1.4.1. Submit hydraulic calculations in approved formats.

1.5. QUALIFICATIONS.

1.5.1. The installation company shall be a member of the Canadian Sprinkler Association and regularly engaged in this work.

2. Products

2.1. MATERIALS

2.1.1. General:

.1 All components used in the sprinkler system shall be ULC Listed and FM Approved. UL Listed and/or FM Approved equipment not bearing a ULC listing shall only be acceptable if written approval from the local authority is obtained.

.2 All components used in the sprinkler system shall be manufactured in Canada or USA, whenever available.

2.1.2. Pipe and fittings less than 1206 kPa (175 psi) working pressure shall be as follows:

.1 Pipe, black steel, Schedule 40, ASTM A53.

.2 Fittings for a minimum of 1206 kPa (175 psi) working pressure, 1035 kPa (150 psi) malleable iron ASME B16.3, 860 kPa (125 psi) cast iron ASME B16.4, butt welding schedule 40 ASME B16.25, or roll grooved Victaulic, Viking Anvil-Gruvlok or Tyco/JCI Grinnell.

.3 All grooved products including couplings, fittings and valves shall be of one manufacturer.

.4 Provide fittings with grooved connections at all legs of the fitting or couplings equal to Victaulic 920, Tyco/Grinnell Figure 730, or Gruvlok Figure 7045 Clamp-T. Fittings and couplings that are not acceptable are ones equal to Victaulic 921, Tyco/Central Sprinkler Strap 40-5, or Gruvlok Figure 7045 U-bolt.

2.1.3. No grooved fittings or products shall be used except for those specified. All grooved products shall be of one manufacturer.

2.1.4. Sprinkler heads shall be the automatic spray type, ULC listed and as approved by I.A.O. or F.M. as applicable. Where heads are located close to heating coils, unit heaters or other hot equipment, they shall be of the high temperature type to suit regulations.

2.1.5. Sprinkler heads in finished areas with acoustic or gypsum wall board ceiling indicated as light hazard or ordinary hazard shall be quick response, concealed type with white cover plate. Reliable Model G4A, Viking Mirage, Tyco/Central RFII, Victaulic V3802.

2.1.6. Unless otherwise specified, hangers shall conform to the requirements of NFPA 13.

3. Execution

3.1. INSTALLATION

3.1.1. Spacing of sprinklers shall suit the hazard of the occupancy shown. Where specific locations of sprinkler heads have been shown on Drawings, these shall be maintained. Sizing of piping shall be based on hydraulic design. Submit all calculations to the city, the Owner's Insurers and the Engineer's Representative for review. The calculations shall be designed and bear the signed stamp the engineer.

3.1.2. For exposed structures the sprinkler head layout, where shown, is to assist in design, layout, and coordination. Ensure that all heads required to suit as-built beam, ducts or other obstructions are provided. Where specific pipe locations have been indicated these shall be maintained.

3.1.3. Installation shall conform to all applicable codes.

3.1.4. Review all other Sections of the Specifications and include for all work that may affect this section. Pay particular attention to the requirements for valve tags and identification.

3.1.5. Fully coordinate the sprinkler piping with that of other trades on the job. Mains and branches shall be run so as not to interfere with the building's structure, electrical, plumbing, ventilation and heating installations. Sprinkler heads shall be located in the centre and/or quarter points of ceiling tile as shown on the reflected installation of additional sprinkler heads.

3.2. TESTING OF SYSTEM

3.2.1. All testing shall be executed in accordance with the latest regulations of NFPA 13 and with any other regulations that the authoritative inspector demands.

3.2.2. Make all required arrangements, pay for, perform and witness flow and residual tests at the site before making hydraulic calculations. A copy of these results shall be submitted with the Shop Drawings.

END OF SECTION

22 05 76.00 Cleanouts

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.2. FINISHED AREAS

2.2.1. Cleanouts in finished areas with membrane floors shall be coated cast iron body with adjustable nickel bronze frame and round scoriated gas tight access cover with secondary gas tight plug. J.R. Smith 4020-F-C, Zurn ZN 1400-KC, Mifab C1100C-R-1-34, Watts CO-100-C-R-1-34G.

3. Execution

3.1. INSTALLATION

3.1.1. Cleanouts in furred ceiling spaces shall extend up through floor slab above, except where the Engineer’s Representative gives specific approval to its location in the ceiling space.

3.1.2. Cleanouts shall be installed in horizontal drains at each change of direction and as required.

END OF SECTION

22 11 13.00 Pipes, Valves and Fittings (Plumbing System)

1. The General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Pipes and fittings shall be in accordance with the following unless specified otherwise by local authorities.

2.1.2. All valves on potable water systems shall be equal in performance to the models specified, shall be lead free or low lead meeting the requirements of CSA B125.3, CSA B125.14, NSF/ANSI 372, NSF/ANSI 61, NSF/ANSI 14, and/or ANSI/AWWA C550 as applicable

2.1.3. All city and domestic water, above ground, 75 mm (3 in.) and smaller, less than 1380 kPa (200 psi) working pressure:

.1 Pipe: Copper Tubing, Type “L”, Hard Drawn, ASTM B88. Fittings: wrought copper solder joint pressure fittings, ANSI/ASME B16.22 or cast copper alloy solder joint pressure fittings, ANSI/ASME B16.18.

.2 Joints made with 95-5 tin antimony, 96-6 tin silver, or 96-4 tin silver solder, ASTM B32.

.3 Gate valves, 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with lead free bronze body, rising stem screwed. Kitz 827/828, Toyo 206A-LF/207A-LF, Apollo 101T-LF.

.4 Globe valves, 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with lead free bronze body, solder ends or with screwed to solder adapter and composition disc for water service. Kitz 811/812, Toyo 211A-LF/212A-LF, Apollo 120S-LF.

.5 Check valves 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with lead free bronze body, swing check, solder ends. Kitz 822/823, Toyo 236A-LF/237A-LF, Apollo 161S-LF

.6 Non-slam check valves downstream from pumps, ANSI Class 150, 1032 kPa (150 psi) WSP pressure rating, dual flapper design with 316 stainless steel body and stainless steel check, renewable disc and resilient seat for flanged installation. Non-slam check valves shall be Velan-ProQuip Model DDD11-1D, Duo CHEK II H15CMF3-14 or Mueller 72-HHH-3-H.

.7 Strainers shall be lead free bronze Y body equal to Colton Industries Model 125YTB, Mueller LF351.

.8 Drain valves and blow-off valves shall be 4137 kPa (600 psi) WG 19 mm (3/4 in.) ball valves with lead free, bronze body or forged brass body, solid ball, male threaded garden hose end, brass cap and chain equal to Watts B-6000, Toyo 5046-LF, Kitz 868C or Apollo 78-100.

2.1.4. All domestic water above ground 75 mm (3 in.) and smaller, over 1380 kPa (200 psi) working pressure and under 2070 kPa (300 psi) working pressure:

2.1.5. Sanitary drains and vents above ground shall be cast iron or copper pipe installed as in regulations, except where copper pipe is used, joints to be made with 95-5 solder. ABS, asbestos cement (Transite) and PVC pipes are not acceptable.

2.1.6. Ball valves 50 mm (2 in.) and smaller shall be lead free, bronze body or forged brass 4137 kPa (600 psi) WOG, virgin Teflon seat, TFE stem packing and thrust washer, 1/4 turn open-closed operation with solid ball. Ball valves shall be Watts No. B-6000, Toyo 5044A-LF/5049A-LF, Kitz 858/859 or Apollo 70-100/200. Stem extensions shall be provided on all ball valves. Ball valves may be substituted for gate valves only.

2.1.7. Except where special feature are required or unless otherwise approved or noted, all valves shall be of one manufacturer with the manufacturer's name and the pressure rating clearly marked on the outside of the valve body. Valves shall be manufactured by Crane, Jenkins, Toyo or Kitz. Butterfly valves shall be by Keystone, DeZurik, Bray, Challenger, Centerline, Crane, Apollo, Kitz or Victaulic. Non-slam check valves shall be Pro-Quip, Duo CHEK II, Centerline, Mueller or Victaulic. Ball valves shall be Apollo, Watts, Toyo or Kitz. Valves shall be equal to the model numbers specified. .

3. Execution

3.1. INSTALLATION

3.1.1. Valves shall be provide as shown and as required for the satisfactory operation and control of all equipment and shall be installed to enable each piece of equipment to be isolated.

3.1.2. Isolation valves shall be installed at the base of each riser and at each branch take-off. Where the equipment is to be isolated within easy view of and not more than 6000 mm (20 ft.) from the main, at the branch take-off, then the branch take-off valve may serve as the equipment isolating valve.

3.1.3. Drain valves shall be installed at each low point in the piping systems and at each tank.

3.1.4. Connections between copper and steel pipe shall be made with brass or bronze fittings where other type of connection is not specified in regulations.

3.1.5. All piping shall run parallel with closest wall.

3.1.6. Slope all drains and vents in accordance with the plumbing code but not less than the minimum slopes shown on the drawings. Slope all water lines 25 mm in 12 m (1 in. in 40 ft.) unless shown otherwise.

END OF SECTION

22 42 00.00 Fixtures and Trim

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

1.2.1. Submit Shop Drawings and/or catalogue cuts of all items supplied in accordance with requirements of Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Plumbing fixtures shall be as indicated and specified with all required supports, accessories, drainage, vent and water connections to make the fixtures complete.

2.1.2. Fittings that supply water to a fixture shall not exceed the maximum flow rates in accordance with the following:

.1 Part 7 of the Building Code

2.1.3. Fixtures shall be American Standard, Crane, Toto, Kohler, Franke, Zurn or Novanni, equivalent to the fixtures specified. American Standard – Eljer and Crane Placidus are not permitted. Fixtures shall be white.

2.1.4. Fittings and trim shall be American Standard, Crane, Kohler, Sloan, Chicago Faucets, Zurn, Moen, Symmons, or Delta/Cambridge except where specified otherwise. All exposed valves, fittings, escutcheons, trim, etc., at each fixture shall be polished chrome plated brass, unless specified otherwise.

2.1.5. Provide Fixtures and Trim equal to product specification sheets. This should be used when the ats style product specification sheets are used.

2.2. GENERAL SINK UNITS

2.2.1. Sinks shown as 'CS-2.1 - One Compartment Stainless Steel Sink (General use)' shall be brushed finish, 27-1/4 in. x 16-9/16 in. x 9 in.) deep, under mounted, 16 gauge stainless steel, single compartment, mirror finished rim, satin finished bowl, self-rimming with crumb cup strainer, and sound deadening. Blanco Quatrus U1

.1 Faucets for sink unit above shall be Moen ALIGN™ Single Handle high Arc Pulldown Prep/Bar Faucet Model 5965 Series. Stainless Steel finish. 1.5 GPM flow rate. 1 hole installation. Lever style handle.

2.2.2. "P" trap for all sink units shall cast brass 38 mm (1½ in.) with union, cleanout, and escutcheon, Delta Commercial 33T360, McGuire 8912C, or Zurn Z8702BD-PC.

2.2.3. Supplies for all sink units shall be a pair of chrome plated, heavy pattern angle lavatory supplies, lockshield, screw driver slot, stuffing box cartridge, 3/8 in. IPS brass inlet supply nipple, flexible braided stainless steel risers, and stainless steel wall flange. Delta Commercial 47P2512SD, McGuire H165LKN5RB, Zurn ZH-8820-LR-LK-PC-3.

2.3. UTILITY SINK UNITS

2.3.1. Janitor sinks shown as 'JS-3.1 - Floor Mounted (Square Unit)' shall be 610 mm x 610 mm x 250 mm (24 in. x 24 in. x 10 in.) deep, floor mounted, precast terrazzo with integral drain and strainer. Stern-Williams MTB-2424, Acorn 242410.

.1 Faucets for janitor sink unit above shall be 200 mm (8 in.) enters, two handle, cast brass wall mount service sink faucet, 2.1 GPM (7.9 L), polished chrome plated finish, ¼ turn ceramic disk cartridge, rigid pail hook spout, integral stops, color indexed 70 mm (2¾ in.) metal handles with vandal resistant screws, plain spout complete with body mounted vacuum breaker, hose threaded outlet and 1220 mm (48 in.) hose and stainless steel hanger. Chicago Faucet 305VB-R-XK, Delta Commercial 28C2083 with 28T911, Kohler K-8905, Zurn Z841L1-XL-SSI-HH.

3. Execution

3.1. INSTALLATION

3.1.1. Provide necessary plates, brackets, cleats, supports, etc, for rigidly securing fixtures in place. Accurately lay out all roughing piping, avoiding offsets.

3.1.2. Examine fixtures for defects. Remove and replace any fixture which, in the opinion of the Engineer’s Representative, is damaged. Make necessary adjustments to ensure fixtures function as per manufacturer’s operating criteria. Clean and polish all fixtures and trim upon completion.

3.1.3. Ensure wall-mounted fixtures with back water connections have an adjacent access door, unless the pipe space is sufficiently wide to allow the water connection to be made from within the pipe space. For this, pipe space shall be 600 mm (24 in.) minimum clear width.

3.1.4. Fixtures shall be installed symmetrical with wall tile pattern, unless otherwise dimensioned or shown on Architectural Drawings.

END OF SECTION

23 05 93.13 Testing and Balancing Piping Systems

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. QUALITY ASSURANCE

1.2.1. The balancing under Section 23 05 93.23 Testing and Balancing Air Systems and this Section shall be performed by the same balancing company.

1.2.2. Balancing companies shall be members of A.A.B.C. or N.E.B.B.

1.2.3. Acceptable balancing companies are limited to the following:

.1

Flowset	Chris Pither Phone: 416-410-9793 x. 1 Mobile 647-321-5114 chrisp@flowset.com

2. Products

2.1. NOT USED

3. Execution

3.1. GENERAL

3.1.1. Sample of a Test Verification Sheet is provide at the end of the section and this sheet or a similar one with all pertinent information is to be filled out for all tests called for in the Specification or required by code. The sheets shall be signed by the Contractor and the Independent Company to verify that the data recorded is correct.

3.1.2. Leakage tests shall be carried out on sections of the work and these sections shall be identified by reference number of the test sheet and by description of the duct system. The reference identification number shall be indicated on the As-Built Drawings.

3.1.3. The following systems shall be tested and balanced:

.1 Life safety and fire protection systems

.2 Plumbing systems

3.1.4. The Contractor shall provide a schedule for all testing and balancing.

3.2. THE CONTRACTORS TESTING AND BALANCING

3.2.1. Test all plumbing systems in accordance with all applicable plumbing codes.

3.2.2. Test all fire protection systems in accordance with all applicable NFPA codes.

3.2.3. All other systems not covered by codes noted above shall be tested and proven tight over a period of 24 hours by a hydrostatic test. Remove vents and gauges and temporarily plug connections.

3.2.4. Test pressure for water systems shall be:

3.2.5. Test pressure for steam and water systems shall be:

.1 1-1/2 times the system working pressure but not less than 1035 kPa (150 psig), or

.2 The maximum working pressure of expansion joints and vibration isolators.

3.2.6. Repair any leaks or defects and repeat the tests to the satisfaction of the Engineer's Representative.

3.2.7. All tests for systems shall be performed in the presence of, and test reports signed by, the Independent Company. Notify the Independent Company in writing a minimum of one week in advance of testing.

3.2.8. Co-ordinate with the Independent Company to ensure all necessary valves for balancing the system are installed.

3.2.9. Notify the Engineer's Representative in writing that this co-ordination has taken place before installation begins. If this Contractor fails to co-ordinate with the Independent Company and if failure to co-ordinate results in being unable to balance the systems, the cost of any changes required shall be paid for by the Contractor at no cost to the Owner.

3.2.10. Ensure that all cooling coil drain pans drain freely and that no standing water remains.

3.2.11. Ensure access is provided to all valves and equipment that requires servicing.

3.2.12. The Contractor is responsible for all equipment operating to design conditions and shall trim impellers, etc., to provide the required conditions, but is not responsible for balancing the system.

3.2.13. The Contractor shall make available staff, as required by the Independent Company, to correct any deficiencies in the mechanical systems which prevent the Independent Company from balancing the system.

3.2.14. The Contractor shall provide copies of all Shop Drawings requested by the Independent Company.

3.2.15. The Contractor referred to is the prime Mechanical Contractor.

3.3. THE INDEPENDENT COMPANY'S TESTING AND BALANCING

3.3.1. The Independent Company shall balance the entire water system to ensure all heat exchangers, etc, are operating to design conditions. Adjust the circuits by means of the balancing valves and record balance position.

3.3.2. Flow through all heat exchangers, chillers, boilers and other such equipment shall be balanced to ensure that the pressure drop through the equipment is within 10% of the manufacturer's design conditions.

3.3.3. The Independent Company shall witness all system tests and sign all test reports. Include one copy of all test reports in each copy of the balancing reports.

3.3.4. Co-ordinate with the Contractor to ensure that all necessary valves for control and balancing are installed in all locations required. Notify the Engineer's Representative in writing that this co-ordination has taken place. Include in this letter any recommendations made regarding valves, locations, installations, etc. If this Independent Company fails to co-ordinate with the Contractor and if failure to co-ordinate results in being unable to balance the systems, the cost of any changes required shall be paid for by the Independent Company.

3.3.5. The Independent Company is responsible for balancing the systems to obtain the design conditions, and shall repeat the balancing until the required conditions have been met.

3.3.6. At the time of final inspection, recheck in the presence of the Engineer's Representative random selections of data recorded in the certified report. Points or areas for recheck shall be selected by the Engineer's Representative and be approximately 10% of the report data.

3.3.7. A measured deviation of more than 10% between the verification reading and the reported data shall be considered as failing the verification procedure.

END OF SECTION

23 05 93.23 Testing and Balancing Air Systems

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. This Section is split into two Sections of work, the Contractors testing and balancing and the Independent Company's testing and balancing.

1.2. INDEPENDENT TESTING AND BALANCING COMPANY PROCUREMENT

1.2.1. The Mechanical Contractor shall administer and obtain bids from the acceptable Independent Companies and shall submit unopened bids for review and selection by the Engineer's Representative or Owner within 20 days from award of the Mechanical Contract.

1.3. QUALITY ASSURANCE

1.3.1. The balancing under Section 23 05 93.13 Testing and Balancing Water Systems and this Section shall be performed by the same balancing company.

1.3.2. Balancing companies shall be members of A.A.B.C. or N.E.B.B.

1.3.3. Acceptable balancing companies are limited to the following:

.1

Flowset	Chris Pither Phone: 416-410-9793 x. 1 Mobile 647-321-5114 chrisp@flowset.com

2. Products

2.1. NOT USED

3. Execution

3.1. THE CONTRACTORS TESTING AND BALANCING

3.1.1. Refer to Section 23 31 13.00 - DUCTWORK AND SPECIALTIES for pressure ratings of ductwork and systems.

3.1.2. The Contractor shall make available staff, as required by the Independent Company, to correct any deficiencies in the mechanical systems which prevent the Independent Company from balancing the system.

3.2. THE INDEPENDENT COMPANY'S TESTING AND BALANCING

3.2.1. Co-ordinate with the Contractor to ensure that all necessary manual and splitter dampers for balancing are installed in all locations required. Notify the Engineer's Representative in writing that this co-ordination has taken place. Include in this letter any recommendations made regarding dampers, locations, installation, etc. If this Independent Company fails to co-ordinate with the Contractor and if failure to co-ordinate results in being unable to balance the systems, the cost of any changes required shall be paid for by the Independent Company at no cost to the Owners.

3.2.2. The Independent Company shall balance the entire air systems including air volumes and control settings under maximum system pressure drop conditions (filter at replacement condition).

3.2.3. The Independent Company will measure, make final adjustments and report upon the air volume at each variable volume box, diffusers, register and grille. The static pressure upstream and downstream of the fan, the fan speed and the motor current.

3.2.4. Air volumes measured by the Independent Company shall be within plus or minus 5% of those shown on Drawings for diffusers, grilles, registers, variable air volume boxes and fans, at both maximum and minimum volumes shown.

.1 Where insulation is damaged it shall be repaired including the vapour barrier in an approved manner. Duct tape is not acceptable.

3.2.5. In all cases where measurements by the Independent Company show failure to comply with the Drawings and Specifications, the Contractor shall change fan sheaves, etc., as required, and new balancing measurements shall be made by the Independent Company.

3.2.6. Ensure all thermostats and controls are set to give specified conditions and include settings is report.

3.2.7. The Independent Company shall witness all system tests and sign all test reports. Include one copy of all test reports in each copy of the balancing reports.

3.2.8. Fans on all systems shall be set up to give the minimum discharge pressure required to overcome the resistance of the box, discharge ductwork and diffusers.

3.2.9. The Independent Company is responsible for balancing the systems to obtain the design conditions and shall repeat the balancing until the required conditions have been met.

3.2.10. Provide PDF of the final testing and balancing reports. Reports shall be complete with index pages and index tabs, and certified by the Independent Company.

END OF SECTION

23 21 13.23 Piping, Valves & Fittings (Except Plumbing)

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. All gate, globe and check valve shall be approved under Canadian Interprovincial Regulations for the Construction and Inspection of Boilers, Tanks, and Appurtenances.

1.1.3. Provide submittal drawings in accordance with Section 20 05 03.00 - SHOP DRAWINGS for all valves, appurtenances, and grooved components.

1.1.4. All steel pipe and fittings shall be manufactured in North America. Off-shore pipe shall not be accepted on site. Pipe shall be clearly marked as being manufactured in North America or it shall be removed from site.

2. Products

2.1. MATERIALS

2.1.1. Use pipes, fittings and valves as shown below unless specifically shown or specified otherwise.

2.2. LOW TEMPERATURE AND/OR PRESSURE WATER

2.2.1. Pipes 50 mm (2 in.) and smaller, black steel ASTM A53, Schedule 40, threaded, ANSI B36.10.

2.2.2. Pipes 100 mm (4 in.) and smaller, alternative for entire system for condenser water in hard-tempered copper ASTN B88, Type L, plain ends. All joints made with 95-5 tin-antimony or tin-silver solder.

2.2.3. Fittings 50 mm (2 in.) and smaller, cast iron ASTM A126, 860 kPa (125 psi) WSP threaded, ASNI B16.4.

2.2.4. Fittings alternative for entire system for heating water, chilled water and condenser water: wrought copper or cast bronze, solder, joint, ANSI B16.22.

2.2.5. Unions 50 mm (2 in.) and smaller malleable iron ASTM A197, 1035 kPa (150 psi) WSP, with bronze to iron ground joint, ANSI B16.3.

2.2.6. Gate valves 50 mm (2 in.) and smaller, bronze 1035 kPa (150 psi) WSP rising stem, threaded shall be Crane #431, Jenkins #2810J, Toyo 298 or Kitz 42.

2.2.7. Check valves 50 mm (2 in.) and smaller bronze 860 kPa (125 psi) WSP, swing check, screwed cover, screwed shall be Crane #37, Jenkins #4092, Toyo 236 or Kitz 22.

2.2.8. Drain valves for blow-off of sediment from strainers and tank drainage shall be 19 mm (3/4 in.) size 4140 kPa (600 psi) WOG ball valve with bronze or forged brass body, solid ball, virgin Teflon seat and packing, male threaded garden hose end, brass cap and chain shall be Watts B6000, Toyo 5046, Kitz 58CC or Apollo 78-100.

2.2.9. Flow balancing valves shall have meter connection for attaching to a portable meter. Each connection shall have positive shut-off valves. Each valve shall be capable of precise flow measurement, accurate flow balancing and positive shut-off. Adjustment shall be by multiple turns of the handle for Vernier type setting and shall have a hidden memory feature for tamper-proof setting. All valves 65 mm (2-1/2 in.) and larger shall be flanged or grooved and shall be Tour Anderson Model STA-F, valves 50 mm (2 in.) and smaller shall be screwed and shall be Tour-Anderson Model STA-D.

.1 Provide a portable flow measuring meter, complete with hoses and carrying case to suit each size of valve provided. Meter shall be computerized, differential pressure type for direct reading of flow rate in either G.P.M. or L/s.

2.3. GROOVED PIPE AND FITTINGS

2.3.1. For systems less than 93.2 deg. C. (200 deg. F.) at 1139 kPa (165 psi) or less than 65.6 deg. C. (150 deg. F.) at 1380 kPa (200 psi).

2.3.2. Grooved pipe and fittings may be used for hot water, chilled water, hot or chilled glycol, and condenser water systems.

2.3.3. Pipes 50 mm (2 in.) to 250 mm (10 in.) black steel ASTM A53, Schedule 40 cut or roll grooved.

2.3.4. Couplings shall consist of two ASTM A536 grade 65-45-12 ductile iron housing segments, ASTM D2000 pressure responsive elastomer gasket, and ASTM A449 zinc-electroplated steel bolts and nuts.

.1 Sizes 300 mm (12 in.) and smaller:

.1 Rigid Type: Housings shall be cast with offsetting angle-pattern bolt pads to prove rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9

.1 50 mm (2 in.) through 150 mm (6 in.): Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket rated to 121 deg C. (250 deg. F). Victaulic Style 107.

.2 As an alternative provide Victaulic Zero-Flex Style 07.

.2 Flexible Type: For use in locations where vibration attenuation and stress relief are required. Three flexible couplings may be used in lieu of a flexible connector. The couplings shall be placed in close proximity to the source of the vibration. Victaulic Style 77.

2.3.5. Fittings 50 mm (2 in.) to 250 mm (10 in.) cast ductile iron ASTM A536 grade 65-45-12 or malleable iron ASTM A47.

2.3.6. Branch connections: ductile iron ASTM A535 or malleable iron ASTM A47; Victaulic Style 920, 921 or 72.

2.3.7. Flanges; ductile iron ASTM A536 or malleable iron ASTM A47 for sizes 50 mm (2 in.) to 600 mm (24 in.); Victaulic Style 741.

2.3.8. Gaskets: EPDM conforming to ASTM D-2000, temperature range -34 deg. C. to 110 deg. C. (-30 deg. F. to 230 deg. F.).

.1 EHP conforming to ASTM D-2000, temperature range -34 deg. C to 121 deg. C. (-30 deg. F. to 250 deg. F.).

2.3.9. Valves 40 mm (1-1/2 in.) to 150 mm (6 in.): ductile iron ASTM A-536, aluminum bronze disc, and EPDM liner for service up to +110 deg. C. (+230 deg. F.). Valves 40 mm to 100 mm (1-1/2 in. to 4 in.) size shall have lever lock handle, and 150 mm (6 in.) shall be gear operated. Valves shall be for bubble-tight service to 1400 kPa (200 psi). Vicatulic Series 700 or MA Stewart W50 AEDGGS-LL/GO.

2.3.10. Valves 50 mm (2 in.) to 300 mm (12 in.): ductile iron Body to ASTM A536, EPDM coated ductile iron disc for temperatures up to +110 deg. C. (+230 deg. F.), for bubble-tight service to 2065 kPa (300 psi). Victaulic Vic-300 MasterSeal or MA Stewart W50 AEDGGS-LL/GO.

.1 Butterfly Valves 350 mm (14 in.) to 600 mm (24 in.): Ductile iron body to ASTM A536, EPDM disc mounted seal, PPS (polyphenylene sulphide) coated ductile iron disc, and stainless steel stem. (Stem shall be offset from the disc centerline to provide full 360-degree circumferential seating). Rated for temperatures up to + 110 deg. C. (+230 deg. F.), for bubbletight service to 2065 kPa (300 psi). Victaulic AGS-Vic300.

2.3.11. Check valves 65 mm (2-1/2 in.) to 300 mm (12 in.): ductile iron ASTM A536 EPDM coated disc spring loaded design for non-slam operation. Victaulic Series 716 or MA Stewart W30-A-RD-GG.

.1 Check valves 350 mm (14 in.) to 600 mm (24 in.): Ductile iron body to ASTM A395, duel stainless steel disc(s), with stainless steel spring and shaft, rated for temperatures up to +110 deg. C. (+230 deg. F.), for service to 1575 kPa (230 psi) Victaulic Series W715.

2.3.12. Strainers 50 mm (2 in.) to 300 mm (12 in.): ductile iron ASTM A536 with type 304 stainless steel screen. Victaulic Style 730/732 or MA Stewart W40-A-YX-GG.

2.3.13. All grooved products, including couplings, fittings, valves and specialty items shall be Victaulic.

2.3.14. For other system components refer to Low Temperature and/or Pressure Water Article.

3. Execution

3.1. INSTALLATION

3.1.1. Flare connections may be used on soft copper tubing where one end of the flare connection is an integral part of the equipment or valve.

3.1.2. Arrange all runs of piping to prevent interference and to achieve a satisfactory and workmanlike installation of neat appearance. Run all piping parallel to walls. All valves, controls, equipment, expansion compensators, flexible connections and, as far as possible, all piping shall be easily accessible for inspection, maintenance and operation.

3.1.3. Pitch all lines 25 mm in 12 m (1 in. in 40 ft.-0 in.) unless shown otherwise.

3.1.4. Carefully ream threaded joints and join with compound on the male thread only. Re-tighten flanged connections after the installation has been brought up to its service. Following testing, apply insulation. Take care not to overstress the material during construction.

3.1.5. Arrange piping to permit ease of equipment removal. Provide flanges or unions on all pipe connections to each piece of equipment.

3.1.6. Provide gate, globe and check valves in all piping systems as shown and as required for satisfactory operation and control of equipment. Provide shut-off valves wherever piping is connected to all equipment. Provide one flow balancing valve and one shut-off valve on water coils.

3.1.7. Install all control devices, valves and any other appurtenances as directed by the controls and/or BAS trades.

3.1.8. Make connections between copper and steel with brass or bronze fittings.

3.1.9. Ball valves may be used in low temperature and/or pressure systems only in lieu of gate valves in 50 mm (2 in.) and smaller. Provide union downstream of ball valves for servicing if ball valve is not a three piece design.

3.1.10. Install flow balancing valves in sections of straight pipe as recommended by the manufacturer, but in no case with less than 10 pipe diameters upstream of the valve.

3.1.11. Install flow balancing valves in the following locations:

.1 Each heat pump

END OF SECTION

23 25 26.00 Cleaning and Filling

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. All cleaning and filling work shall be perfomed by the Base Building Chemical Treatment Supplier: PMC Water Systems.

PMC Water Systems	Barry Macdonald Phone: (905) 432-4134 barrymacdonald@pmcwatersystems.com

1.2. SUBMITTALS

1.2.1. Shop Drawings: Submit Shop Drawings of all chemicals used in the system in accordance with SECTION 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Water piping cleaning solution for closed loop systems shall be equal to GE W&P Technologies FERROQUEST FQ7103 or Ashland Drew CSW 600. Refer to manufacturers instructions for chemical concentrations.

1.1.7. Boiler system cleaning formulation shall be equal to GE W&P Technologies OPTISPERSE ADJ0346 or Ashland Drew LAC PN 0057-40-7. Refer to manufacturers instructions for chemical concentrations.

3. Execution

3.1. INSTALLATION

3.1.1. All systems shall have been hydrostatically tested prior to cleaning.

3.1.2. Thoroughly flush all systems with raw water to remove loose mill scale and debris. Remove and clean all strainers and flush low points before chemical cleaner is added.

3.1.3. All coils shall be disconnected and flow shall be by-passed.

3.1.4. A temporary pump shall be installed in the system and shall be capable of pumping adequate discharge at adequate head.

3.1.5. A temporary heater shall be installed in the system and shall be capable of maintaining the circulating water temperature as required for chemical treatment.

3.1.6. Systems shall be filled with city water and approved chemical cleaner introduced by a small temporary chemical injector pump at the temporary circulating pump section. Cleaner shall be introduced to maintain concentrations as per the manufacturer’s recommendations.

3.1.7. All systems shall be cleaned in accordance with manufacturer's instructions and under the supervision of the chemical supplier's representative. Minimum cleaning procedures shall be to fill all water piping cleaning solution, circulate at 1.5 times specified system flow rate and maintain at highest possible temperature for 72 hours. During this period heavy blowdown of all low points shall be carried out every 6 hours. Strainers shall be cleaned as necessary to permit maximum flow possible and, in any event, at least every 6 hours. Drain the solution, all strainers, and flush entire system with clean water for a minimum of 24 hours. Repeat fill and flush procedure as often as required, adding inhibitor with each fill, to achieve acceptable contaminant levels. Systems shall then be refilled, ready for use. Temperature of system for cleaning shall be to suit chemical supplier's requirements.

3.1.8. Take samples of system from a series of representative drains as directed by the Engineer's Representative. If system is still dirty, repeat cleaning procedure specified above until acceptable. Acceptable samples shall indicate that alkalinity and pH have returned to potable water levels. Copies of all test reports shall be submitted by the water treatment supplier to the Engineer's Representative for verification prior to final filling.

3.1.9. Add fluid and chemical treatment immediately after cleaning has been completed and accepted. Acceptable control parameters shall be as follows:

.1 Nitrite: 1000 - 1500 ppm

.2 pH: 8.5 – 10 or as required by equipment manufacturer

.3 Iron: Less than 2.0 ppm

.4 Copper: Less than 0.3 ppm

.5 Molybdate: 100 - 150 ppm

.6 Hardness (CACO3): Less than 50 ppm or as required by equipment manufacturer (soften water as required)

3.1.10. For ground source closed loop heat pump systems after cleaning and draining, fill the system with alcohol or propylene glycol anti-freeze solution as specified or shown in equipment schedules.

3.1.11. For tenant work the base building Contractor shall drain and fill the base building system. Arrange and pay for this work.

3.1.12. The Mechanical Contractor shall supply the Engineer's Representative with certified documentation from the water treatment supplier that the systems have been properly equipped, chemically cleaned and that they are maintaining sufficient levels of scale/corrosion inhibitor. The contractor shall request such documentation form the water treatment supplier within one week of presentation to the Engineer's Representative.

3.1.13. A label or tag identifying any chemical additives, their concentration, and their maintenance requirements shall be permanently and prominently displayed on the heat source

END OF SECTION

23 23 01.00 Refrigerant Piping

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

1.2.1. Submit product data sheets for all products required, except for pipe and fittings.

1.2.2. Submit a schematic piping diagram for each refrigerant piping system indicating pipe sizes, slopes, valves, traps, and piping specialties sealed by a Professional Engineer in the Province of the installation.

1.2.3. Submit confirmation of registration of the project with the Authority having Jurisdiction.

1.3. REGULATORY COMPLIANCE AND QUALITY ASSURANCE

1.3.1. The installing Contractor shall be certified and shall register all projects in accordance with the requirements of the Authority having Jurisdiction.

1.3.2. All components of a refrigeration piping system shall have a Canadian Registration Number or CSA certification acceptable to Authority having Jurisdiction.

1.3.3. All systems shall display appropriate Ozone Depletion Prevention (ODP) tags prior to commissioning. Manufacturer shall not commission any system not displaying proper ODP tags.

1.4. SPECIAL CONSIDERATIONS FOR VARIABLE REFRIGERANT FLOW (VRF) PIPING SYSTEMS

1.4.1. VRF refrigeration piping systems shall be installed as per the balance of this specification with the following considerations and/or exceptions:

1.4.2. Refrigerant contractors shall be certified by the VRF equipment supplier. Proof of training certification shall be made available upon request.

1.4.3. There shall be minimal use of refrigeration specialties (filter driers, accumulators, receivers, check valves, etc.) in the VRF pipe system. Install in accordance with VRF manufacturer’s recommendations.

1.4.4. Pressure relief valves shall be 4482 kPa (650 PSI) rated and installed in pairs (two valves per circuit).

1.4.5. Y style piping joints and headers shall be provided by the manufacturer to ensure proper refrigerant balance and flow for optimum system capacity and performance.

1.4.6. T style joints, field fabricated joints, or Y joints that are not provided by the manufacturer shall not be permitted.

1.4.7. Approved R-410a flaring block, and approved torque wrenches, both available from VRF manufacturer, shall be used for all flare connections.

1.4.8. Pipe clamps shall fasten around the piping insulation. Pipe clamps that compress the copper directly shall be installed a minimum of 900 mm (36 in) away from joints, and shall be loosely tightened to allow for copper expansion.

1.4.9. Provide VRF manufacturer with actual pipe lengths installed for calculation of refrigerant charge. Supply and charge VRF system with required quantity of R-410a prior to VRF manufacturer commissioning. Refrigerant charging shall be done in the liquid state.

2. Products

2.1. PIPE, FITTINGS AND JOINTS

2.1.1. Copper piping shall be air conditioning / refrigerant grade ASTM B280, annealed or hard drawn as required. Soft annealed copper tubing shall not be used in sizes larger than 22 mm (7/8 in).

.1 Braze all joints except as noted.

.2 Joints 22 mm (7/8 in) and smaller may be flared.

.3 Fittings shall be cast copper alloy for flared copper tube, or wrought copper and bronze solder-joint pressure fittings.

.4 Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings.

.5 Cast sweat-type joints and fittings shall not be permitted for brazed joints.

.6 Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of equipment.

2.2. BRAZING FILLER METAL

2.2.1. Filler metal shall be type BAg-5 with AWS Type 3 flux except as noted,

2.2.2. Copper to copper joint filler metal shall be BCuP-5 or BCuP-6.

2.2.3. Brazing rods for all joints shall be 15% Lucas Milhaupt “sil-Fos”.

2.3. VALVES

2.3.1. Valves shall be designed, manufactured, and tested specifically for refrigerant service. Valve bodies shall be of brass, bronze, steel, or ductile iron construction. Valves 25 mm (1 in) and smaller shall have brazed or socket welded connections. Valves larger than 25 mm (1 in) shall have butt welded end connections. Threaded end connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts shall be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere shall be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow shall be legibly and permanently indicated on the valve body. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

2.3.2. Refrigerant access valves and hose connections shall be in accordance with ARI 720.

2.3.3. Isolation valves shall be installed where shown on the schematics. Isolation valves shall be bi-flow self-seating with operating pressures up to 4482 kPa (650 PSI). Valves shall be complete with brass Schrader connections located on the valve body only.

2.3.4. Check Valves shall be Mueller Industries Inc. “Checkmaster” straight through type for valves 6.4 mm to 16 mm (1/4 in to 5/8 in) diameter, globe type for valves 22 mm (7/8 in) diameter and larger, each complete with extended tubing for brazing connections, and as follows:

.1 Straight through type check valves are to be complete with a machined brass gasketed body, phosphor bronze spring, and neoprene seat.

.2 Globe type check valves are to be complete with a cast bronze body, forged brass cap, phosphor bronze spring, PTFE seat disc, and neoprene O-ring seal.

2.3.5. Liquid Solenoid Valves

.1 Ball type valves as specified above, each in accordance with ARI 760 and be suitable for continuous duty with applied voltages 15% under and 5% over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions, direct-acting or pilot-operating type, moisture-proof, ULC approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have an operating pressure differential suitable for the refrigerant used.

2.3.6. Expansion Valves

.1 Valve shall be the diaphragm and spring-loaded type with external equalizers, and bulb and capillary tubing. Valve shall be equipped with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 1Deg. C. (2 Deg. F.) of saturated suction temperature at evaporator conditions. Pilot-operated valves shall have a characterized plug to provide required modulating control.

.2 Electronic expansion valves shall be brass body, needle valve with floating needle and machined seat, stepper motor drive.

2.3.7. Safety Relief Valves

.1 Suction lines shall be rated at 2413 kPa (350 PSI) and liquid at 4482 kPa (650 PSI) or liquid and discharge lines at 4482 kPa (650 PSI) respectively.

.2 Purpose built Y-fitting shall be Superior Products model 3155W.

2.3.8. Evaporator Pressure Regulators, Direct-Acting

.1 Valve shall include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 1 Deg. C. (2 Deg. F.) change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

2.4. PIPING ACCESSORIES

2.4.1. Filter Driers

.1 Sizes 15 mm (5/8 in) and larger shall be the full flow, replaceable core type. Sizes 15 mm (1/2 in) and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 10.3 MPa (1500 PSI).

2.4.2. Discharge Line Oil Separator

.1 Discharge line oil separator shall be provided in the discharge line from each compressor. Oil return line shall be connected to the compressor as recommended by the compressor manufacturer.

2.4.3. Accumulator

.1 Accumulators shall be provided in the suction line to protect the compressor from liquid refrigerant damage. Accumulator shall be cUL listed under the required operating pressures and must be installed as close to the compressor as possible.

2.4.4. Refrigerant Moisture and Liquid Indicators

.1 Indicators shall be single or double port, ULC listed. Body shall be copper or brass with flared or soldered ends. Sight glass shall have color coded paper moisture indicator with removable element cartridge and plastic cap. Maximum working pressure shall be 3447 kPa (500 PSIG). Maximum working temperature shall be 93.3 Deg. C. (200 Deg. F.).

2.4.5. Pressure and Vacuum Gauges

.1 Gauges shall conform to ASME B40.100 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 85 mm (3-1/2 in) in diameter with a range from 0 kPa (0 PSIG) to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.4.6. Insulation

.1 Liquid, suction and hot gas lines shall be individually insulated in accordance with Section 20 07 00.00 - Mechanical Insulation

3. Execution

3.1. GENERAL

3.1.1. Consider the piping shown on the Drawings as diagrammatic, indicating the general runs and connections only, and parts may not be shown in the true position. Be responsible for the proper erection of the systems of piping in every respect suitable for the work intended.

3.1.2. Install all piping in the best workmanlike manner and in accordance with the best practices of the trade. Piping shall be pitched 13 mm (1/2 in) for every 3000mm (10 ft) of length in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and as shown.

3.1.3. Pipe supports shall be a maximum of 1800 mm (6 ft) apart. Pipe clamps shall fasten around the piping.

3.1.4. Piping supports and guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.5. Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal.

3.1.6. Install in accordance with CSA B52 and ASME B31.5 Mechanical Refrigeration Code.

3.1.7. Safety pressure relief valves shall be installed in the piping as per CSA B52. All pressure relief valves and brazed joints shall be suitably sized.

3.1.8. Install two pressure relief valves per refrigeration circuit using a purpose built “Y” fitting complete with integral ball valves.

3.1.9. Install on the liquid and suction line or liquid and discharge line as per Drawing details.Pressure relief valves shall be individually isolated to allow for maintenance and replacement.

3.1.10. Nitrogen purging / sweeping shall be used when brazing and welding to minimize oxidization.

3.1.11. Isolation valves shall be installed where shown on the schematics or as required.

3.1.12. Prevent the release of refrigerants into the atmosphere during installation and testing.

3.1.13. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Pipe or tubing shall be cut square reamed to remove burrs, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

3.1.14. Install pipe, valves, and fittings to facilitate easy maintenance. Do not locate valves, couplings, or flanged/union connections directly above electrical panels, motor starters or MCC’s.

3.1.15. A liquid line filter dryer shall be installed in each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturer's recommendations for the system in which it is installed.

3.1.16. A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of all filter dryers and where indicated. Site glasses shall be full line size.

END OF SECTION

23 31 13.00 Ductwork and Specialties

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Fabricate all ductwork unless specifically noted otherwise, of galvanized sheet steel with Z180 coating to A653/A653M-98.

2.1.2. Sealing compound: Minnesota Mining and Manufacturing or other approved manufacturer. Duct tape shall be Duro-Dyne or other approved manufacturer.

2.1.3. Flexible ducting:

.1 Flexible metal ducting shall be Flexmaster Triple-Lock Aluminum Flexible ducting T/L. ULC listing S110

2.1.4. Flexible Connections:

.1 Ventfabrics, Duro Dyne or Dyne-Air.

.2 For fans less than 0.5 kPa (2 in. wg.) connections shall be minimum 680 gm/sq.m. (20 oz./sq.yd.) fire retardant polyvinyl-chloride polyester fabric equal to Vinyl-Flex.

2.1.5. Dampers:

.1 Fabricate manual duct dampers as shown on Standard Details from galvanized steel 1.26 mm thick (0.048 in - 18 GSG gauge) or heavier. Dampers for ducts up to 300 mm (12 in.) deep shall be one blade carried on a 9 mm (3/8 in.) square steel rod mounted inside the duct. Dampers for ducts of greater depth than 300 mm (12 in.) shall be multi-blade, opposed-acting type, and shall have blades mounted in 38 mm (1-1/2 in.) steel channel frame, and interconnected for operation from one locking type hand quadrant. Dampers for right angle take-off of branch from vertical riser shall have operator extended to an accessible location. For externally insulated ducts, mount quadrant on a bracket, designed to clear the insulation. All dampers shall have indicator to show position of damper blade.

.2 Fabricate splitter dampers as shown on Standard Details from at least the same thickness of galvanized steel as the duct in which it is installed, down to a minimum of 0.95 mm thick (0.0374 in - 20 GSG gauge). Fabricate of double thickness so that the entering edge presents a round nose to the air flow, and mount securely on hinges at the air leaving edge. Length of splitter shall be at least 1-1/2 times the width of the smaller branch duct, but in no case less than 300 mm (12 in.) long. Attach splitter hinge near the air entering edge with support passing through a clamp on the side of the duct, located where it is most accessible for external adjustment and locking of the damper.

2.1.6. Acoustic Insulation: 25 mm (1 in.) thick rigid coated glass fibre.

2.1.7. Interior Duct Protective Coating: Chlorinated rubber base paint or Eisenheiss Black.

2.1.8. Hardware and Accessories:

.1 Spin-in connections shall be specifically built for that purpose. Dampers shall be a minimum 1 gauge heavier than the ductwork in which it is installed and shall have a full

length shaft pivoted at two diametrically opposed points. An indicator shall be attached to the shaft to indicate the damper position.

.2 Hardware for balancing or splitter dampers shall be rattle-free and leak resistant. Bearing rods shall be sized to suit the damper size. Neoprene seals shall be used to minimize leaks. Hardware shall be Dyn-Air or equal.

2.2. FABRICATION

2.2.1. Fabricate ductwork in accordance with applicable duct construction requirements of SMACNA.

3. Execution

3.1. INSTALLATION

3.1.1. Make all laps in the direction of air flow. Use no sheet metal screws in the duct where it is possible to use rivets and bolts. Hammer down all edges and slips so as to leave smooth finished surface inside the ducts.

3.1.2. Brace and stiffen all ducts, and make tight so that they will not breathe, rattle, vibrate or sag. Cross-break all rectangular ducts with heights or widths of 300 mm (12 in.) or larger.

3.1.3. Where rectangular ducts are shown, round ducts may be substituted at the Contractor's option, provided there is sufficient room. Conversion from rectangular to round duct, sizing shall be as shown on charts in ASHRAE.

3.1.4. Hang all ductwork securely and in a rigid manner. Provide hangers as follows:

TABLE 1: HANGERS

DUCT DIMENSION	HANGER CONSTRUCTION
Horizontal rectangular duct	
Up to 1500 mm (60 in.) for Low Pressure Ductwork Only	Two 25 mm (1 in.) x 16 US gauge straps with two screws on side of duct one screw on bottom. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
Horizontal round duct	
Up to 450 mm (18 in.)	One 25 mm (1 in.) x 16 US gauge hanger ring supported from one 25 mm (1 in.) x 16 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.

3.1.5. Support all vertical ducts at each floor, on all sides, with angle riveted to the ducts.

3.1.6. The following low pressure, medium pressure and high pressure duct construction is based on an ASHRAE method of construction, and gives a minimum standard of construction. Alternative ASHRAE or SMACNA duct construction is acceptable, provided it meets the minimum standards as outlined by these Specifications. Submit proposed alternatives for review prior to fabrication.

3.1.7. Construct low pressure rectangular ducts for systems less than 0.5 kPa (2 in.) static pressure and under 10.2 m/s (2000 fpm) velocity as follows:

TABLE 2: LOW PRESSURE DUCT CONSTRUCTION

MAX. DUCT DIMENSION	SHEET METAL US GAUGE	TRANSVERSE JOINT CONNECTION AND BRACING
Up to 300 mm (12 in.)	26	Flat drive or flat ‘S’ no bracing
325 mm to 425 mm (13 in. to 18 in.)	24	Flat drive or flat ‘S’ no bracing

.1 Bracing spacing shown is maximum spacing between two bracings or between bracing and joint.

.2 Locate bracings mid-way between joints.

.3 Make longitudinal joints Pittsburgh lock seam at edge of duct, and grooved seam on face of duct.

3.1.8. Medium pressure rectangular ducts are required for all smoke exhaust systems and in the following areas. Construct medium pressure rectangular ducts as follows:

TABLE 3: MEDIUM PRESSURE RECTANGULAR DUCT CONSTRUCTION

MAX. DUCT DIMENSION	SHEET METAL US GAUGE	TRANSVERSE JOINT CONNECTION & BRACING
Up to 300 mm (12 in.)	24	25 mm (1 in.) standing seam, 16 mm (5/8 in.) welded flange 25 mm (1 in.) pocket lock, no bracing.
325 mm to 425 mm (13 in. to 18 in.)	24	25 mm (1 in.) standing seam, 22 mm (7/8 in.) welded flange, 25 mm (1 in.) pocket lock, bracing 25 mm x 25 mm x 16 gauge (1 in. x 1 in. x 16 UG gauge) at 1200 mm (48 in.) centres.

.1 Bracing spacing shown above is maximum spacing between two bracings or between bracing and joint. Locate bracing mid-way between joints.

.2 Make longitudinal joints Pittsburgh lock seam at edge of duct, and grooved seam on face of duct.

3.1.9. Seal all joint of all ducts. Brush joints with the compound before and again after assembly.

3.1.10. Seal the bottom and side joints of outside air ducts or plenums water-tight.

3.1.11. Flexible duct shall be connected to sheet metal duct and diffusers using duct sealer, minimum of two screws separated by 180 degrees and metal draw bands. Duct tape is not acceptable.

3.1.12. Flexible ductwork may be used under the following conditions:

.1 Flexible ductwork shall be used where shown to allow easy location of diffusers.

.2 Minimum length of flexible duct used to connect diffusers and interior troffers shall be 2,400 mm (84 inches).

.3 Maximum length of flexible duct shall be 3,000 mm (120 inches).

.4 Flexible ductwork shall not pass through floors or fire walls,

.5 Flexible ductwork shall be a single section of duct (no joints). In the event that building construction requires connection between lengths of flexible duct use a rigid section of duct as the joint. Flexible duct shall be secure to the rigid section using ties and sealant.

.6 Flexible duct lengths greater than 2,400 mm (84 inches) shall be supported at the midpoint with strap hangers.

3.1.13. Where ductwork passes through a wall or floor, other than when a fire damper is required, pack around the duct using a fire resistant material to ensure a sound and airtight joint.

3.1.14. If changes of size of ducts are necessary because of building construction, maintain the same circular equivalent for the new size. Ratio of the longest side of the duct to the least shall not exceed 4 to 1 unless specifically authorized by the Engineer's Representative.

3.1.15. Select the gauge of metal and method of construction for the new size. Notify the Engineer's Representative of any change before such changes are incorporated into the work.

3.1.16. If changes of location of duct, are required because of building construction, review with the Engineer's Representative before the locations indicated are changed in any way.

3.1.17. Make changes of direction of horizontal ducts with elbows having an inside radius not less than 3/4 the width of the duct. Make change of direction from horizontal to vertical duct with elbows having an inside radius equal to the depth of the duct. Where this is not possible due to the building construction, use turning vanes.

3.1.18. Provide flexible connections at each air handling unit (where not provided internally) and fan duct connections before and after any required transitions on the fan inlet and outlet respectively (i.e. on the largest duct perimeter and not directly installed on the fan inlet and outlet to reduce noise and air turbulance).

3.1.19. Install manual duct dampers as shown on Standard Details. Ensure dampers for right angle take-off of branch from vertical riser have operator extended to an accessible location. Adjust quadrants to clear duct insulation.

3.1.20. Install fire dampers where shown and at all penetrations through all fire rated assemblies. Where fire dampers are shown in grilles or diffusers at ceiling level they shall be firestop flap. Obtain local authorities approvals for all damper locations and keep one set of marked-up prints on site. Approvals shall be obtained before installation of fire dampers.

3.1.21. Where duct is acoustically lined, duct dimensions shown are net, inside of lining.

3.1.22. Apply acoustic insulation internally to ductwork where shown. In addition, internally line all low or medium pressure supply air ductwork in mechanical rooms, fan rooms, or equipment rooms. Install using both pins and adhesive. Pins shall be maximum 450 mm (18 in.) centres and shall be tack welded to the duct or plenum. Seal all edges of acoustic insulation to prevent air erosion with sheet metal nosing that overlaps the insulation by 19 mm (3/4 in.) minimum.

3.1.23. Ductwork shall be run parallel to the closest wall. Coordinate with piping and structural elements.

END OF SECTION

23 09 01.00 Building Automation System (BAS) Open System

1. General

1.1. WORK INCLUDED

1.1.8. Provide all labour, materials, products, equipment and services to supply, install, test and commission Direct Digital Control (DDC) for building mechanical systems and interface with other microprocessor based building subsystems as indicated on drawings and described herein.

1.1.9. Provide all labour, materials, products, equipment and services to supply, install, test and commission building automation system (BAS) with direct digital control (DDC) for building mechanical and electrical systems and interface with other microprocessor based building subsystems as indicated on drawings and described herein

1.1.10. All control work shall be perfomed by Siemens Canada Ltd.

Siemens Building Technologies Limited	1577 North Service Rd. East, Oakville, ON, L6H 0H6	Peter Christiansen Phone: (416) 357-7897 peter.christiansen@siemens.com

2. Products

1.2. SYSTEM OUTLINE:

1.2.1. The documentation contained in this section and other contract documents pertaining to building automation system (BAS) is schematic in nature. The contractor shall provide all required hardware and software necessary to implement the functions shown or implied in the contract documents. Connect new BAS to the existing base building BAS.

1.3. SUBMITTALS

1.3.1. Before start of construction, submit completely engineered and coordinated shop drawing package with all control diagrams, points lists, valve, damper, room and room temperature sensors schedules and all equipment data sheets.

1.4. POWER SUPPLIES

1.4.1. Provide a separate power supply for every controller with the exception of application specific controllers.

1.5. CONTROL DEVICES

1.5.1. Actuators for Dampers, Electronic: floating control signal is acceptable only for VAV damper application. Angle of rotation adjustable between 0° to 90°. Stall protection mechanical or electronic. Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation. Non-spring return for VAV terminals; spring return for other applications.

1.5.2. Combination CO2 and Temperature Sensors: resistance type, two-wire 1000 ohm nickel RTD, two-wire 1000 ohm platinum RTD or two-wire 10,000 ohm thermistor.

1.5.3. Temperature Sensors:

.1 General Requirements:

.1 Temperature sensors shall be of the resistance type, two-wire 1000 ohm nickel RTD, two-wire 1000 ohm platinum RTD or two-wire 10,000 ohm thermistor.

.2 Space Temperature Sensors:

.1 Stainless Steel plate sensors or white-plate sensors For installation throughout the facility where local control is not required (such as corridors or lobby) unless otherwise noted.

.3 Space Temperature Sensors With Adjustable Set-Point, Override and Display:

.1 Key pad or slider for temperature set-point adjustment.

.2 LED display.

.3 Timed override request push button with LED status for activation of after-hours operation.

.4 Covers for Wall Mount Sensors:

.1 Overrides: Exposed set point adjustment and override button.

.2 Communication Port: For communication between Portable Operator Terminals and ASC controllers.

.5 Averaging Temperature Sensors:

.1 Minimum 1.5 m (5 ft) of capillary per 1 sq m (10 sq ft) of duct cross-section.

.2 Provide multiple sensors where single averaging element is unable to be positioned to provide complete duct or plenum traverse.

1.5.4. CO2 Sensors:

.1 Sensor shall employ non-dispersive infrared technology (NDIR).

.2 Accuracy shall be +/- 75 ppm over 0-1500 ppm range.

.3 Response time shall be less than 1 minute.

.4 Sensor shall have field selectable 0-10 VDC and 4-20 mA outputs.

.5 Power voltage shall be 20-30 VDC/AC.

.6 Operating temperature range shall be 0°C to 50°C.

.7 The sensor shall be wall mount.

1.5.5. Control Valves:

.1 Characteristics, materials and pressure ratings suitable for the application; refer to schedules.

.2 Flow Characteristic:

.1 Water:

.1 Two-way: Equal percentage.

.2 Three-way: A Port: Equal percentage. B Port: Linear or modified linear.

.2 Steam: Linear.

.3 Sizing Water Valves:

.1 Two-position: Line size with full ports.

.2 Two-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).

.3 Three-way Modulating: Non Radiation: Pressure drop equal to the pressure drop through the coil or 27 kPa (4 psi), whichever is greater. Radiation: Pressure drop equal to 7 kPa (1 psi).

.4 Butterfly Valves:

.1 Type: High-performance (HPBV).

.2 Make and Model: Dezurik BHP or equivalent.

.3 Tee-fitting: Provide for three-way application; with motor mounting bracket and linkage hardware.

.5 Valves 12 mm (1/2 in.) through 50 mm (2 in.):

.1 Screwed ANSI Class 250 bronze body.

.6 Valves 62 mm (2-1/2 in.) and Larger:

.1 Water temperature less than 121 deg. C (250 deg. F) at 1035 kPa (150 psi) or less than 93.2 deg. C (200 deg. F) at 1139 kPa (165 psi): Flanged ANSI Class 125 cast iron body.

.2 Water temperature greater than 121 deg. C (250 deg. F) at 1035 kPa (150 psi) or greater than 93.9 deg. C (200 deg. F) at 1138 kPa (165 psi): Flanged ANSI Class 250 cast iron body or ANSI Class 300 cast steel body.

1.5.6. Actuators for Control Valves, Electronic:

.1 Control Signal: Compatible with BC, AAC and ASC.

.2 Floating control signal is not acceptable.

.3 Operating Time: Maximum 120 seconds throughout the full rotation.

.4 Mounting: Corrosion resistant hardware.

.5 Stall Protection: Electronic overload or digital rotation sensing.

.6 Failsafe: Non-spring return for radiation and terminal reheat coils; spring return for others. Spring returns to normal position within 15 seconds.

.7 Manual Override: Crank type. External gear release for non-spring return actuators.

.8 Position Indicator: Provide. Indicate valve open and closed positions.

1.5.7. For installation only where indicated on drawings, controls diagrams or sequences of operations

3. Execution

1.6. GENERAL WORKMANSHIP

1.6.1. Install all controllers, cabinets, control devices and power supplies in readily accessible locations providing adequate ambient conditions for its specified application and to the Canadian electrical code. Install products to manufacturer’s installation instructions. Install parallel to building walls and floors unless indicated or specified or required otherwise by manufacturer’s installation instructions. Mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

1.7. EXISTING PRODUCTS

1.7.1. Apply reused existing products to the same requirements for new products. During construction check and verify reused existing products are operational. For existing product that is not operational submit a proposal to replace existing product for approval by the consultant.

1.8. WIRING AND CONDUIT

1.8.1. Wire shall be neatly tie wrapped to conduit mounted to the building structure but must be installed at right angles or parallel to the building. Loose wiring shall only be allowed over a distance of 1500 mm (5 ft.), but must not pass over lighting fixtures. Wiring in equipment room, between floors, or between concrete walls shall be installed in conduit. Exposed wiring will not be accepted. Conduit shall be installed at right angles or parallel to the building walls.

1.9. POWER WIRING

1.9.1. Power for building automation system (BAS) shall be provided under electrical division at 120 VAC 60 Hz single phase and shall terminate in junction boxes installed where shown on electrical and mechanical drawings. Wiring and conduit from these boxes to control devices being electrically powered to be provided by building automation system (BAS) contractor.

1.10. COMMUNICATION WIRING

1.10.1. Install communication wiring per controls manufacturer recommendations as to type of wire used and segment lengths.

1.11. IDENTIFICATION

1.11.1. All wires shall be tagged at both ends. The tagging shall identify the device it is connected to. Use of the point object name is acceptable. Label wires, control devices, controllers.

1.12. TESTING AND COMMISSIONING

1.12.1. Test and commission the BAS prior to the Demonstration. Prepare test forms which shall identify each test. The forms shall be sub-divided into points, controllers, programs, loops, networks and graphics.

1.13. DEMONSTRATION

1.13.1. When all tests have been completed and the documentation completed, request a meeting with the Consultant and Owner. Provide at this meeting a demonstration that all systems on the BAS are operating.

1.14. INSTRUCTION AND TRAINING

1.14.1. Provide one day of instruction that shall cover the operation and maintenance of the BAS.

END OF SECTION

23 09 23.00 Sequence of Operation for BAS

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS and SECTION 23 09 00.00 - BUILDING AUTOMATION SYSTEM.

1.1.2. The locations of all sensors shall be discussed with and approved by the Owner and/or Engineer's Representative, before installation. Locations shown are approximate only, and are given to assist the Contractor in pricing only, and shall not be construed as being the final approved location.

1.1.3. The control sequence descriptions are complementary. Provide detailed sequences of operation and all points required to implement the sequences.

1.1.4. All settings and set points listed in this Section shall be variable and Operator adjustable without the need to create or modify Custom Application Programs.

1.1.5. All set points and reset schedules shall be visual on the associated dynamic graphic.

2. Products

2.1. GENERAL APPLICATION PROGRAMS

2.1.1. Provide a specific set of programs to achieve automated, operator independent control of facility sub-systems.

2.1.2. Refer to SECTION 23 09 00.00 - BUILDING AUTOMATION SYSTEM SECTION for software programs.

3. Execution

3.1. VAV WITH REHEAT COIL

3.1.1. Applicable Systems:

3.1.2. System Start:

.1 The VAV box shall be enabled when the associated VAV air handling unit is started. Heating coil valve and electric duct heater shall be enabled.

3.1.3. Normal Operation:

.1 Provide static independent control. Provide set-points for minimum and maximum air flows.

.2 In occupied mode VAV box Damper (VAVD) and the Reheat Valves (RHV) shall modulate in sequence to maintain Space Temperature (SPCT) at set-point (adjustable).The damper shall be modulated between its minimum and maximum air flow settings and shall be at minimum setting before the reheat and electric heat are enabled.

.3 In unoccupied mode, heating coil valve and electric duct heater shall modulate to maintain the night set-back space temperature set-point.

3.1.4. System Stop:

.1 The VAV box shall be disabled when the associated VAV air handling unit is stopped. Heating coil valve shall remain enabled.

3.1.5. Schedule:

.1 To be determined by the owner.

3.1.6. Alarms:

.1 Space Temperature (SPCT) out of range.

3.2. VAV WITH REHEAT COIL AND ELECTRIC HEAT

3.2.1. Applicable Systems:

3.2.2. System Start:

.1 The VAV box shall be enabled when the associated VAV air handling unit is started. Heating coil valve and electric duct heater shall be enabled.

3.2.3. Normal Operation:

.1 Provide static independent control. Provide set-points for minimum and maximum air flows.

.2 In occupied mode VAV box Damper (VAVD) and the Reheat Valves (RHV) and SCR controller on duct heaters shall modulate in sequence to maintain Space Temperature (SPCT) at set-point (adjustable). SCR controller shall act as second stage heating.The damper shall be modulated between its minimum and maximum air flow settings and shall be at minimum setting before the reheat and electric heat are enabled.

.3 In unoccupied mode, heating coil valve and electric duct heater shall modulate to maintain the night set-back space temperature set-point.

3.2.4. System Stop:

.1 The VAV box shall be disabled when the associated VAV air handling unit is stopped. Heating coil valve shall remain enabled.

3.2.5. Schedule:

.1 To be determined by the owner.

3.2.6. Alarms:

.1 Space Temperature (SPCT) out of range.

3.1. SUPPLEMENTARY AC UNITS (AC-2.1/CU-2.1)

3.1.1. Applicable Systems:

3.1.2. System Start:

.1 System start shall be initiated by space temperature demand. Upon signal to start the system, the unit's internal controls shall be enabled.

3.1.3. Normal Operation:

.1 In occupied mode, the unit's internal controls shall stage fan speed and DX variable compressor in sequence to maintain Space Temperature (SPCT) at set-point (adjustable). The Space Temperature (SPCT) set-point shall be adjustable at the thermostat or override centrally through the BAS.

3.1.4. System Stop:

.1 System stop is initiated when space temperature is satisfied. A minimum operating time of 20 minutes (adjustable) shall be provided to prevent cycling. Upon signal to stop the system the supply fan shall stop. DX cooling is disabled.

3.1.5. Monitor:

.1 The BAS shall monitor all control points available from the unit's internal controls.

.2 Condensing Unit Status from current sensor.

.3 Evaporator Unit Status from current sensor.

.4 Space Temperature (SPCT) out of range.

3.1.6. Schedule:

.1 To be determined by each respective room's temperature.

3.1.7. Alarms:

.1 Condensing Unit Status from current sensor.

.2 Evaporator Unit Status from current sensor.

.3 Space Temperature (SPCT) out of range.

3.2. EXISTING WASHROOM EXHASUT FAN

1.1.1. Applicable Systems:

1.1.2. System Start:

.1 System start shall be initiated through time schedule where fan is to run countinuously at low speed.

1.1.3. Normal Operation:

.1 Exhaust fan shall run continuously at low speed during occupied hours.

.2 Exhaust fan shall run continuously at high speed for one hour when activated

1.1.4. System Stop:

.1 System stop is initiated through time schedule. Upon signal to stop the system, the exhaust fan shall stop.

1.1.5. Schedule:

.1 To be determined by the owner.

1.1.6. Alarms:

.1 Exhaust Fan Status (EFST) from current sensor.

END OF SECTION

23 36 16.00 Variable Volume Boxes

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Actuator for damper and controller furnished under Section 23 09 00.00 - BUILDING AUTOMATION SYSTEM (BAS).

1.3. SUBMITTALS

1.3.1. Shop Drawings: Submit Shop Drawings of all components in accordance with Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.3.2. Manufacturer's Data: Submit manufacturer's certified sound power ratings with an octave band analysis when tested in accordance with ASHRAE Standard 36B-63. Where a second sound attenuator is required in the system or where attenuators with outlets are used in conjunction with rated outlets and not as straight attenuators without outlets, submit certified data for review.

2. Products

2.1. MATERIALS

2.1.1. The mechanical variable volume boxes shall be E.H. Price, Titus, Nailor, Krueger, or Environmental Technologies as shown and specified below.

2.1.2. Boxes shall be low pressure terminal boxes having unit casings fabricated of galvanized steel of sufficient thickness to prevent drumming or rattling, and lined with 25 mm (1 in.) thick thermal and sound attenuating insulation. The units shall be end outlet and shall be complete with D.D.C. actuator. Leakage through the unit casing shall be less than 0.3% of the design volume.

2.1.3. Design volumes shall be factory preset and calibrated and both maximum and minimum volumes shall be independently adjustable in the field, by using a cfm scale and without changing components. The box volumes are shown on Drawings. For all boxes, the minimum volume shall be set at the minimum volume recommended by the manufacturer. Maximum volume control shall be maintained within plus 5% of volume shown for box, with inlet pressures of 0.05 to 1.5 kPa (0.2 in. to 6 in.) of water.

2.1.4. Acoustically line ductwork downstream from boxes as shown. Lengths of 25 mm (1 in.) thick acoustic lining, shall be as designed in following Schedules:

BOX VOLUME	LENGTH
283.5 to 755 L/s (601 to 1600 cfm)	4600 mm (15 ft.)
95 to 283 L/s (201 to 600 cfm)	3000 mm (10 ft.)

2.1.5. With the scheduled lengths of lined duct and a room attenuation of 8 db, the sound power level with reference to 10 to the -12 power watts shall be such that the sound pressure level in the room receiving air and in room in which the box is located, shall not exceed noise criterion 32 at an inlet static pressure 0.37 kPa (1.5 in. wg.) with noise generated by diffusers excluded. Provide manufacturer's certified sound power ratings with an octave band analysis when tested in accordance with ASHRAE Standard 36B-63.

2.1.6. When the scheduled lengths of lined duct cannot be obtained and/or where specifically shown, utilize straight attenuators.

2.1.7. With these attenuators and a room attenuation of 8 db, the sound power level with reference to 10 to the -12 power watts shall be such that the sound pressure level in the room receiving air and in room in which the box is located, shall not exceed noise criterion 32 at an inlet static pressure 0.37 kPa (1.5 in.wg.) with noise generated by diffusers excluded. Provide manufacturer's certified sound power ratings with an octave band analysis when tested in accordance with ASHRAE Standard 36B-63.

2.1.8. Where one attenuator fails to provide the sound attenuation required, utilize additional attenuators or lengths of duct lining. Where attenuators with outlets are used they shall be rated with the outlets and not as straight attenuators without outlets.

2.1.9. Where outlets are provided they shall be complete with manual dampers in each outlet.

2.1.10. The box radiated noise level shall meet the criteria for specific room noise levels as specified under Section 20 05 48.00 - VIBRATION AND NOISE CONTROL.

2.1.11. Pressure drop for L/s (cfm) ranges shown for each box size shall be 0.07 kPa (0.3 in.wg.) maximum. Boxes shall be capable of modulating down to the minimum volume shown and shall shut-off tight where zero L/s (zero cfm) is shown.

2.1.12. All interior and perimeter boxes shall be normally open.

3. Execution

3.1. INSTALLATION

3.1.1. Install VAV boxes in accordance with reviewed Shop Drawings and to manufacturer's instructions.

3.1.2. Air velocity sensor, actuator for damper, controller and interconnecting tubing and cable are installed by terminal box manufacturer at its manufacturing facilities; the costs for installation labour are paid for by this Section. Make control devices readily accessible from the access panel in the suspended ceiling.

3.1.3. Where a VAV box does not meet specified sound ratings, field enclose with (0.80 mm thick (1 lb.) lead sheeting over a 25 mm thick (1 in.) glass fibre blanket wrap, as part of the work.

END OF SECTION

23 37 13.00 Diffusers, Grilles and Registers

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. SUBMITTALS

1.2.1. Shop Drawings: Submit detailed Shop Drawings of all components furnished under this Section. Manufacturer to indicate ceiling installation type for each type of diffuser specified.

1.2.2. Sample of exposed duct detail. See mechanical standard details on the drawings.

2. Products

2.1. MATERIALS

2.1.1. Diffusers, registers and grilles shall be Price, Nailor, Krueger, or Carnes equal to the units specified.

2.1.2. Select all diffusers to provide uniform air coverage without overlap. Air velocity up to a height of 1800 mm (6 ft.) above the floor shall be 0.127 to 0.254 m/s (25 to 50 fpm).

2.1.3. Noise generated by diffusers shall be such that room sound pressure level does not exceed noise criteria 32 with an 8 db room attenuation, the sound power level reference to 10 to -12 power watts.

2.1.4. All volume and air pattern devices shall be fully adjustable from the face of the diffuser, register or grille.

2.1.5. In gypsum board or plaster ceiling applications, provide matching mounting frame. Finish shall be prime painted, off-white in plaster and gypsum board ceilings. .

2.1.6. In T-bar ceilings, manufacturer shall coordinate diffuser compatibility with t-bar ceiling specified by the architectural division. Colour shall match colour of ceiling tile in lay-in ceilings. Diffusers to suit ceiling grid as required imperial or metric.

2.1.7. Diffusers shall meet test requirements of A.S.H.R.A.E. Standard 36B-63, including air pattern and noise levels for air quantities from 10% to 110% of the required maximum air flow. Sound power tests shall be measured in accordance with ASHRAE Standards 36B-63 and NC ratings shall be determined using an 8 db room attenuation factor

2.2. SQUARE SUPPLY DIFFUSERS

2.2.1. All diffusers shown as type “P” shall be steel square plaque diffuser 600 mm x 600 mm (24 in. x 24 in.) face size and shall be square, coned metal. Diffusers shall consist of a precision formed back cone of one piece seamless construction which shall incorporate a round (or square) inlet collar of sufficient length for connecting rigid or flexible duct as shown. An inner plaque assembly shall be incorporated that drops no more than 1/4" below the ceiling plane to assure proper air distribution performance. The inner plaque assembly shall be completely removable from the diffuser face to allow full access to any dampers or other ductwork components located near the diffuser neck. E.H. Price SPD, Nailor UNI, Krueger PLQ, Carnes SFPA.

2.3. LINEAR SUPPLY AND RETURN DIFFUSERS

2.3.1. All diffusers shown as type “T” shall be T-bar plug-in, 1 slot diffuser modified with square ends to limit side spread, and of lengths shown. Diffuser shall be installed with manufacturer plenum to match the length of the diffuser shown. Provide diffuser with mounting clips to suit in continuous T-bar openings. Pattern controllers shall be split mid length to allow each half of diffuser shall be set for different throw patterns. Throw patterns shall be fully adjustable from vertical to horizontal and variations in between. Provide blank-off panels between diffusers. Pattern controllers and blank-off panels shall be finished matte black. Plenum shall be fabricated from coated steel. Refer to Architectural Details for installation of continuous supply air slot. Duct connection to diffuser shall be of sufficient height to allow for 175 mm (7 in.) clearance from ceiling to underside of duct. EH-Price TBD3 series, Nailor 5800, Krueger PTBA, Carnes DASC.

.1 Provide MAT Remotely Operated Damper Systems RT-250 Cable Actuated Round Damper Drive System for linears diffusers located within drywall ceilings. Provide at all the spin-off connections at each linear diffuser. Inside the air stream – damper adjustment at the face of the diffuser. Include for extra control cable distance as required.

2.4. WALL AND DUCT GRILLES

2.4.1. All supply registers shown as type “B” shall be standard double deflection type with adjustable horizontal face bars and vertical rear bars. Frame shall be gasketted. Construction shall be aluminum with prime coat. Registers larger than listed sizes shall be shop fabricated in Sections such that the Sections will appear as one integral register when installed. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The damper shall be coated or galvanized steel. E.H. Price 620D, Nailor 5100 Series, Krueger 5880 Series, Carnes RNGM.

.1 All diffusers shown as type “B1” shall be as specified above but for installation on round or spiral duct. E.H. Price SDGE, Nailor 61L Series, Krueger 5DMGDU

2.5. RETURN, EXHAUST AND TRANSFER GRILLES

2.5.1. Return grilles shown as type “E” shall be size as shown and shall be egg crate type with aluminum construction. Egg crate shall be 12 mm (1/2 in.) deep, formed of 12 mm (1/2 in.) wide aluminum strips on 12 mm (1/2 in.) centres. Strips shall be approximately 0.64 mm (0.025 in.) thick. Grilles shall be enclosed in a channel frame for inverted T-bar mounting or with a flanged frame for plaster or gypsum ceiling mounting. Grilles shall lay on inverted T-bar ceiling suspension system. Colour shall match adjacent ceiling tiles. E.H. Price Series 80, Nailor 5100 Series, Krueger EGC5 Series, Carnes RAPAH.

3. Execution

3.1. INSTALLATION

3.1.1. Refer to the architectural drawings for actual locations of diffusers, grilles and registers and install to suit these drawings. The mechanical drawings show intent and number of diffusers, grilles and registers required.

3.1.2. Provide transfer grilles in all finished spaces where air is transferred though a ceiling or partition.

3.1.3. For special mounting of diffusers, grilles and registers refer to Architectural Drawings.

3.1.4. Where rigid duct is connected to the diffuser, grille or register all devices used for flow pattern adjustment, flow balancing and flow equalizing shall be accessible from the face of the diffuser.

3.1.5. Contractor shall be responsible for mounting concealed flange linear diffusers in heated environment and following manufacturers' instructions.

END OF SECTION

23 81 26.00 Unitary Air Conditioning Units

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Unitary Air Conditioning Units (UACU) shall be Mitsubishi Electric, Daikin, LG.

2.1.2. UACU shall be split system type with minimum two speed indoor evaporator section and remote outdoor compressor/condensing unit.

2.1.3. Model arrangements shall be as shown, and specified below:

Unit Tag	Make	Model #	MBH
A/C-1.1	Mitsubishi	PKA-A30KA7	30
CU-R.1	Mitsubishi	PUY-A30NHA7	30

2.1.4. Where indicated on the drawing, units to be supplied complete with a Sauermann Delta Pack fully automatic condensate pump ‘Model No. DP10UL02UN23’. Pump to be supplied with a resevoir, an integral junction box, power cord and plug and interlocked with the a/c unit when sensing high level of condensate in the receiver. include two float controls for operating and safety.

2.1.5. Outdoor condensers shall require a 208/1/60 single point electrical connection. Evaporators shall be powered and controlled from it’s related outdoor condenser. Where a unit manufacturer requires separate electrical connections for each component, this section shall arrange and pay for all interconnecting wiring or dedicated service for a complete and operational system.

2.1.6. The combination of the evaporator and condensing sections shall be provided with the capacities designated in Schedules.

2.1.7. Compressor condensing unit shall be capable of low temperature operation down to minus 34.4 deg. C. (30 deg. F.).

2.1.8. Provide unit with room thermostat. Dampers for right angle branch duct take-off from vertical riser shall be Air Vector, Vectrol, or other approved manufacturer.

2.1.9. Unit shall be provided with filter.

3. Execution

3.1. INSTALLATION

3.1.1. Install complete refrigeration and controls in accordance with the manufacturer’s recommendations.

3.1.2. All indoor units shall be indirectly drained to the nearest hub drain within ceiling space.

END OF SECTION

23 82 39.22 Electric Duct Heaters

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Electric Duct Heating Coils: Stelpro, Indeeco, or P.M. Wright

2.1.2. Provide flanged frame for installation in a horizontal duct

2.1.3. Duct heaters shall have a minimum 1.26 mm thick (0.048 in. - 18 GSG gauge) galvanized steel frames with completely enclosed terminal box. Heating element shall be open coil nickel chromium resistance wire supported on ceramic coil bushings. Maximum wall density shall be per 25 mm sq. (30 watts per sq. in.).

2.1.4. Provide automatic recycling high temperature thermostat across the face of the coil, air flow switch and control contactor to fail heaters to off on either high temperature or low air flow.

2.1.5. Terminal box shall contain integral disconnect switch, control circuit transformer, terminals for power connections and remote mounted SCR controller. Remote interface to SCR controller provided under Section 23 09 00.00 - BUILDING AUTOMATION SYSTEM (BAS).

2.1.6. EDH-2.1 shall have a capacity of 2kW and be rated for 208 volt, 1 phase, 60 Hz supply and shall be CSA approved and labeled. Heater shall be as shown on the Drawings.

3. Execution

3.1. NOT USED

END OF SECTION

EQUIPMENT NO.			4		5		6		7		8		9		10		12	
Make			E.H. Price		E.H. Price		E.H. Price		E.H. Price		E.H. Price		E.H. Price		E.H. Price		E.H. Price	
Model			SDVQ		SDVQ		SDVQ		SDVQ		SDVQ		SDVQ		SDVQ		SDVQ	
Inlet Size (Diameter)	In	mm	4	102	5	127	6	152	7	178	8	203	9	229	10	254	12	305
Maximum Airflow	cfm	L/s	200	94	300	142	400	189	550	260	700	330	950	448	1,150	543	1,700	802
Minimum Airflow	cfm	L/s	50	24	63	30	90	42	135	64	180	85	270	127	285	135	450	212
Fan Airflow	cfm	L/s		--		--		--		--		--		--		--		--
Fan Motor	hp	kW		--		--		--		--		--		--		--		--
Air Pressure Drop	In H2O	Pa	0.01	2	0.01	2	0.04	10	0.05	12	0.03	7	0.01	2	0.02	5	0.01	2
SOUND DATA																		
Inlet Static Pressure	In H2O	Pa	1.50	373	1.50	373	1.50	373	1.50	373	1.50	373	1.50	373	1.50	373	1.50	373
2nd Band	Discharge	Radiated	45	37	44	44	44	45	49	50	49	48	53	52	51	51	54	52
3rd Band	Discharge	Radiated	29	32	27	33	32	42	34	38	39	43	42	47	42	46	47	49
4th Band	Discharge	Radiated	23	30	28	27	24	35	20	31	33	38	34	42	37	42	42	46
Outlet Width	In	mm	12.0	305	12.0	305	12.0	305	12.0	305	12.0	305	14.0	356	14.0	356	16.0	406
Outlet Height	In	mm	8.0	203	8.0	203	8.0	203	10.0	254	10.0	254	12.5	318	12.5	318	15.0	381
Return Width	In	mm		--		--		--		--		--		--		--		--
Return Height	In	mm		--		--		--		--		--		--		--		--
Remarks			Includes discharge silencer		Includes discharge silencer		Includes discharge silencer		Includes discharge silencer		Includes discharge silencer		Includes discharge silencer		Includes discharge silencer		Includes discharge silencer	

EQUIPMENT NO.			RHC-1.8		RHC-2.3	
Maximum Airflow Rate	cfm	L/s	400	189	700	330
Minimum Airflow Rate	cfm	L/s	62	25	110	30
Outlet Width	In	mm	12	305	12	305
Outlet Height	In	mm	8	203	10	254
Type			HEATING		HEATING	
Minimum Rows			1		1	
Series			6		8	
AIR SIDE						
Entering Air Temperature (db)	°F	°C	69.0	20.6	69.0	20.6
Leaving Air Temperature (db)	°F	°C	87.6	30.9	83.7	28.7
Air Pressure Drop	In H2O	KPa	1.3	0.31	1.3	0.31
FLUID SIDE						
Fluid			Water		Water	
Fluid Flow Rate	USgpm	L/min	0.4	1.6	0.5	2.0
Entering Fluid Temperature	°F	°C	130.0	54.4	130.0	54.4
Leaving Fluid Temperature	°F	°C	100.0	37.8	100.0	37.8
Fluid Pressure Drop	ft H2O	kPa	0.2	1	0.4	1
MINIMUM CAPACITY						
Total	MBH	kW	6.0	1.8	8.0	2.3
Turbulators	Yes/No		no			
REMARKS						

EQUIPMENT NO.			CU-2.1	
Model			PUY-A30NHA7	
Size	MBH		30	
Manufacturer			Mitsubishi	
CONDENSER				
Cooling				
Ambient Air Temperature	°F	°C	95.0	35.0
Output at Ambient Air	MBH	kW	115.0	34
ELECTRICAL DATA				
Maximum Overcurrent Protection	A		26	
Maximum Circuit Ampacity	A		19	
Volts/Phase/Cycle			208/1/60	
Dimensions				
WxHxD	Inches		37-1/8 x 37-13/32 x 13	
Weight	Lbs.		151	
REMARKS			Complete with: - Low Ambient Kit - Windscreen - Ecofoot Stand	

EQUIPMENT NO.			**SL-01**	
Manufacturer			EH Price	
Type			XT-Z Cross Talk	
Width	In	mm	24	610
Height	In	mm	10	254
Length	In	mm	48	1,219
Thickness	In	mm	7	178
INSERT LOSS				
2nd Band	dB		11	
3rd Band	dB		17	
4th Band	dB		28	
Class				
Air Pressure Drop	In H2O	Pa	0.10	25
Remarks			Contractor to verify exact dimensions on site prior to ordering	