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MECHANICAL SPECIFICATION

FOR

CENTRAL YORK FIRE STATION
984 GORHAM ST,
NEWMARKET, ON

THIS SPECIFICATION SHALL BE READ IN CONJUNCTION WITH DRAWINGS:

REFER TO DRAWING LIST ON TM-0.1

OUR PROJECT NUMBER:

25274.001.M.001

DATE:

2025-09-05

ISSUED FOR:

PERMIT/TENDER

20 00 00.00 Index

SECTION	NAME	Page #
20 00 00.00	Index	1
20 05 00.00	General Instructions for Mechanical Sections	2
20 05 02.00	As-built drawings	13
20 05 03.00	Shop Drawings	16
20 05 05.00	Selective Demolition for Mechanical Services	18
20 05 29.00	Hangers and Supports	22
20 05 48.00	Vibration and Noise Control	25
20 05 88.00	Cutting and Patching	29
20 07 00.00	Insulation	31
20 08 02.00	Cleaning and Protection	39
21 25 00.00	Portable Fire Extinguishers	40
22 11 23.29	Circulators	41
22 13 19.13	Floor Drains	42
22 33 00.00	Domestic Electric Hot Water Heaters	43
22 42 00.00	Fixtures and Trim	45
22 42 46.00	Fixture Carriers	49
23 05 93.13	Testing and Balancing Piping Systems	51
23 05 93.23	Testing and Balancing Air Systems	54
23 11 23.00	Natural Gas Piping Systems	58
23 31 13.00	Ductwork and Specialties	60
23 34 53.00	Room Ventilators	65
23 37 13.00	Diffusers, Grilles and Registers	67

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. Consider any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, 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. DEFINITIONS

- 1.4.1. Where used on the Drawings or in the Specifications, the following words are given the meanings below.
 - .1 Provide: means supply, install, connect and test.
 - .2 Demolish: detach existing items and legally dispose of them off site.
 - .3 Remove and Reinstall: Detach existing items, prepare them for reuse, and reinstall them where indicated.
 - .4 Existing to Remain: existing items that are not removed and that are not otherwise indicated as being removed, removed and salvaged (turned over to Owner), or removed and reinstalled.
 - .5 Remove and Salvage: detach existing items and turn over to Owner.

1.5. REGULATIONS

- 1.5.1. Perform Work in accordance with codes, rules, regulations, by-laws and requirements of the authorities having jurisdiction.

- 1.5.2. Comply with all guidelines and standards issued by the authorities having jurisdiction.
- 1.5.3. Where names of codes and standards are referenced on the Contract Documents, comply with the latest in force edition in the jurisdiction of the Place of the Work.
- 1.5.4. 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 Building Code Part 7.
- 1.5.5. For natural gas systems, follow the requirements of:
 - .1 Regulations made under the Technical Standards and Safety Act
 - .2 CAN/CSA B149.1 - Natural Gas and Propane Installation Code.
- 1.5.6. Provide materials and assemblies with flame-spread ratings and smoke developed classifications in conformance with CAN/ULC-S102 "Test for Surface Burning Characteristics of Building Materials and Assemblies." Compliance with ASTM E84 "Surface Burning Characteristics of Building Materials" in lieu of CAN/ULC-S102 is not acceptable.
- 1.5.7. These Specifications are supplementary to the requirements above.
- 1.5.8. Drawings and Specifications should not conflict with the above regulations but where there are apparent discrepancies, notify the Engineer's Representative.
- 1.5.9. Where equipment utilizing refrigerants is provided, comply with regulatory refrigerant phase out requirements and dates applicable in the jurisdiction where the Project is taking place. Where equipment not meeting refrigerant phase out requirements or dates is supplied to site, provide revised unit(s) operating on a new refrigerant at no additional cost to the Owner; cover all costs of any electrical, structural, mechanical, architectural, etc. changes required to accommodate the new refrigerant.
- 1.5.10. Where equipment described in these Specifications utilizes refrigerants, provide refrigerants that have a global warming potential (GWP) of less than 700 and that are compatible with the equipment.
- 1.6. PERMITS, FEES AND INSPECTIONS
- 1.6.1. Obtain all permits, make submissions, pay all fees and arrange for all inspections required for the Work of this Division.
- 1.7. EXAMINATION OF SITE
- 1.7.1. Before submitting Bids, 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.
- 1.8. DRAWINGS, CHANGES AND INSTALLATION
- 1.8.1. The Drawings show the general character and scope of the Work and not the exact details of the installation. Install all equipment and systems complete with all accessories required for a complete and operational installation.
- 1.8.2. 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.

- 1.8.3. 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.
- 1.8.4. Install equipment in accordance with the manufacturer's written installation requirements. In the event of conflicts between the Drawings or Specifications and the manufacturer's written installation requirements, notify the Engineer's Representative for resolution.
- 1.8.5. 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 are applicable to every occurrence.
- 1.8.6. Conceal all piping and ductwork in finished areas in ceiling spaces and shafts or furred into walls. Do not install exposed piping or ductwork in such areas unless specifically reviewed and accepted by the Engineer's Representative. Do not install piping in outside walls.
- 1.8.7. Do not install vent pipes, exhaust hoods or other mechanical equipment mounted on the roof, or housing for such equipment, closer to the edge of the roof than a distance equal to the height of the pipe, hood or equipment, unless specifically reviewed and accepted by the Engineer's Representative.
- 1.8.8. The location and size of existing services shown on the Drawings are based on the best available information. Site verify the actual location of existing services before commencing Work. Pay particular attention to underground services.
- 1.8.9. Make changes and modifications necessary to ensure co-ordination and to avoid interference and conflicts with other Trades, or to accommodate existing conditions, at no additional cost.
- 1.8.10. Leave areas clear of piping and ducts where space is indicated as reserved for future equipment and equipment for other Trades.
- 1.8.11. Coordinate piping low point drain locations so that they are not above or adjacent to electrical equipment, including junction boxes.
- 1.8.12. Allow adequate space and provisions for the removal of coils and servicing of equipment, with minimum inconvenience to the operation of systems.
- 1.8.13. Where equipment is shown to be 'roughed-in only,' obtain accurate information from the Engineer's Representative before proceeding with the Work.
- 1.8.14. 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. Submit any problems that cannot be solved in agreement with the other Trades affected, for resolution. If ductwork or piping is prefabricated prior to the investigation and reaching of a solution to possible interference problems, make necessary changes in such prefabricated items at no additional cost.
- 1.8.15. 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 Supplemental Instructions in all regards. Revise any Work not installed in the correct location (at the sole discretion of the Engineer's Representative) at no additional cost. Mark-out fully co-ordinated Work with all other trades, in sufficient time for review by Engineer's Representative prior to rough-in. Precisely locate all mechanical and sprinkler services.
- 1.8.16. 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.

1.9. INSTALLATION, INTERFERENCE AND SETTING DRAWINGS

1.10. BID FORM AND SUBMISSIONS OF BIDS

- 1.10.1. Submit with the bid, all information called for on the Bid Form. Bids not completed in full may, at the discretion of the Owner, be rejected.
- 1.10.2. Show alternative and unit prices for optional equipment or systems called for as additions to or deductions from the Bid amount.
- 1.10.3. Where only one name appears in the Specification, include the specified equipment in the Bid.
- 1.10.4. Where two or more names are shown in the Specifications as alternatives or equal to, this Division can select which manufacturer is to be carried, provided the choice is shown on the Bid Form. Where the choice is not indicated, supply the equipment described in the Specification or first named on the Bid Form.
- 1.10.5. Substitute equipment may be offered as a price deduction to the Bid price. Acceptance of substitute equipment is at the discretion of the Owner whose decision is final.
- 1.10.6. Only propose alternative and/or substitute equipment that is equal in performance and quality to that specified. Include the cost of all changes required to accommodate alternative and/or substitute equipment, in the price shown on the Bid Form, including but not limited to space, power, structural or any other requirements that are different from the equipment specified.
- 1.10.7. The Owner reserves the right to accept or reject any substitution without question.
- 1.10.8. Include the cost of premium time in the Bid 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.

1.11. MATERIALS

- 1.11.1. Make and quality of materials used in the construction of this Work are subject to the approval of the Engineer's Representative.
- 1.11.2. Supply only new materials and equipment, free from defects and as specified by the manufacturer's name and catalogue reference.
- 1.11.3. Where a manufacturer's equipment has been specified by name and/or model number, 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 written installation recommendations. Provide all required piping, duct and electrical connections at no additional cost.

1.12. CO-OPERATION WITH ENGINEER'S REPRESENTATIVE

- 1.12.1. To assist in the successful execution of the Project, the Contractor will receive an initial job report that summarizes the expectations of the Engineer's Representative and the Contractor. This job report covers topics such as progress billings, shop drawing requirements, Change Order pricing, the commissioning process, installation drawings, the Specifications, as-built drawings and operations and maintenance manuals, along with a number of other items. This job report is intended to reiterate key items from the Contract Documents and is not intended to impose new requirements.
- 1.12.2. At the appropriate time during construction, submit the applicable documentation listed below. The Engineer's Representative will review the information and identify when the information is complete. The Engineer's Representative's general review letter (required for building occupancy) will only be issued when the information requested below is submitted by the Contractor and deemed to be complete by the Engineer's Representative.

- 1.12.3. For mechanical systems occupancy, provide a PDF copy of the following documents to the Engineer's office for review:
- .1 Contractor's letter confirming ventilation supply air and return air available for each room
 - .2 Start up report(s) for heating systems, air handling unit(s), heating boiler(s), fan coil unit(s), heat pump(s), fan(s), etc.
 - .3 Start up report(s) for ventilation systems, air handling unit(s), fan coil unit(s), heat pump(s), fan(s), exhaust fan(s), etc.
 - .4 Final plumbing inspection certificate
 - .5 Pressure test report on all piping systems
 - .6 Contractor's letter verifying that all plumbing fixtures are installed and operational
 - .7 Test reports and certificates from local building inspection authority confirming that the following items are installed, pressure tested and operational: building drains, sanitary and storm building sewers, drainage system and venting system, pipes, fittings, fixtures, etc.
 - .8 Contractor verification of accessibility of the fire dampers, fixtures, cleanouts, valves, plumbing appliances, devices and equipment
- 1.12.4. For mechanical systems financial close, provide the following additional documents to the Engineer's office for review:
- .1 Copies of as-built drawings
 - .2 Operating and maintenance manual
 - .3 Warranty letter
- 1.13. SUBSTANTIAL PERFORMANCE
- 1.13.1. The Owner will not deem the Project "ready for use" as defined in the provincial or territorial lien legislation until the following minimum items are complete:
- .1 Everything required in the clauses above for occupancy.
 - .2 All mechanical items commissioned and accepted by Engineer's Representative as noted in Specification Section 20 08 00.00 – COMMISSIONING.
 - .3 Submission of final, reviewed Operating and Maintenance Manuals including final reviewed Shop Drawings turned over to the Engineer's Representative and Owner as outlined in Section 20 08 03.00 – OPERATING AND MAINTENANCE INSTRUCTIONS.
 - .4 Submission of final, reviewed as-built documentation to the Engineer's Representative and Owner, as outlined in Specification Section 20 05 02.00 – AS-BUILT DRAWINGS. Note that this includes all final balancing reports.
- 1.14. CO-OPERATION WITH OTHER DIVISIONS
- 1.14.1. Pay particular attention to the proximity of electrical conduit and cable to mechanical piping and equipment.
- 1.14.2. Maintain at least 150 mm (6 in.) separation between pipes transporting hot fluids and pipes carrying cold fluids, unless approval from the Engineer's Representative is obtained.
- 1.14.3. Do not allow Electrical conduits to touch or be supported from piping or ductwork.

- 1.14.4. Install 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, relocate the materials to their proper space allocation in such a manner to complete the Work using space allocated to the various Sections and Divisions. Relocate materials and Work involved at no additional cost.
- 1.14.5. 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.
- 1.14.6. 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. Report any discrepancy between the requirements identified within the Contract Documents and those of the Electrical Division to the Engineer's Representative and supply equipment to suit the appropriate power requirements. Bear all costs associated with failure to perform this coordination prior to ordering of the motors or equipment.
- 1.15. TEMPORARY USE OF EQUIPMENT
 - 1.15.1. Where systems, or a part thereof, are operated during construction, maintain the system and equipment in proper operating condition.
 - 1.15.2. Prior to application for Substantial Performance of the Work as certified by the Engineer's Representative, return the systems and/or equipment to new condition by replacing all consumables such as air or water filters, belts in belt driven equipment, etc. with new components. Clean the air side of all coils in the air handling systems, lubricate all bearings according to manufacturer's written factory standards and adjust the thermostatic control system according to Specifications. Clean all duct systems to NADCA Standards.
- 1.16. EXISTING SERVICES AND EQUIPMENT
 - 1.16.1. 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. Replace filters in all base building air handling equipment i.e., Air Handling Units, Induction Units, Fan Coil Units, etc., after construction is completed.
 - 1.16.2. Reuse existing materials and equipment wherever possible. Provide new materials and equipment as required to ensure a complete installation. Package and turn-over to Landlord all existing equipment, materials and associated controls not used in this contract. Include in the bid 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.
 - 1.16.3. Schedule all changes and connections to existing services at a time approved by the Engineer's Representative so as to avoid any interruption of such services during normal working hours. If necessary, make changes and connections to existing services outside of normal working hours, without additional cost.
 - 1.16.4. Prior to operating any existing or new equipment during any stage of construction, receive written approval from the Landlord and Engineer's Representative.
 - 1.16.5. Whenever existing services or equipment are to be removed, remove all associated piping and ducts back to the main, nearest pipe or duct and securely cap or plug open ends in an approved manner. If necessary to facilitate installation of new Work, remove existing services and equipment and then replace without additional cost.
 - 1.16.6. Whenever it becomes necessary to relocate existing piping, ducts or equipment to make possible installation of the Work under this Contract, make such relocation without additional cost.

- 1.16.7. Where connections are made to existing services, replace and make good existing insulation.
- 1.17. INTERRUPTION OF SERVICES
- 1.17.1. Perform all shutdown, draining, filling and chemical treatment for any portion of the existing base building systems to the satisfaction of the Landlord's building operations staff and co-ordinate 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 bid price.
- 1.17.2. Schedule interruptions of the mechanical services to any part of the building 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.
- 1.17.3. Obtain approval from the Engineer's Representative for testing and operation of major equipment to avoid excessive utility charges. Such testing is to be generally carried out after normal working hours or on weekends.
- 1.17.4. Perform all such overtime Work at no additional cost.
- 1.18. STATEMENT OF PRICES
- 1.18.1. For the purpose of progress applications, submit a summary statement of 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 must equal the total price of the Work covered under Divisions 20, 21, 22 and 23.
- 1.18.2. Submit the summary of Work for this Contract to the Engineer's Representative for review and approval. Provide sufficient detail in the summary to enable the Engineer's Representative to evaluate the progress of Work and identify all major equipment, components and sub trades.
- 1.19. METRIC CONVERSIONS
- 1.19.1. Take particular care with imperial versus SI metric conversions. This applies to all services including, but not limited to, equipment, pipes, ductwork and site services in both new and existing installations.
- 1.19.2. Conform to CAN/CSA-Z234.1 "Metric Practice Guide."
- 1.20. ALTERNATIVE AND IDENTIFIED PRICES
- 1.20.1. If alternative and unit prices have been requested, include 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.
- 1.20.2.

Equipment	PURCHASE PRICE
	\$
	\$
	\$
	\$

1.21. DEMOLITION

- 1.21.1. 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.
- 1.21.2. 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 caps to all valves at the termination point of existing services.
- 1.21.3. Where valves are removed, remove valve tags, revise existing charts and hand tags over to Owner.

1.22. SCHEDULE, ACCESS, PROTECTION AND CLEAN-UP

- 1.22.1. 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.
- 1.22.2. There may be access restrictions to the site (location, time of day, days of week). Refer to Front End Specifications for more information and conform to all requirements stated within.
- 1.22.3. Refer to the security and protection requirements in the General Conditions and conform to all requirements. In particular:
- .1 No open flames without prior written approval of the Owner.
 - .2 No smoking.
 - .3 Keep the site clean at all times.

1.23. HOISTING FACILITIES

- 1.23.1. Provide hoisting facilities for the Work of this Division.
- 1.23.2. Hoisting facilities provided by the General Contractor may be available for Subcontractor's use. If the General Contractor's hoisting facilities are inadequate, provide hoisting facilities for the Work of this Division. Coordinate requirements with the General Contractor prior to submission of Bid.

1.24. INTELLECTUAL PROPERTY

- 1.24.1. The Contractor acknowledges, represents, warrants and agrees that the Owner, its Consultants, and the Engineer's Representative are not responsible, and are 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.

1.25. MATERIALS AND EQUIPMENT

- 1.25.1. Use new materials and equipment as specified or shown that are free from defects that impair strength, durability, or aesthetics.
- 1.25.2. Manufacture in Canada wherever possible.
- 1.25.3. Labelled and/or Listed as required by the Authority Having Jurisdiction or Code.

- 1.25.4. Mechanical systems are designed and coordinated based on the manufacturer and model number and/or parameters indicated on the Equipment Schedules. Accept all costs for differences in physical properties or performance between scheduled equipment and acceptable alternative equipment manufacturers or models identified in these Specifications. Differences may include, but are not limited to, size, layout, arrangement of components, connection sizes, maintenance access, locations and/or quantity of service connections, and performance differences such as noise, power consumption, flow rates, etc.
- .1 Electrical coordination: accept all extra costs to revise the electrical provisions, including but not limited to feeder/wiring sizes, breaker sizes, fuse sizes, starters and equipment, to supply power to the non-basis of design piece of equipment.
- 1.25.5. Be responsible for all design costs associated with differences between scheduled equipment and alternate manufacturers or models identified in these Specifications.
- 1.26. WARRANTY
- 1.26.1. Except where longer warranty periods are required by other specification sections, provide a one (1) year warranty for the Work, starting at Substantial Performance of the Work.
- 1.26.2. Coordinate the extension of manufacturer warranties to comply with the clause above, based on the duration of construction.
- 1.27. VALUATION OF CHANGES
- 1.27.1. Further to Contract requirements, use the following method in determining the value of a change to the Work, by either Change Order or Change Directive:
- .1 Estimate and acceptance in a lump sum, unless the Engineer's Representative otherwise determines that the method shall be unit prices set out in the Contract.
- 1.27.2. Provide the Engineer's Representative with a detailed cost analysis of the proposed change including:
- .1 Quantity of each material.
- .2 Unit cost of each material.
- .3 Labour units based on Mechanical Contractors Association of America (MCAA) Labour Estimating Manual.
- .4 Labour (hours) involved.
- .5 Suppliers' quotation or credit memo for equipment noted in proposed change, with detailed breakdown.
- .6 Sub-trade quotations including a complete cost breakdown of the proposed change meeting the requirements of this section.
- .7 Sub-trade's suppliers' quotation or credit memo for equipment noted in proposed change, with detailed breakdown.
- .8 Mark-ups, if applicable.
- .9 Value of GST or HST, as applicable.
- .10 Proposed change in contract time, if any.
- .11 S+A proposed change number in every quotation to facilitate record keeping.
- 1.27.3. Comply with requirements of Contract Documents for all materials included in quotations for proposed changes.
- 1.27.4. List material and labour separately for each item/clause of the proposed change, on the detailed cost breakdown.

- 1.27.5. Not be entitled to any additional compensation arising out of changes to the Work other than the amounts determined and agreed to under CCDC 2-2020 GC 6.2.
- 1.27.6. Inform the Surety Company or Companies who have issued any bonds for this Contract, and any Insurers who have insured any part of the Work or operations or who have an interest in this Contract, of all changes in the Contract. Pay all costs of any changes in bonds or insurances required to maintain bonds or insurances in conformance with the requirements of the Contract Documents. Provide Owner immediately with any revised bonds or insurances.
- 1.27.7. Charge special equipment rental rates at cost. Provide an official quotation of the equipment rental with the proposed change quotation as backup, otherwise special equipment rentals will not be accepted by the Owner/Consultant.
- 1.27.8. The maximum percentage fee for mark-ups is as stated in the Division 0/1 specifications or Contract Supplementary Conditions.
- 1.27.9. All changes, change notices, proposed changes, revisions to contract, Supplemental Instructions, Change Directives or any additional costs or deletes to the stipulated lump sum Contract Price are subject to review and scrutiny by a qualified third party or individual.
- 1.27.10. Use material costs based on a discount to nationally available pricing guides (i.e. Trade Service, Allpriser, etc.) to reflect a value with a fair and reasonable markup to the actual cost of the materials purchased from distributors. The Owner and/or Engineer's Representative reserve the right to negotiate material pricing to a value that is fair and reasonable to the Owner. Indicate on the Bid Form or Supplementary Bid Form: which pricing guide is proposed to be used and discount rate compared to list price.
- 1.27.11. Base the hourly labour rate for all changes on a Journeyperson rate as listed on the Bid Form and/or Supplementary Bid Form. The Owner and/or Engineer's Representative reserve the right to renegotiate the labour rate. The hourly labour rate will be inclusive of overhead, markup and profit.
- 1.27.12. At the request of the Owner or the Engineer's Representative, submit a detailed labour cost breakdown showing a breakdown of all adders to the base wage rate to show how the Contractor has come to the proposed hourly rate. The Owner and the Engineer's Representative reserve the right to negotiate the hourly labour rate with the Contractor.
- 1.27.13. When pricing additional work for proposed changes, only price new materials that are required for the proposed change. Where existing materials and/or infrastructure can be re-used for the proposed change, utilize these items in the valuation of the change at no extra cost.
- 1.27.14. Where a proposed change includes both credits and extras, overhead and permitted mark-ups apply to the net extra or credits, if any, of the entire change.
- 1.27.15. When pricing proposed changes containing both additions and credits, and where no work and/or materials have been installed on site, only price the net new materials and net new labour that are required for the proposed change. Utilize equal per unit labour and material costs for credits and additions.
- 1.27.16. Utilize equal per unit labour and material costs for credits and additions.

1.28. STATEMENT OF PRICES

- 1.28.1. To form a basis for progress payments, submit a sample progress draw for the various portions of the work. Provide sample progress draw format matching that shown in the example progress draw below. As part of the sample progress draw, include a breakdown which illustrates all categories shown on the example progress draw which are relevant to the project. Break down the categories to clearly illustrate the value of the material being supplied as the first subcategory and the value of the labour being supplied as the second subcategory, as shown on the example progress draw. Provide further material and labour breakdowns by floor, area, or phase if the project sequencing or schedule focuses on distinct areas, one at a time. The Engineer's Representative reserves the right to request that additional categories be added to the progress draw if the Engineer's Representative feels that doing so will aid in assessing the Contractor's progress on site, thereby expediting Contractor payment. Progress draws not including the categories shown on the example progress draw where relevant to the project and / or not providing separate labour value and separate material value subcategories will be rejected.
- 1.28.2. Ensure that the total price of all portions of the work equals the total price of the work covered under the Mechanical Division. Present cost for as-built drawings and O&M manuals as separate line items as shown below. Present line items from Section 20 08 00.00 – COMMISSIONING as shown below.
- 1.28.3. List and track each of the approved changes on separate lines on the progress draw.
- 1.28.4. Provide progress draw where the amount claimed is for the value, proportionate to the amount of the Contract, of Work performed and Products delivered to the Place of the Work as of the last day of the payment period. Do not include items on the progress draw which don't meet these conditions.
- 1.28.5. Amortize costs of temporary facilities and utilities over the duration of the Work. Claims for 'mobilization,' 'bidding costs,' or similar lump sums at or before start of Work are not acceptable.

2. Products

2.1. NOT USED

3. Execution

3.1. NOT USED

END OF SECTION

20 05 02.00 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 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.
 - 1.4. SUBMITTALS
 - 1.4.1. Submit as-built drawings in Revit/CAD format and PDF format for underground services for review prior to slab pour.
 - 1.4.2. Submit as-built drawings in Revit/CAD format and PDF format for all other areas of the building prior to request for occupancy.
 - 1.4.3. Comply with Section 20 05 03.00 - SHOP DRAWINGS for all submittals.
 - 1.5. WARRANTY
 - 1.5.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
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 Underground piping invert elevations and pipe locations dimensioned to column lines after review and acceptance by the Authority Having Jurisdiction.
 - .2 Inverts of underground piping at building exit and entry, below floor slab at each branch connection, riser base, and change in direction as well as a least 3 points on long straight runs.

- .3 Above ground piping revisions.
- .4 Duct revisions.
- .5 Equipment revisions.
- .6 Locations of access doors and panels. Identify the equipment and components they serve.
- .7 Locations of valves.
- 3.1.3. Keep revisions up-to-date during construction including Change Orders, Change Directives, and Supplemental Instructions. Make documentation available for review at all times.
- 3.1.4. 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.
- 3.2. SUBMISSION REQUIREMENTS
 - 3.2.1. 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.
 - 3.2.2. 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 software 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 (Mechanical Drawings) in AutoCAD. Documents to be forwarded via a secure file transfer. The Engineer's Representative will provide the Drawings one time at no charge. Where the Drawings are requested more than one time throughout the course of the project, a nominal charge of \$500.00 will apply to the second and subsequent requests.
 - .4 Clearly label electronic files with Engineer's Representative and Owner, Contract number, file names and the Drawing number.
 - 3.2.3. 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.
 - 3.2.4. If required, the Engineer's Representative will provide a quotation to this Contractor to transfer "as-built" information from the mark-up documentation to the acceptable software.
 - .1 Include a cost of \$400.00 per sheet for the transfer of marked up "as-built" information to AutoCAD and forwarding of the mechanical information by the Engineer's Representative to the Owner.
 - 3.2.5. The Project will remain incomplete and monies retained until a satisfactory as-built submission is provided.
- 3.3. AUTOCAD SPECIFIC SUBMISSION REQUIREMENTS
 - 3.3.1. Submit a complete list of layer names and brief description of each layer's use with all files.
 - 3.3.2. Submit a complete list of symbol (block) names with a description of each symbol.
 - 3.3.3. 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.

- 3.3.4. Use the standard fonts available in the software. Do not use custom fonts, shape files, etc.
- 3.3.5. 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.
 - 1.2. RELATED WORK SPECIFIED ELSEWHERE
 - 1.2.1. Comply with Section 01 33 00.00 (01 33 23.00) for Submittals except as amended below.
2. Products
 - 2.1. SHOP DRAWINGS
 - 2.1.1. Submit Shop Drawings organized by Specification Section. Ensure shop drawing package for a given Specification Section is complete, including all equipment, products, materials, and systems to be used as part of that Specification Section, and submit as a single shop drawing package. Do not submit numerous separate Shop Drawings for the same Specification Section. Do not combine more than one Specification 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 20 MB
 - .3 Provide FTP hyperlink for all attachments in excess of 20 MB with appropriate information for downloading the file (as required)
 - .4 Shop Drawing Submission to the following email address:
 - .1 ContractAdmin.Toronto@smithandandersen.com
 - 2.1.3. Shop drawings submitted directly to Smith + Andersen personnel (and not copied to the email address provided above) without advanced permission will not be processed nor considered as received.
 - 2.1.4. Shop Drawings shall indicate clearly the materials and/or equipment actually being supplied, all details of construction, accurate dimensions, capacity, operating characteristics and performance. Each Shop Drawing shall give the identifying number as noted in the documents of the specific pump, fan, etc. for which it was prepared.
 - 2.1.5. 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.
 - 2.1.6. 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.
 - 2.1.7. 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.

2.2. ENVIRONMENTAL PRODUCT DECLARATIONS (EPD)

- 2.2.1. Where EPDs are available for Products, submit them for review.
- 2.2.2. Follow Product Category Rules (PCRs) for Life Cycle Assessment (LCA) presented on EPDs.
- 2.2.3. Where multiple EPDs are available for the same Product, the order of preference is as follows:
 - .1 Product Specific, Facility Specific EPD: a Product and manufacturer specific EPD, where the environmental impacts are unique to the specific manufacturing facility.
 - .2 Product Specific EPD: a Product and manufacturer specific EPD where the environmental impacts are considered across multiple manufacturing facilities (i.e. an average of the different facilities in which the Product is manufactured).
 - .3 Industry Average EPD: an EPD for a type of Product, representing the typical environmental impacts averaged across a number of different manufacturers.

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 Shop Drawings for review.
- 3.1.2. Scanned PDF versions are not acceptable.
- 3.1.3. Manufacturing of equipment, installation of equipment or connecting services shall not start until after final review of Shop Drawings by the Engineer's Representative has been completed.
- 3.1.4. Should equipment or materials that arrive on site differ from those shown on the Shop Drawings, bear all costs for:
 - .1 Revising the equipment and materials.
 - .2 Revising the Work of other Contractors impacted.

END OF SECTION

20 05 05.00 Selective Demolition for Mechanical Services

1. General

1.1. WORK INCLUDED

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

1.1.2. These Specifications are an integral part of the Contract Documents and apply to all Division 20, 21, 22 and 23 Sections.

1.1.3. Provide labour, materials, products, equipment and services required to complete the decommissioning and/or demolition Work specified herein.

1.1.4. Refer to Drawings for extent of decommissioning and/or demolition Work. The Drawings indicate the approximate locations of services as far as these are known. The Drawings do not necessarily represent the full extent of the installed service(s) to be removed and are inferred to include decommissioning of all pipes, valves, fittings, appurtenances, etc. except where a service or component is explicitly identified to remain as an abandoned service.

.1 For decommissioning and demolition of all services within a floor or identified area, refer to as-built drawings for reference for additional detail as required.

.2 Where full removal of services or equipment is required and existing as-built drawings are not available, review the service locations on site, plan the removal to avoid disruption or accidental discharge from services, and mark all services for demolition with colour coding as required for phased removal.

1.1.5. Dispose of all debris offsite in accordance with the jurisdictional authorities.

1.1.6. Remove and pay for the disposal of refrigerants, oils, glycol, or similar materials in accordance with all municipal by-law or code requirements.

1.1.7. Remove and store salvageable items as directed herein or indicated on Drawings.

1.1.8. Mechanical decommissioning and/or demolition Work associated with this building is indicated on the Mechanical Drawings and generally consists of the following:

.1 HVAC systems including all ducts, pipes, controls, and appurtenances.

.2 Plumbing and drainage including all sanitary, storm, venting, water distribution, natural gas distribution, specialty piping such as compressed air, fuel oil, etc.

.3 All fire protection systems including sprinkler systems, standpipe systems, fire hose cabinets and all appurtenances.

.4 Remove services in a staged or phased approach to allow for immediate repair or service replacement where required to temporarily maintain the integrity of the building envelope against weather, etc.

1.2. REFERENCE STANDARDS

1.2.1. Meet the requirements of all Municipal, Provincial and Federal By-laws and Ordinances for the Province and Municipality for the Place of the Work.

1.2.2. Execute this Work in accordance with the latest or in force edition of the following codes and standards:

.1 Ontario Building Code.

.2 Occupational Health and Safety Act.

.3 Regulations for Construction Projects.

- .4 Ontario Fire Code.
- .5 National Fire Code of Canada.
- .6 Regulations under Fire Protection and Prevention Act.
- .7 Technical Standards and Safety Authority (TSSA).

1.3. QUALITY ASSURANCE

- 1.3.1. Provide adequate equipment and skilled labour with appropriate certifications suitable to the demolition task.
- 1.3.2. Remove from site and dispose of debris, refrigerants, oils, etc. in accordance with the requirements of the Authority Having Jurisdiction.
- 1.3.3. Arrange and pay for all permits, notices and inspections necessary for the proper execution and completion of the demolition Work.
- 1.3.4. Decommissioning of special equipment, where noted on the Mechanical Drawings, must be provided by the equipment manufacturer.
- 1.3.5. Review and sign off on all demolition Work prior to demobilization of demolition trades. Any associated costs due to failure to review and sign off on demolition Work will be the responsibility of the Mechanical Contractor.

2. Products

2.1. DISPOSAL OF MATERIALS

- 2.1.1. Except as required by Law for disposal, the Contractor may claim ownership of all materials which have not been designated for salvage from the demolition. Remove all material and debris from the site as quickly as possible and dispose of in a legal manner. Properly remove and dispose of all refrigerant and other toxic or hazardous materials. Burning of debris or selling of materials on site is not permitted. The Contractor is responsible for all future use (or misuse) of items once they have been removed from the installed location.
- 2.1.2. Conform to the requirements of the Municipality regarding disposal of waste materials.
- 2.1.3. Materials prohibited from municipality waste management facilities shall be removed from site and disposed to recycling companies specializing in recyclable materials.

2.2. SALVAGEABLE ITEMS TO BE REMOVED AND STORED

- 2.2.1. The following is a list of salvageable items to be carefully disconnected, removed and turned over for storage for future use:
 - .1 NONE.

3. Execution

3.1. GENERAL INSTRUCTIONS

- 3.1.1. At the end of each Work shift, leave Work in a safe condition.
- 3.1.2. Demolish Work into sections of practical size for removal without alteration or damage to existing building structure or finishes that are indicated to remain.

- 3.1.3. Demolish Work in sections, replacing with new materials as required, for services to remain in operation during the demolition and construction process. This may include, but is not limited to systems such as storm drainage, sanitary drainage, etc.
- 3.2. STORAGE OF MATERIALS
- 3.2.1. Store materials only in areas designated and as permitted by the local jurisdictional authorities.
- 3.2.2. Do not stack materials and debris in the building to the extent that overloading of any part of the structure will occur.
- 3.3. PROTECTION OF PREMISES
- 3.3.1. Adhere strictly to the Owner's requirements.
- 3.3.2. Adhere strictly to the requirements for heritage preservation.
- 3.3.3. Adhere to an agreed upon schedule for dust and noise control prior to commencing Work in or adjacent to existing facilities where such Work might affect other facilities or their occupants.
- 3.3.4. Execute Work with least possible interference or disturbance to the building occupants, public, and normal use of adjacent premises.
- 3.3.5. Provide temporary means to maintain security when security has been reduced by this Contractor.
- 3.3.6. Utilize only elevators, dumbwaiters, conveyors or escalators assigned for Contractor's use for moving workers and material within the building. Protect walls of passenger elevators prior to use. Accept liability for damage, safety of equipment and overloading of existing equipment.
- 3.3.7. Provide temporary dust screens, barriers, warning signs in locations where renovations and alteration Work is adjacent to public areas which will be operative during Work.
- 3.3.8. Protect all heritage or other mechanical systems indicated to remain against damage.
- 3.3.9. Provide and maintain ready access to firefighting equipment at all times.
- 3.3.10. Provide and maintain proper and suitable fire extinguishers throughout the duration of the Work.
- 3.3.11. The Drawings indicate the approximate locations of services, as far as these are known. Should any mechanical or electrical service that is anticipated to remain in place (i.e. storm drainage) be broken or disrupted by operations specified under this contract, repair the service and make good all damage. Temporarily remove and replace all services or parts of services to permit the full removal of services identified.
- 3.3.12. The existing Drawings and/or as-built drawings indicate the approximate locations of services as far as these are known. Where specific services are identified for removal within an area of Work, immediately advise the Engineer's Representative in writing when unknown or unexpected services are encountered. Investigate and clearly document these services back to their source, as required, to facilitate further direction regarding removal.
- 3.3.13. Accept liability for costs incurred by the Owner in repairing and cleaning equipment, etc., resulting from failure to comply with the above requirements.
- 3.4. RESTRICTIONS REGARDING USE OF PREMISES
- 3.4.1. Use only those existing entrances and stairs designated for access to and egress from the existing buildings and various floors where Work of this contract is to be carried out. No traffic through other areas of the building will be permitted without the prior consent of the Owner.

- 3.4.2. Keep stairs and corridors clear and open as required for exit purposes in case of fire, and as required for use by the Contractor's personnel.
- 3.5. PREPARATION
- 3.5.1. Prior to commencing this Work, arrange to have the appropriate trades present to disconnect all utility services where required.
- 3.5.2. Drain completely all gravity or pressurized water services to avoid damage or hazard due to accidental discharge. Where sections of the installed services cannot be drained fully utilizing existing valves, drain connections, etc., open the service and control the discharge of water appropriately to avoid discharge during service removal.
- 3.5.3. Identify and protect all existing services designated to remain.
- 3.6. INTERRUPTION OF EXISTING SERVICES TO REMAIN
- 3.6.1. Arrange, schedule and perform Work to mitigate disturbance to existing facilities and services.
- 3.6.2. Submit a complete master schedule of anticipated service interruptions and changeovers with approximate dates required, durations and times of day, for approval by the Owner before proceeding with any Work. Update and submit the schedule on a weekly basis during construction.
- 3.6.3. Notify the Owner in writing at least 36 hours in advance (unless specified elsewhere) of the planned interruption of existing services that are to remain.
- 3.6.4. Interruption of services must occur at the times and for the duration stipulated by the Owner.
- 3.6.5. Keep service interruption duration to an absolute minimum. Carry out all preparatory Work, measurements, etc., without interruption of existing services where possible.
- 3.7. PARTIAL REMOVAL OF A SERVICE
- 3.7.1. Remove services back to the main (service pipe or duct) or nearest branch (pipe or duct) serving other areas to remain. Cap services tight to the main or branch.
- 3.7.2. Do not abandon unused services in the ceiling space, furred walls, shafts, etc. unless expressly permitted by the Engineer's Representative or Owner.
- 3.7.3. Where an unused service is indicated or permitted to remain, mark the abandoned services clearly including the service type (i.e. Do Not Connect - Abandoned Chilled Water).

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. For piping and equipment provided under the Mechanical Division, provide complete with all necessary supports and hangers required for a safe and professional installation.

1.1.3. Hangers, supports, anchors, guides, and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment.

1.2. SUBMITTALS

1.2.1. Submit Shop Drawings in accordance with Section 20 05 03.00 – SHOP DRAWINGS.

1.2.2. The Mechanical Division shall prepare detailed Shop Drawings showing all anchors and guides for all systems with the potential for thermal expansion/contraction and/or loads due to weight or thrust. The drawings shall bear the signed seal of a Professional Engineer licensed to practice in the appropriate discipline and Place of the Work. The drawings shall include all details of construction, static and dynamic forces at points of attachment, etc. necessary for review and acceptance by the Project Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division. No anchor points shall be permitted without reviewed Shop Drawings and, where installed prior to review, shall be removed and replaced to the satisfaction of the Engineer's Representative.

1.3. WARRANTY

1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

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

2.1.2. All pipe hangers and supports shall be manufactured to the latest requirements of ANSI MSS-SP-58 "Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation." Where applicable, design and manufacture of hangers and supports shall also conform to ANSI/ASME B31 "Code for Pressure Piping."

2.1.3. All hangers, supports, brackets and other devices installed exterior to the building or in corrosive environments (pool mechanical rooms, pools, pool change rooms, etc.) shall be galvanized to prevent failure from environmental corrosion. If galvanized components cannot be used submit samples of proposed substitute for review prior to installation.

2.1.4. Provide supplemental support to minimize the risk of joint separation under high thrust conditions for large diameter no-hub cast iron fittings over 102 mm (4 in.) in accordance with the Standard Details and manufacturer's recommended installation instructions.

- .1 As an alternative to the above field devised methods and materials, provide engineered pipe and fitting restraints designed and manufactured for the specific purpose of

restraining no hub cast iron pipe and fittings against separation under thrust forces equivalent to 145 kPa (50 ft) head pressure. Equal to Holdrite #117.

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. Approved type expansion shields and bolts may be used for pipe up to 100 mm (4 in.) diameter where the presetting of concrete inserts is not practical. 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.

3.1.7. 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.

3.1.8. 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
50 mm (2 in.) and under	9 mm (3/8 in.)
65 mm (2-1/2 in.) and 75 mm (3 in.)	12 mm (1/2 in.)
100 mm (4 in.) and 125 mm (5 in.)	16 mm (5/8 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 38 mm (1-1/2 in.)	2.1 m (7 ft.)

50 mm (2 in.) to 125 mm (5 in.)

3 m (10 ft.)

- 3.1.10. In addition, provide a hanger within 600 mm (2 ft.) on each side of valves, fitting or tees on pipes 38 mm (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 50 mm (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 domestic hot water piping, 38 mm (1-1/2 in.) and smaller, use line size hangers.
- 3.1.16. For domestic cold water piping, 25 mm (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 - INSULATION.
- 3.1.17. For domestic cold water piping larger than 25 mm (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 - INSULATION.
- 3.1.18. For insulated ducts, ensure supports are on the outside of the insulation so as to not be directly connected to the duct creating a vapour barrier issue. Provide high density insulation in the area of the supports and spread the load.
- 3.1.19. The shield width shall be minimum 1/4 of the pipe circumference. The length and gauge shall be as follows:
 - .1 150 mm (6 in.) long and 14 US gauge for pipe larger than 25 mm (1 in.) up to 50 mm (2 in.) diameter
 - .2 250 mm (10 in.) long and 12 US gauge for pipes 65 mm (2-1/2 in.) to 300 mm (12 in.) diameter
- 3.1.20. 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.
- 3.1.21. Other means of support shall be as shown or as specified hereunder.

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. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Concrete Work on grade or cast integrally with a floor is provided under Division 3.

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.

1.4. WARRANTY

1.4.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

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, Isotech, 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 consist of a steel spring and welded steel housing. Spring diameter and hanger box hole shall be large enough to permit the hanger rod to swing through a

- 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 19 mm (3/4 in.) larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.
- .2 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 9 mm 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 spring mounts shall be complete with levelling devices 6 mm (1/4 in.) thick ribbed neoprene sound pads and completely colour coded stable springs.
- 2.2.3. Where steel spring isolation systems are described in the Specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 80 % of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after spring installation.
- 2.2.4. 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.
- 2.2.5. 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.
- 2.2.6. Grout: Non-shrink, self-levelling grout having ability to withstand thermal, vibratory and impact stresses.
- 2.2.7. Acoustic Sealant: Non-hardening, non-skinning permanently flexible, to CAN/CGSB-19.21 "Sealing and Bedding Compound, Acoustical." Tremco, CGC Acoustic Sealant or approved equivalent.
- 2.3. INTERNAL ACOUSTIC DUCT LINING
- 2.3.1. Fiberglass duct lining manufacturer: Certainteed, Owens-Corning, Knauf Insulation, or Johns Manville.
- 2.3.2. Natural fibre duct lining manufacturer: Bonded Logic.
- 2.3.3. Provide acoustic duct lining with a minimum density of 24 kg/m³ (1.5 lbs/ft³).
- 2.3.4. Provide acoustic duct lining that complies with the requirements of NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilation Systems" and the "Duct Liner Materials Standard" of the Thermal Insulation Manufacturer's Association.
- 2.3.5. Provide internal acoustic duct lining that incorporates means to prevent fiber entrainment in the air stream, such as airstream surface and long edges complete with acrylic polymer surface coating.
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 flexible conduit installed in a slack "U" shape.
- 3.1.5. Elastomeric isolators that will be exposed to temperatures below 0 deg. C. (32 deg. F.) shall be fabricated from natural rubber instead of neoprene.
- 3.1.6. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
- 3.1.7. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
- 3.1.8. Fans and air handling units shall be levelled with fans operating before the flexible connectors are attached.
- 3.1.9. 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. Vertical in-line pumps ceiling hung shall be supported by Type SPNH spring isolators. Refer to Mechanical Standard Details.
 - 3.2.2. 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.
 - 3.2.3. Where a pipe connects to multiple pieces of equipment in the Mechanical Room the pipe isolators for the entire run shall be chosen to suit the connected equipment of the greatest static deflection.
 - 3.2.4. No rigid connections between equipment and the building structure shall be made that degrades the specified noise and vibration control system.
 - 3.2.5. Any conflicts with other trades which result in rigid contact with the equipment or piping due to inadequate space or other unforeseen conditions shall 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.
 - 3.2.6. 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.
 - 3.2.7. 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. ACOUSTICAL LINING OF DUCTS
 - 3.3.1. Acoustically line ductwork where shown on the Drawings and as Specified.
 - 3.3.2. Provide a minimum of 25 mm (1 in.) thick acoustical duct lining in all internally lined sheet metal ducts, unless otherwise specified or shown on the Drawings.
 - 3.3.3. In addition, internally line all low or medium pressure supply air ductwork in mechanical rooms, fan rooms, or equipment rooms.

- 3.3.4. Install acoustic lining using both pins and a minimum of 50 % coverage of a fire-resistant adhesive. Install pins on maximum 450 mm (18 in.) centres on all sides and tack weld to the duct or plenum. Mechanical fasteners that pierce the duct are unacceptable. Seal all edges of acoustic lining to prevent air erosion with sheet metal nosing that overlaps the insulation by 19 mm (3/4 in.) minimum. Coat all ends of the liner with a fire resistant cementing material to prevent delamination, leakage or erosion. Firmly butt all joints and coat ends with an adhesive to ensure that the lining is smooth across all joints.
- 3.3.5. For acoustic lining downstream of VAV boxes refer to Section 23 36 16.00 - VARIABLE VOLUME BOXES.
- 3.3.6. Where acoustical duct lining is installed, increase the dimensions of the sheet metal 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.
- 3.3.7. Internally insulate the following ductwork:
- .1 All return air transfer ductwork.
 - .2 All ductwork specifically identified in Specifications and/or on the Drawings.
 - .3 All supply and return air ductwork in the amenity spaces, lobbies, and common areas that serve that space.

END OF SECTION

20 05 88.00 Cutting and Patching

1. General

1.1. WORK INCLUDED

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

1.1.2. Openings required for mechanical services for new construction shall be in accordance with Section 20 05 83.00 - SLEEVES AND ESCUTCHEONS. This Section shall apply for openings required in existing construction or where sleeves for mechanical services have been omitted in new construction in error.

1.1.3. Include for all cutting and patching for all mechanical services for holes and openings with dimensions up to 200 mm (8 in.) in size and related patching. Perform cutting and patching Work in accordance with requirements of Section 01 60 00.00 - PROJECT FORMS.

1.1.4. Cutting and Patching shall be in accordance with Section 01 60 00.00 - PROJECT FORMS.

1.2. WARRANTY

1.2.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. All services and materials used for the cutting and patching shall meet all requirements specified in Section 01 60 00.00 - PROJECT FORMS, and shall be carried out by professional workers experienced in the cutting and patching Work to be done.

3. Execution

3.1. INSTALLATION

3.1.1. Locate all openings in non-structural elements requiring cutting and patching in cooperation with the applicable Trades in a timely manner to avoid unnecessary cutting. All openings shall be shown on drawings and submitted to the Engineer's Representative for review. No holes through structure shall be permitted prior to review by the Structural Engineer's Representative.

3.1.2. Core drilling for individual services shall be by this Division. Cut all openings no larger than is required for the services.

3.1.3. Locate all openings in structural elements requiring cutting and patching (concrete walls or floors) and x-ray the structure to obtain Structural Engineer's Representative's approval prior to cutting or core drilling of structure. Make adjustments to location of openings as required to minimize cutting of rebar and completely avoid electrical conduit.

.1 Cut holes through slabs or walls only.

.2 Do not cut holes through beams.

.3 Holes to be cut are 200 mm (8 in.) diameter or smaller only.

- .4 Maintain at least 100 mm (4 in.) clear from all beam faces. Space at least 3 hole diameters on Centre.
 - .5 For holes that are required closer than 25% of slab span from the supporting beam face, use cover meter above the slab to clear slab top bars.
 - .6 For holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars.
 - .7 X-rays shall be performed by a qualified technician, in a safe manner and in accordance with all applicable regulations governing this activity.
- 3.1.4. Obtain written approval from the Landlord and the Structural Engineer's Representative before cutting or core drilling openings or holes.
- 3.1.5. Patch all openings after services have been installed to match the surrounding finishes.

END OF SECTION

20 07 00.00 Insulation

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. Provide Shop Drawings with technical data on all types of insulation to be installed, in accordance with Section 20 05 03.00 – SHOP DRAWINGS.

1.2.2. Provide two samples of each type of insulation indicating where each is to be used, and a sample of a typical vapour barrier dam, where vapour barrier dams are called for: in Part 3 or on the Drawings. 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.

1.3. WARRANTY

1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. GENERAL

2.1.1. Provide insulation and jacket systems that are fire retardant, with a flame-spread rating not to exceed 25 and a smoke developed classification not to exceed 50, when tested in accordance with CAN/ULC S102 "Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies."

2.1.2. For indoor applications, provide insulation systems (insulation, jackets, adhesives, coatings, etc.) that are Certified under the UL GREENGUARD Certification Program for low chemical and particle (volatile organic compounds (VOC)) emissions.

2.2. PIPE INSULATION

2.2.1. Type P1 - Inorganic mineral fibre: glass wool, rock wool, or slag wool.

.1 To ASTM C547 "Standard Specification for Mineral Fiber Pipe Insulation."

.2 Rigid, pre-formed, with pressure sensitive longitudinal adhesion strip.

.3 Reinforced all service jacket (ASJ) vapour retarder.

.4 Suitable for temperature range of pipe application in question.

.5 Acceptable manufacturers:

.1 Johns Manville

.2 Knauf

.3 Manson

.4 Owens-Corning

2.2.2. Type P3 - Closed cell flexible elastomeric:

- .1 To ASTM C534 "Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form."
- .2 Preformed, with self closing adhesion strips.
- .3 Suitable for temperature range of pipe application in question.
- .4 UV resistant with protective jacket/cladding where used outdoors.
- .5 Adhesive for both surfaces to be joined.
- .6 Acceptable manufacturers:
 - .1 Armacell

2.3. DUCT INSULATION

2.3.1. Type D1 - Inorganic mineral fibre blanket - glass wool, rock wool, or slag wool:

- .1 To ASTM C553 "Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications."
- .2 Flexible blanket, with foil scrim kraft (FSK) facing jacket vapour barrier.
- .3 Density: 24 kg/cu.m. (1.5 lbs/cu.ft.).
- .4 Suitable for temperature range of duct application in question.
- .5 Acceptable manufacturers:
 - .1 Johns Manville
 - .2 Knauf
 - .3 Rockwool

2.3.2. Type D2 - Inorganic mineral fibre board - glass wool, rock wool, or slag wool:

- .1 To ASTM C612 "Standard Specification for Mineral Fiber Block and Board Thermal Insulation."
- .2 Semi-rigid board, with factory applied foil scrim kraft (FSK) facing jacket vapour barrier.
- .3 Suitable for temperature range of duct application in question.
- .4 Density: 48 kg/cu.m. (3 lbs/cu.ft.).
- .5 Acceptable manufacturers:
 - .1 Johns Manville
 - .2 Knauf
 - .3 Owens-Corning
 - .4 Rockwool

2.3.3. Type D3 - Closed cell flexible elastomeric:

- .1 To ASTM C534 "Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form."
- .2 Preformed.
- .3 Suitable for temperature range of duct application in question.
- .4 UV resistant with protective jacket/cladding where used outdoors.
- .5 Adhesive for both surfaces to be joined.
- .6 Acceptable manufacturers:
 - .1 Armacell

2.4. JACKETS

2.4.1. All service jacket (ASJ)

- .1 As indicated in insulation types above.

2.4.2. Foil skim kraft (FSK)

- .1 As indicated in insulation types above.

2.4.3. Insulation Jacketing System:

- .1 Multi-layered, reinforced laminate jacketing tape with acrylic pressure sensitive adhesive.
- .2 Zero permeability; self-adhesive; UV and weather resistant.
- .3 Colour: Natural aluminum or white, as chosen at Shop Drawing stage.
- .4 Finish: flat or embossed, as chosen at Shop Drawing stage.
- .5 Acceptable manufacturers:
 - .1 3M – VentureClad Insulation Jacketing System 1577 Series
 - .2 3M – VentureClad Heavy Duty Jacketing System 1579 Series

2.4.4. Canvas jacket:

- .1 ULC listed plain weave cotton fabric insulation jacket.
- .2 Weight of canvas: 220 g/sq.m (6 oz/sq.yd.).
- .3 Complete with two coats of fire retardant lagging finish.

2.5. SECUREMENT

2.5.1. Banding

- .1 Aluminum or Stainless steel.

2.5.2. Tie Wire

- .1 Stainless steel.
- .2 Minimum 1.3 mm (16 gauge).
- .3 Twisted ends.

2.5.3. Corner beads and channels at floor line:

- .1 Minimum 0.4 mm (28 gauge) galvanized sheet metal.

2.5.4. As per insulation / jacket manufacturer's written installation instructions.

2.6. CEMENTS AND ADHESIVES

2.6.1. Where cements or adhesives are required, provide those that are compatible with insulation and jacket, per insulation and jacket manufacturer's written recommendations / instructions.

2.6.2. Fire retardant lagging coating:

- .1 Chil Seal CP-50A by Childers Products Company or Henry equivalent.

2.6.3. Vapour barrier dam:

- .1 CHIL-PERM CP-30 with fibreglass cloth reinforcing.

3. Execution

3.1. INSTALLATION

- 3.1.1. Install insulation in accordance with the manufacturer's written 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 "Energy Standard for Buildings except Low-rise Residential Buildings" and in National Energy Code of Canada for Buildings (NECB), (refer to Table 2 below), 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. Do not commence insulation installation until testing report is submitted to Engineer's Representative and is reviewed by Engineer's Representative without requesting a resubmit.
- 3.1.5. Where pipes and ducts are specified to be insulated, insulate complete piping system and duct system with no gaps in insulation.
- 3.1.6. Protect insulation and pipe from moisture ingress where insulation is installed exterior to the building.
- 3.1.7. Utilize oversized hangers and pipe supports where pipes are installed exterior to the building and are to be insulated. Hangers and supports to support assembly on the outside of the insulation, so as to protect insulation and pipe from water damage due to ambient conditions.
- 3.1.8. 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 26.7 deg. C. (80 deg. F.), including but not limited to the following:
 - .1 Domestic cold water piping
- 3.1.9. Terminate insulation on pipes passing through fire rated walls or floors, and fit tight to the fire stop material.
- 3.1.10. 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.
- 3.1.11. On piping systems specified to be insulated, include insulation on valves, flanges, couplings and unions.
- 3.1.12. Do not use staples to secure joints of insulation jackets.
- 3.1.13. Where tie wires are used, install on maximum 305 mm (12 in.) centres.
- 3.1.14. Install insulation jackets with minimum 50 mm (2 in.) laps.
- 3.1.15. Provide insulation and jacket systems in accordance with Table 1 below:

TABLE 1: INSULATION AND JACKET SYSTEMS

Pipe Application	Insulation	Thickness	Jacket
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Domestic hot water piping	Type P1	Per Table 2	Per insulation type
Domestic cold water piping	Type P1 or P3	Per Table 2	Per insulation type
Duct Application	Insulation	Thickness	Jacket
Flexible duct connections do not require insulation except where a factory applied insulation has been specified with the flexible duct connection.	See ductwork spec	See ductwork spec	See ductwork spec
Ductwork internal to the building within conditioned spaces	Type D2	25 mm (1 in.)	Per insulation type
Ductwork in conditioned concealed spaces and on round duct smaller than 600 mm (24 in.)	Type D1	38 mm (1-1/2 in.)	Per insulation type

3.1.16. Hot Services

- .1 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.
- .2 For domestic hot water piping, apply insulation with all joints butted firmly together, and bond securely, sealing flaps by pasting down to give a smooth finish.
- .3 Provide removable sections at access doors/manholes and all components requiring servicing.

3.1.17. Cold Services

- .1 Protect insulation by means of sheet steel shields at each hanger or support on the following:
 - .1 All sizes of chilled water
 - .2 Domestic cold water piping larger than 25 mm (1 in.)
- .2 Provide Type P5 closed cellular glass insulation inserts the full length of shields at all hangers and supports.
- .3 For domestic cold water piping 25 mm (1 in.) and less where hangers on cold water lines penetrate vapour barrier, ensure that the penetration is properly sealed with insulation and vapour barrier continued up hanger a further 75 mm (3 in.).
- .4 Where sheet metal shields are used, refer to Section 20 05 29.00 - HANGERS AND SUPPORTS.
- .5 On cold water service valves, water meters, drain valves, vent connections, thermometer wells, pressure gauges and other irregular shaped objects, cut and mitre insulation as necessary. Bond and seal edges of insulation to the adjacent surfaces.
- .6 Refer to the Table 2 for required insulation thicknesses.

3.1.18. Ductwork and Equipment

- .1 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.
 - .2 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.
- 3.1.19. Except where other methods of fire rating are shown on the Drawings, where fire wrap systems for pipes are acceptable to the local authority having jurisdiction, install fire wrap system, in accordance with the CCMC listing and the manufacturer's written instructions.

3.1.20. TABLE 2: MINIMUM PIPE INSULATION THICKNESS/PERFORMANCE (BASED ON ASHRAE 90.1 AND NATIONAL ENERGY CODE FOR BUILDINGS)

- .1 Comply with the more stringent (i.e. larger) minimum pipe insulation thickness when comparing ASHRAE 90.1 and National Energy Code for Buildings.
- .2 Minimum pipe insulation thickness - mm (in.)
 - .1 ASHRAE 90.1: Domestic Water Systems

Fluid Design Operating Temp. range deg. C. (deg. F.)	Insulation Conductivity		Nominal Pipe Diameter - mm (in.)					
	Conductivity W/(m-K) ((Btu-in.)/h-sq.ft. – deg. F.)	Mean Rating Temp deg. C. (deg. F.)	Runouts* <38.1 (<1.5)	<25.4 (<1)	25.4 to <38.1 (1 to <1-1/2)	38.1 to <101.6 (1-1/2 to <4)	101.6 to <203.2 (4 to <8)	≥203.2 (≥8)
41-60	0.032 to 0.040	38	25.4	25.4	25.4	38.1	38.1	38.1
(105 to 140)	(0.22 to 0.28)	(100)	(1.0)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)

*For piping located in partitions within conditioned spaces, reduction per footnote to ASHRAE 90.1 table.

.2 National Energy Code for Buildings: Domestic Water Systems

Fluid Design Operating Temp. range deg. C. (deg. F.)	Insulation Conductivity		Nominal Pipe Diameter - mm (in.)					
	Conductivity W/(m-deg. C) ((Btu-in.)/h-sq.ft. – deg. F.)	Mean Rating Temp deg. C. (deg. F.)	Runouts ^y ≤51 (2)	≤25.4 (<1)	32 to 51 (1-1/4 to 2)	64 to 102 (2-1/2 to 4)	≥127 (≥5)	Not used
41-60	0.035 to 0.040	38	25.4	25.4	38.1	38.1	38.1	
(105 to 140)	(0.24 to 0.28)	(100)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)	

^yRefers to runouts to individual terminal units not exceeding 3.7 m in length.

.3 ASHRAE 90.1: Domestic Cold Water.

Fluid Design Operating Temp. range deg. C. (deg. F.)	Insulation Conductivity		Nominal Pipe Diameter - mm (in.)					
	Conductivity [W/(m-K)] [(Btu-in.)/h-sq.ft. – deg. F.]	Mean Rating Temp deg. C. (deg. F.)	Not used	<25.4 (<1)	25.4 to <38.1 (1 to <1-1/2)	38.1 to <101.6 (1-1/2 to <4)	101.6 to <203.2 (4 to <8)	≥203.2 (≥8)
4.4-16	0.030 to 0.039	24		12.7	12.7	25.4	25.4	25.4
(40-60)	(0.21 to 0.27)	(75)		(0.5)	(0.5)	(1.0)	(1.0)	(1.0)
<4.4	0.029 to 0.038	10		12.7	25.4	25.4	25.4	38.1
<(40)	(0.20 to 0.26)	(50)		(0.5)	(1.0)	(1.0)	(1.0)	(1.5)

.4 Domestic Cold Water.

Fluid Design Operating Temp. range deg. C. (deg. F.)	Insulation Conductivity		Nominal Pipe Diameter - mm (in.)					
	Conductivity [W/(m-deg. C)] [(Btu-in.)/h-sq.ft. – deg. F.]	Mean Rating Temp deg. C. (deg. F.)	Runouts ^y ≤51 (2)	≤25.4 (<1)	32 to 51 (1-1/4 to 2)	64 to 102 (2-1/2 to 4)	≥127 (≥5)	Not used
4-16	0.030 to 0.039	24	25.4	25.4	25.4	25.4	25.4	
(39-61)	(0.21 to 0.27)	(75)	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)	
<4	0.030 to 0.039	24	25.4	25.4	38.1	38.1	38.1	
<(39)	(0.21 to 0.27)	(75)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)	

^yRefers to runouts to individual terminal units not exceeding 3.7 m in length.

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.

1.2. WARRANTY

1.2.1. Provide a warranty in accordance with the requirements of 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 written 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. Any unpainted steel surfaces, installed for longer than one year prior to the completion date, shall be prime coated under this Division.

3.1.5. 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.

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

3.1.7. 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 work quality shall be equal to the manufacturer's original.

END OF SECTION

21 25 00.00 Portable Fire Extinguishers

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. Finish painting for prime painted cabinets - under Section 09 90 00.00 - PAINTING AND COATING.

1.3. WARRANTY

1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Portable fire extinguishers shall be rated and identified in accordance with CAN/ULC-S508 "Standard for the Rating and Fire Testing of Fire Extinguishers." All ratings identified below shall be considered as a minimum.

2.1.2. Provide 6A80BC rating, 4.53 kg (10 lbs.) multi-purpose dry chemical powder type and ULC labelled in Mechanical and Electrical Rooms, as well as in bike / scooter storage spaces.

2.1.3. Provide 4A80BC rating, 4.53 kg (10 lbs.) multi-purpose dry chemical powder type and ULC labelled (ammonium phosphate) in general areas.

3. Execution

3.1. INSTALLATION

3.1.1. Install Portable Fire Extinguishers in accordance with the National and Provincial Fire Codes and NFPA 10 "Standard for Portable Fire Extinguishers."

3.1.2. Install extinguishers so that travel distance to extinguishers conforms to the Authority Having Jurisdiction. Provide maximum travel distance for Class B fires in ordinary hazard occupancies of 9 m (29.5 ft.) for 10 BC extinguisher and 15 m (49.2 ft.) for 20 BC extinguishers, but ensure that there is not less than one extinguisher in each electrical room, kitchen or mechanical room. Provide maximum travel distance for Type A extinguishers in Class A fires of 22.9 m (75 ft.).

END OF SECTION

22 11 23.29 Circulators

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 03.00 - SHOP DRAWINGS.

2. Products

2.1. MATERIALS

2.1.1. Circulators for domestic hot water recirculation shall be in the line type, mechanical seal and suitable for 125 psig working pressure.

2.1.2. For domestic water systems (potable) pump body shall be lead free bronze or stainless steel with impeller meeting the low lead requirements of NSF/ANSI/CAN 372 "Drinking Water System Components - Lead Content" for all wetted parts.

2.1.3. Domestic hot water recirculation pump (P-1.1) shall be:

Make	Model	Flow rate	Head	Power	Connection
Grundfos	UP 15-10 B5	1.0 GPM	5.0 FT	115/60 25W	½" SWEAT

2.1.4. Pump shall run continuously.

3. Execution

3.1. INSTALLATION

3.1.1. Support pump as shown on Standard Details.

END OF SECTION

22 13 19.13 Floor Drains

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 03.00 - SHOP DRAWINGS.

1.3. WARRANTY

1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Floor drains shall be J.R. Smith, Mifab, Watts, or Zurn.

2.2. FINISHED AREAS

2.2.1. Floor drains in finished areas shall be all coated cast iron body, flashing clamp with seepage openings and adjustable 127 mm (5") diameter nickel bronze 6.35 mm (1/4") thick strainer, secured with SS screws, 100 mm (4") throat on strainer. Drain shall be complete with trap primer connection. J.R. Smith 2005A05NB-P050, Zurn ZN-415-B5, Mifab F1100C-5-1, Watts FD-100-C-A5-1.

2.2.2. Hub drains shall be similar to floor drains in finished areas but with cast iron hub. J.R. Smith 2005-2645, Zurn Z-415-S, Mifab F1100C-DD-50, Watts FD-100-DD-50.

2.2.3. Shower drains shall be Stainless Steel Linear Shower Drain. Complete with vertically adjustable anchoring support legs, anti-ponding V-shaped channel with 2" [51mm] No-Hub center outlet, adjustable secured leveling frame with built-in tile edge, integral membrane flange for glue on waterproofing membrane, and secured, light-duty, slotted heel-proof grate. Zurn ZS880.

3. Execution

3.1. INSTALLATION

3.1.1. Provide trap seal primer assemblies for all floor drain traps. Trap primer shall be installed at the nearest cold water served fixture or faucet, except drinking fountains.

.1 Provide access to primer assembly for repair or replacement.

.2 Provide a globe valve on the water supply for regulation and shut-off.

- .3 Where integral backflow prevention is not sufficient to the meet the requirements of CSA B64, provide a reduced pressure backflow prevention device on the water supply to the trap seal primer in a suitable location and discharge piped to drain.

END OF SECTION

22 33 00.00 Domestic Electric Hot Water Heaters

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 03.00 - SHOP DRAWINGS.
 - 1.2.2. Ensure Shop Drawings include unit Short Circuit Current Rating (SCCR).
 - 1.3. WARRANTY
 - 1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. MATERIALS
 - 2.1.1. Tank based domestic electric hot water heaters:
 - .1 Provide CSA approved domestic electric hot water heaters by John Wood, Bradford White, AO Smith or Rheem.
 - .2 Provide glass lined steel tank, factory insulated and covered with an enamelled steel jacket. Provide tank rated for 860 kPa (125 psi) working pressure.
 - .3 Provide heater elements of electric immersion type located at the top and bottom of the tank and complete with thermostats. Arrange elements to operate alternatively or simultaneously, as shown. Provide an additional high limit thermostat that prevents overheating. Provide access panels in jacket that provide access to thermostats and elements.
 - .4 Provide tanks complete with temperature pressure relief valve. Pipe relief valve to nearest drain.
 - .5 Provide tanks of size and heaters of capacity as shown on the Domestic Hot Water Heater Schedule.

Unit tag	Make & Model	Storage	Power input	Heat revcovery rate	Electric data	Remarks
DHWH-1.1	A.O. Smith DRE-80-9	80Gal (302L)	9kW	37GPH	208/1/60	Floor mounted

- 2.1.3. System shall bear a minimum Short Circuit Current Rating (SCCR) listed by a Nationally Recognized Testing Lab, acceptable to the local Authority Having Jurisdiction, and shall be **10,000 A**. Lower SCCR listed units implying the use of current limiting fuses ahead of them in the field, in lieu of an actual appropriate SCCR rating, are not acceptable.

3. Execution

3.1. NOT USED

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 03.00 – SHOP DRAWINGS.

1.2.2. For manual flush water closets located in barrier free applications, ensure that Shop Drawing clearly illustrates that flushing control is located on the transfer side (adjacent the clear floor space) of the water closet.

1.3. REFERENCES

1.3.1. Comply with CSA B45 Series of standards for fixtures.

1.4. WARRANTY

1.4.1. Provide a warranty in accordance with the 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. Provide fixtures from American Standard, T&S Brass, Toto, Kohler, Franke, Zurn, Blanco, Mirolin or Novanni, equivalent to the fixtures specified. American Standard – Eljer and Placidus are not permitted. Provide white vitreous china fixtures unless indicated otherwise.

2.1.4. Provide fittings and trim from American Standard, T&S Brass, Kohler, Sloan, Chicago Faucets, Zurn, Moen, Symmons, or Delta/Cambridge except where specified otherwise. Provide polished chrome plated brass for all exposed valves, fittings, escutcheons, trim, etc., at each fixture, unless specified otherwise.

2.1.5. Provide Fixtures and Trim equal to Product Specification sheets.

2.1.6. Carriers shall be furnished for all wall hung water closets, urinals, and lavatories. Carriers shall be in conformance with Section 22 42 46.00 - FIXTURE CARRIERS.

2.2. WATER CLOSETS AND URINALS

2.2.1. All tanks of water closets shall be internally lined with anti-sweat insulation except pressure assist water closets.

- 2.2.2. For manual flush water closets located in barrier free applications, provide water closet with flushing control that is located on the transfer side (adjacent the clear floor space) of the water closet.
- 2.2.3. Water closets shown as type "WC-1 - Floor mounted pressure-assist tank": "Pressure-Assist Low Consumption" tank toilet, floor mounted, vitreous china, elongated siphon jet flush action bowl, fully glazed 50 mm (2 in.) internal trapway, 250 mm x 300 mm (10 in. x 12 in.) large water surface, "Speed Connect" P.A. tank complete, 6 L (1.6 gal.) flush, with cast sanitary guard on bowl for china to china tank assembly, and bolt caps. Provide floor flange, flange bolts and gasket. American Standard Cadet Elongated 2333.100, Crane Economizer 3835, Eljer Aqua-Saver 091-7025, or Kohler Wellworth Pressure-Assist K-3458.
- .1 Seat for WC unit above: elongated heavy-duty solid plastic toilet seat, less cover, with stainless steel check hinge and stainless steel posts, washers, and nuts. Bemis 1955-C, Centoco #500STSCC, Kohler Lustra K-4670-C, or Olsonite 10CCSS.
 - .2 Supplies for WC unit above: chrome plated, heavy pattern angle lavatory supplies, lockshield, screw driver slot, stuffing box cartridge, 3/8 in. IPS brass inlet supply nipple, flexible riser tubes, and stainless steel wall flange. Delta Commercial 47T1316SD, or McGuire H166 LKN3.
- 2.2.4. Water closets shown as type "WC-2 - Floor mounted pressure-assist (Barrier free design)": "Low Consumption" tank toilet, floor mounted, vitreous china, elongated siphon jet flush action bowl, fully glazed 50 mm (2 in.) internal trapway, 250 mm x 300 mm (10 in. x 12 in.) large water surface, "Speed Connect" P.A. tank complete, 6 L (1.6 gal.) flush, with cast sanitary guard on bowl for china to china tank assembly, and bolt caps. Provide floor flange, flange bolts and gasket. American Standard Cadet Elongated 2333.100, Crane Economizer 3838, Eljer Aqua-Saver 091-7045, or Kohler Highline Pressure Lite K-3544.
- .1 Seat for WC unit above: elongated heavy-duty solid plastic toilet seat, open front with cover, with stainless steel check hinge and stainless steel posts, washers, and nuts. Bemis 1950SS, Centoco 820STS, Kohler Lustra K-4650-EB, or Olsonite 46SS.
 - .2 Supplies for WC unit above: chrome plated, heavy pattern angle lavatory supplies, lockshield, screw driver slot, stuffing box cartridge, 3/8 in. IPS brass inlet supply nipple, flexible riser tubes, and stainless steel wall flange. Delta Commercial 47T1316SD, McGuire H166 LKN3, or Zurn Z-8820-CR-LK-3.
- 2.2.5. Urinals shown as type "U-1 - Wall hung" shall be "Low Consumption", wall hung, vitreous china, wash out flush action 0.5 L (0.125 US gal.), flush, extended sides for privacy, integral flush spreader, 19 mm (¾ in.) top spud, wall hangers, open trap, removable stainless steel strainer, 50 mm (2 in.) outlet, and connecting flange with gasket and bolts. American Standard Washbrook FloWise 6590.001.020, Crane Cromwell 7398, Kohler Bardon K-4991-ER, Zurn Z5760-STR.
- .1 Exposed flush valve for urinal unit above shall be 0.5 L (0.125 US gal.), quiet action, exposed diaphragm flush, renewable seat, polished chrome plated finish, volume control, vandal resistant cover screw, metal "non hold open" handle, 1 in. FIP/copper sweat inlet adaptor angle check stop with protecting cap, adjustable 120 mm (4¾ in.) plus or minus 11 mm (7/16 in.) inlet/valve outlet centers, vacuum breaker, 38 mm (1½ in.) dia. cover tube and wall flange, spud flange, and concealed spud nut. Delta Commercial 81T201, Sloan 186-0.125, Zurn Z6003AV-WS1.

2.3. LAVATORIES

2.3.1. Lavatories shown as type "L-1 - Wall hung (Barrier free design & general use)," tight space areas shall be 533 mm x 445 mm x 133 mm - 175 mm (21 in. x 17½ in. x 5¼ in. - 6-7/8 in.) deep, wall hung, vitreous china, rear overflow, for concealed arm support. Unit shall be provided with faucet holes to suit the faucet below. American Standard Murro 095x.000, Crane Serena 129, or Zurn Z5324-PED. Provide semi pedestal American Standard Murro 0059.020, Crane Serena 132, Kohler Pinoir K-2035 to cover exposed piping.

- .1 Faucet for lavatory unit above shall be single hole mount solid cast brass faucet, polished chrome plated finish, ceramic valve with high temperature rotational limit stop, vandal resistant 3½ in. (90 mm) OBC compliant metal lever handle with color index, standard spout less pop-up, and standard 0.5 USGPM (1.9 L) flow control aerator. American Standard 2000.100X.002, Delta Commercial 534LF-LPU, Zurn Z82200-XL-CP4, Kohler July K-P97282-4/K-20003 escutcheon plate.

2.3.2. Lavatories shown as type "L-2 - Under counter mounted (Barrier free design & general use)" shall be 480 mm x 400 mm x 86 mm - 140 mm (19 in. x 15¾ in. x 3-3/8 in. - 5½ in.) deep, under counter mounted, vitreous china, rear overflow, with mounting kit. American Standard Ovalyn Universal Access 9482.000, Crane Tiara 1992, Eljer Baroness 051-3399, Kohler Caxton K-2211-G.

- .1 Single lever faucet for lavatory unit above shall be 100 mm (4 in.) single control center set faucet, polished chrome plated finish, ceramic valve with high temperature rotational limit stop, vandal resistant 90 mm (3½ in.) OBC compliant metal lever handle with color index, standard spout less pop-up, and standard 0.5 USGPM (1.9 L) flow control aerator. American Standard 2000.100x.002, Delta Commercial 534LF-LPU, Zurn Z-82200-XL-CP4, Kohler July K-P97282-4/K-20003 escutcheon plate.

2.3.3. Drain for all lavatory units with concealed under counter installation shall be 32 mm (1¼ in.) size, polished chrome plated inline open grid and cast brass lavatory waste strainer, 17 gauge straight tubular tailpiece. Delta Commercial 33T260, Kohler K-7129-A, McGuire 155A, Zurn Z8743-PC.

2.3.4. "P" trap for all lavatory units shall be polished chrome plated cast brass, adjustable body 32 mm (1¼ in.) size with cleanout plug, 17 gauge tubular wall bend. Safety covers are to be supplied as per local codes for exposed under counter installation. Delta Commercial 33T311, McGuire 8872C, Zurn Z8700-D-PC, Kohler K-8998.

2.3.5. Supplies for all lavatory 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 47T2512SD, McGuire H165LKN3RB, Zurn ZH8820-LR-LK-PC-3.

2.4. GENERAL SINK UNITS

2.4.1. Sinks shown as "CS-1 - Two Compartment Stainless Steel Sink (General use)" shall be stainless steel three hole bar sink, 200 mm (8 in.) centers, 520 mm x 780 mm x 203 mm (20½ in. x 31 in. x 8 in.) deep, counter mounted, back ledge, grade 18-8 type 302 stainless steel, double compartment, mirror finished rim, satin finished bowl with spillway, self-rimming with crumb cup strainers, and sound deadening. Aristaline LBD6408-1, Kindred QDL2031-8, Kohler K-3369 with K-8813 sink strainer, Architectural Metal Industries 2009-B-I or Novanni 2007EI.

- .1 Faucets for sink unit above shall be 200 mm (8 in.) centre, single control, brass body deckmount faucet, polished chrome plated finish, stainless steel rotating ball mechanism or ceramic disk cartridge, brass spout and trim, 200 mm (8 in.) swing spout, and 2.1 USGPM (7.9 L) vandal resistant flow aerator and vandal resistant 150 mm (6

in.) handle. American Standard 2021.600.002, Delta Commercial 100LF-HDF, Kohler K-15171-F, Zurn Z82300-XL-CP8-2M.

2.4.2. "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.

2.4.3. 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 ZH8820-LR-LK-PC-3.

2.5. SHOWERS

2.5.1. Shower valves shown as "SH-1" shall be concealed in-wall, single lever pressure balancing control, polished chrome plated finish metal trim, integral stops and checks, 57 mm (2¼ in.) vandal resistant metal lever handle with shower unit only, brass adjustable spray shower head arm & flange, and flow of shower head not to exceed 1.75 USGPM (6.6 L). Moen – ARRIS CHROME M-CORE 2.

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. Provide cleanouts in accordance with the requirements of Section 22 05 76.00 – CLEANOUTS.

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

END OF SECTION

22 42 46.00 Fixture Carriers

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 03.00 - SHOP DRAWINGS.

1.3. WARRANTY

1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Fixtures carriers shall be J.R. Smith, Zurn, or Mifab, or Watts.

2.1.2. Carriers shall be furnished for all wall hung water closets, urinals, lavatories, service sinks and drinking fountains. Carriers shall be floor mounted and supported independently of the wall. Carriers shall be suitable for each particular fixture. Carrier feet shall not project beyond finished wall.

2.1.3. All fixture carriers with integral cast iron fittings shall be certified to CSA B70 "Cast iron soil pipe, fittings, and means of joining" as required by Authority Having Jurisdiction.

2.2. URINAL CARRIERS

2.2.1. Carriers for wall hung urinals shown as (FILL IN LIST OF TYPES HERE) shall be all coated with block base feet supports and plate type system with bottom bearing plates. J.R. Smith 637, Zurn Z-1222, Mifab M-32, Watts CA-321.

2.3. LAVATORY CARRIERS

2.3.1. Carriers for wall-hung lavatories shown as L-1 shall be all coated with rectangular steel uprights and welded block base feet support and plate. J.R. Smith 800-M31, Zurn Z1224, Mifab MC-3, Watts CA-421.

2.3.2. Carriers for barrier free wall-hung lavatories shown as L-2 shall be all coated with rectangular steel uprights, welded block base feet support and extended concealed arms with locking device and levelling screws. J.R. Smith 700-27-M31, Zurn Z1231-79, Mifab MC-42, Watts CA-411-W.

3. Execution

3.1. INSTALLATION

- 3.1.1. Rigidly secure all fixture carriers to the floor using approved anchor bolts and inserts.
- 3.1.2. Verify the finished wall location and type of wall construction and elevation of finished floor before installation of carriers.

END OF SECTION

22 47 13.00 Drinking Fountains and Bottle Fillers

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 03.00 - SHOP DRAWINGS.

2. Products

2.1. MATERIALS

2.1.1. Type "DF-1" Drinking Fountains: Wall hung fountain with stainless steel top, light grey vinyl covered steel enclosure, safety bubbler with front and side pushbar activation, laminar flow bottle filler with sensor activation, filter with visual filter status indicator. ADA compliant and NSF/ANSI/CAN 61 "Drinking Water System Components - Health Effects" & 372 "Drinking Water System Components - Lead Content" certified. Elkay LZSDWSLK.

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.

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 AABC or NEBB.

1.3. WARRANTY

1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. NOT USED

3. Execution

3.1. GENERAL

3.1.1. Arrange for walk-through of site during project construction phase, prior to commencement of balancing, to confirm that all valves and appurtenances to fully balance and test the systems are available and accessible. Review Mechanical Contractor's proposed access door locations and sizes per Section 20 05 63.00 – ACCESS DOORS AND ACCESSIBILITY indicated on Shop Drawing and ensure that sufficient access is available.

3.1.2. A sample of a Test Verification Sheet is provided at the end of the section. Fill out this sheet or a similar one with all pertinent information for all tests called for in the Specification or required by code. Have the sheets signed by the Contractor and the Balancing Company to verify that the data recorded is correct.

3.1.3. Carry out leakage tests on sections of the Work and identify them by reference number on the test sheet and by description of the piping system. Indicate the reference identification number on the as-built drawings.

3.1.4. Test and balance the following systems:

.1 Plumbing systems

3.1.5. Provide a schedule for all testing and balancing.

3.1.6. Test all plumbing systems in accordance with all applicable plumbing codes and the requirements of the authority having jurisdiction.

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

- 3.1.8. After completion of the testing, rough balance the water systems and ensure all coils, convertors, etc., are operating to approximately design conditions to ensure freezing conditions will not occur anywhere. Adjust the circuits by means of balancing valves.
- 3.1.9. Confirm that appropriate balancing valves have been installed on all domestic hot water recirculation branch lines.
- 3.1.10. Obtain balance on water lines by inserting thermometers in thermometer wells provided for this purpose or between pipe and insulation at each balancing valve and adjusting flow until all thermometers read the same appropriate system temperature.
- 3.1.11. Co-ordinate with the balancing company to ensure all necessary valves for balancing the system are installed.
- 3.1.12. Ensure access is provided to all valves and equipment that requires servicing.
- 3.1.13. Be responsible for all equipment operating to design conditions and trim impellers, etc., to provide the required conditions.
- 3.1.14. Correct any deficiencies in the mechanical systems which prevent balancing the system.
- 3.1.15. Do not commence insulation installation until testing report is submitted to Engineer's Representative and is reviewed by Engineer's Representative without requesting a resubmit.
- 3.1.16. If the design conditions cannot be met by adjusting the balancing valves throughout the system, then change or trim pump impellers as required.
- 3.1.17. Have Balancing Company witness all system tests and sign all test reports. Include one copy of all test reports in each copy of the balancing reports.
- 3.1.18. Co-ordinate to ensure that all necessary valves for control and balancing are installed in all locations required.
- 3.1.19. Be responsible for balancing the systems to obtain the design conditions, and repeat the balancing until the required conditions have been met.
- 3.1.20. 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 will be selected by the Engineer's Representative and be approximately 10 % of the report data.
- 3.1.21. A measured deviation of more than 10 % between the verification reading and the reported data shall be considered as failing the verification procedure.
- 3.1.22. A failure of more than 10 % of the selected verification readings shall result in rejection of the report as unacceptable.
- 3.1.23. In the event the report is rejected, rebalance all systems, submit new certified reports and make a re-inspection.
- 3.1.24. Following final acceptance of the certified reports by the Engineer's Representative, permanently mark the settings of all valves and other adjustable devices so that balance set position can be restored if disturbed at any time. For circuit balancing valves, record the valve position by the number of turns registered on the valve and lock the valve into that position. Do not mark such devices until after final acceptance.
- 3.1.25. Submit report showing the balanced temperatures at all systems.
- 3.1.26. Provide a digital copy of the final testing and balancing reports for review by the Engineer's Representative. Include copies of the final testing and balancing reports in the O&M Manuals. Ensure reports are complete with index pages and index tabs, and are certified by the Balancing Company. Prepare all diagrams as single line representation of a Mechanical system specifically prepared for this Project using a CAD system acceptable to Engineer's Representative.

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.
 - 1.2. QUALITY ASSURANCE
 - 1.2.1. The balancing under Section 23 05 93.13 - TESTING AND BALANCING PIPING SYSTEMS and this Section shall be performed by the same balancing company.
 - 1.2.2. Balancing companies shall be members of AABC or NEBB.
 - 1.3. WARRANTY
 - 1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.
2. Products
 - 2.1. NOT USED
3. Execution
 - 3.1. GENERAL
 - 3.1.1. Arrange for walk-through of site during project construction phase, prior to commencement of balancing, to confirm that all dampers and balancing devices to fully balance and test the systems are available and accessible. Review Mechanical Contractor's proposed access door locations and sizes per Section 20 05 63.00 – ACCESS DOORS AND ACCESSIBILITY indicated on Shop Drawing and ensure that sufficient access is available.
 - 3.1.2. A sample of a Test Verification Sheet is provided at the end of the Section. Fill out this sheet or a similar one with all pertinent information for all tests called for in the Specification or required by code. Have the sheets signed by the Contractor and the Balancing Company to verify that the data recorded is correct.
 - 3.1.3. Carry out leakage tests on Sections of the Work and identify these Sections by reference number on the test sheet and by description of the duct system. Indicate the reference identification number on the as-built drawings.
 - 3.1.4. Test and balance the following systems:
 - .1 Air conditioning, ventilation and heating systems
 - .2 Miscellaneous ventilation or exhaust systems
 - .3 Air distribution (supply, return and exhaust)
 - 3.1.5. Provide a schedule for all testing and balancing.
 - 3.1.6. Duct Pressure Tests
 - .1 Perform pressure tests before ductwork is concealed or insulated.

- .2 Follow SMACNA HVAC Air Duct Leakage Test Manual procedures.
- .3 Provide blower and all test equipment.
- .4 Test the percentage of ductwork indicated in the table below. If a test specimen fails to meet the specified air leakage criteria, modify fabrication methods to bring it into compliance and retest until acceptable duct air leakage is demonstrated. If pressure test fails any sample twice, increase percentage of ductwork tested as indicated in the rightmost column of the table below.
- .5 Include as a minimum, 5 transverse joints, typical seams, an access door, 2 branch connections and 1 elbow in test samples.
- .6 Ensure leakage amount does not exceed the allotted amount in the table below for the duct construction pressure class in question.
- .7 Seal any leaks causing noise.
- .8 Leakage Class:

Duct Construction Pressure Class	Rectangular Leakage Class	Round Leakage Class	Amount of Ductwork to be Tested	Percentage of Ductwork to be Tested if Test Fails any Sample Twice
10 in. w.g.	4	2	100 %	N/A
6 in. w.g.	4	2	100 %	N/A
4 in. w.g.	4	2	25 %	50 %
3 in. w.g.	8	4	25 %	50 %
1/2, 1, and 2 in. w.g.	16	8	10 %	20 %

- .9 Submit testing report, including leakage calculations, as a submittal complying with the requirements of Section 20 05 03.00 – SHOP DRAWINGS.
- 3.1.7. Do not commence insulation installation until testing report is submitted to Engineer's Representative and is reviewed by Engineer's Representative without requesting a resubmit.
 - 3.1.8. Refer to Section 23 31 13.00 - DUCTWORK AND SPECIALTIES for pressure ratings of ductwork and systems.
 - 3.1.9. Test HEPA filter housings by pressure decay (ANSI/ASME N510) and ensure leakage does not exceed 0.2 % duct volume/minute at 2500 Pa (10 in. W.G.).
 - 3.1.10. Test the entire system for noise, tightness of joints and proper functioning of the system. Make noise tests under minimum system pressure drop conditions (highest air velocities and clean filter conditions). Make all necessary alterations and repeat the tests until satisfactory operation is achieved.
 - 3.1.11. Adjust minimum outside air controller and adjust return air and exhaust air damper linkages to approximately design air quantities, for both maximum and minimum conditions where required, to ensure freezing conditions will not occur.
 - 3.1.12. Ensure all necessary manual dampers for balancing the systems are installed.
 - 3.1.13. Itemize the testing equipment in the test reports. Ensure calibration of the test equipment is current before any tests are undertaken and document calibration dates in test reports.
 - 3.1.14. Be responsible for all equipment operating to design conditions and change fan sheaves, etc., to provide the required conditions.
 - 3.1.15. Ensure that all necessary manual dampers for balancing are installed in all locations required.

- 3.1.16. Balance the entire air systems including air volumes and control settings under maximum system pressure drop conditions (filter at replacement condition).
- 3.1.17. Measure, make final adjustments and report upon: the air volume at each variable volume box, diffuser, register and grille; the air quantity handled by each fan; the static pressure upstream and downstream of the fan; the fan speed; and the motor current.
- 3.1.18. Report upon the air flow at outside, return and exhaust air dampers under conditions of minimum outside air, for maximum and minimum volumes and maximum outside air, exhaust air and return air.
- 3.1.19. Only take coil working conditions in conjunction with the fluid flow working conditions for the coil.
- 3.1.20. Ensure air volumes measured are 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 Take duct traverse readings through the access ports provided. Where no access ports have been provided, make new holes as required. Reseal these holes after final readings with sheet metal cover plates and sealant. Duct tape is not acceptable.
 - .2 Where insulation is damaged, repair it including the vapour barrier in an approved manner. Duct tape is not acceptable.
- 3.1.21. In all cases where measurements show failure to comply with the Drawings and Specifications, change fan sheaves, etc., as required, and make new balancing measurements.
- 3.1.22. Ensure all thermostats and controls are set to give specified conditions and include settings in report.
- 3.1.23. Witness all system tests and sign all test reports. Include one copy of all test reports in each copy of the balancing reports.
- 3.1.24. Set up fans on all systems to give the minimum discharge pressure required to overcome the resistance of the box, discharge ductwork and diffusers.
- 3.1.25. Be responsible for balancing the systems to obtain the design conditions and repeat the balancing until the required conditions have been met.
- 3.1.26. At the time of final inspection, recheck in the presence of the Engineer's Representative random selections of air quantities and fan 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.
- 3.1.27. At the time of verification, measure space temperature and humidity in a representative number of rooms to verify performance. Tabulate these results and bind into certified report as an appendix.
 - .1 A measured flow deviation of more than 10 % between the verification reading and the reported data shall be considered as failing the verification procedure.
 - .2 A failure of more than 10 % of the selected verification readings shall result in rejection of the report as unacceptable.
 - .3 In the event the report is rejected, rebalance all systems, submit new certified reports and make a reinspection, all at no additional cost to the Owner.
- 3.1.28. Following final acceptance of the certified reports by the Engineer's Representative, permanently mark the settings of all valves, dampers, and other adjustable devices so that balance set position can be restored if disturbed at any time. Do not mark such devices until after final acceptance.

- 3.1.29. Provide a digital copy of the final testing and balancing reports for review by the Engineer's Representative. Include 3 copies of the final testing and balancing reports in the O&M Manual. Ensure reports are complete with index pages and index tabs. Prepare any diagram as single line representation of a Mechanical System specifically prepared for this Project using a CAD system acceptable to the Engineer's Representative.
- .1 Submit a sample to the Engineer's Representative for review.

END OF SECTION

23 11 23.00 Natural Gas Piping 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. Conform to Section 23 35 16.00 - ELECTRIC POWER GENERATOR.

1.2. REFERENCE

1.2.1. CSA B149.1 - Natural gas and propane installation code, latest edition.

1.3. WARRANTY

1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Pipe and fittings for 860 kPa (125 psi) and lower, fully welded as accepted by Authority Having Jurisdiction:

- .1 Schedule 40 steel, ASTM A106 or ASTM A53 up to 250 mm (NPS 10)
- .2 Standard weight steel, ASTM A106 or ASTM A53 larger than 250 mm (NPS 10)
- .3 Steel fittings, ANSI/ASME B16.3, Welded
- .4 Malleable Iron fittings, threaded, up to 50 mm (2 in.) diameter for connections close to equipment and dirt pockets
- .5 Factory-applied, three-layer coating of epoxy, adhesive, and PE protective coating for underground steel pipe.
 - .1 Epoxy paint, adhesive, and heat-shrink PE sleeves joint cover kits.

2.1.2. Manual valves for 860 kPa (125 psi) and lower, as accepted by the Authority Having Jurisdiction:

- .1 Ball or plug type
- .2 CSA/CGA B3.16
- .3 Supervisory switch (where specified or shown)

2.1.3. Roof penetrations:

- .1 Thaler MEF-9-18 gas pipe flashing with perforated neck, removable cap, EPDM grommet seal.

3. Execution

3.1. INSTALLATION

3.1.1. Connect to the metering station and provide all downstream pipe and appurtenances.

- 3.1.2. All piping up to and including the meter and incoming service pressure reducing station is by the natural gas service provider or their agent.
- 3.1.3. Provide pressure reducing valves and overprotection devices where shown or as required for conformance with CSA B149.1 for equipment supplied under this Contract.
- 3.1.4. Pipe relief from pressure reducing valves to outdoors. Vent-less pressure reducing valves may be used where permitted by the Authority Having Jurisdiction.
- 3.1.5. Weld all distribution piping within the building, and utilize screwed and/or flanged fittings at equipment only.
- 3.1.6. Paint natural gas piping in its entirety an approved colour in accordance with CSA B149.1. Banding is not permitted.
- 3.1.7. Provide thermal expansion control for gas piping on the roof as required by CSA B149.1.
- 3.1.8. Install underground, PE, natural-gas piping according to ASTM D2774.

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.

1.2. WARRANTY

1.2.1. Provide a warranty in accordance with the requirements of 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.

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. Access Ports shall be Lawson-Taylor or other approved manufacture of 32 mm (1-1/4 in.) dia. ports.

2.1.5. 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.
- .3 For fans in excess of 0.5 kPa (2 in. wg.) connections shall be minimum 1,080 gm/sq.m. (32 oz./sq.yd.) non-toxic neoprene coated fibreglass fabric equal to Neoprene N.T.
- .4 For all flexible connections located outside the building (e.g. roof top units) flexible connections shall be fire retardant Hypalon coated fibreglass fabric and shall be a minimum 9915 gm/sq.m. (27 oz./sq.yd.) equal to Hypalon.
- .5 For all systems where the temperature may exceed 112 deg. C. (235 deg. F.) silicone rubber coated fibreglass shall be used, and shall be equal to Silicone H1-T. Submit flexible connections for review before installation.

2.1.6. Dampers:

- .1 Dampers: For right angle branch duct take-off from vertical riser; Air vector Vectrol or other approved manufacturer.
- .2 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.

- .3 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.
- .4 Counterbalanced backdraft dampers shall be multi-blade louvre type, constructed of extruded aluminum in extruded aluminum frames with adjustable coated counterbalance weights. Blades shall be joined with a tie bar and have rust-proof shafts rotating in synthetic bearings.

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.
- .3 Provide single thickness turning vanes built to and supported at intervals dictated by SMACNA HVAC Duct Construction Standards Metal and Flexible. Provide rails securely set in the elbow so that they cannot loosen.

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 in accordance with SMACNA Standard "HVAC Duct Construction Standards Metal and Flexible."
- 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. Low pressure ductwork 0.5 kPa (2 in. wg) static pressure and less as follows:
- .1 Rectangular/round duct location:
 - .1 Ductwork serving fans with an external static pressure of 0.5 kPa (2 in. wg) or less.
 - .2 Downstream of terminal heating and cooling devices.
 - .2 Seal ducts to Seal Class C in accordance with SMACNA "HVAC Duct Construction Standards Metal and Flexible" and "HVAC Air Duct Leakage Test Manual."
 - .3 SMACNA leakage class:
 - .1 Rectangular ductwork: 16
 - .2 Round ductwork: 8
 - .4 Refer to tables for low pressure rectangular duct construction and round duct construction below for further duct construction requirements.
- 3.1.8. Comply with the tables below in conjunction with the clauses above.

TABLE 1: LOW PRESSURE RECTANGULAR 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
<ul style="list-style-type: none">.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.		

TABLE 4: ROUND DUCT CONSTRUCTION

1. Round ducts up to 750 mm (30 in.) diameter factory fabricated, helically wound galvanized iron strips with spiral lock seam.			
DIAMETER	STRIP METAL US GAUGE	STRIP JOINT	GIRTH JOINT
Up to 200 mm (8 in.)	26	100 mm (4 in.)	50 mm (2 in.) long slip
225 mm to 550 mm (9 in. to 22 in.)	24	100 mm (4 in.)	50 mm (2 in.) long slip

Join with galvanized iron coupling sleeves or conduit fittings of welded construction.

- 3.1.9. 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.
- 3.1.10. Flexible ductwork may be used under the following conditions:
- .1 Where shown on Drawings to allow easy location of diffusers.
 - .2 Except where indicated otherwise in clauses below, minimum length of flexible duct used to connect diffusers and interior troffers: 2,400 mm (84 in.).
 - .3 Except where indicated otherwise in clauses below, maximum length of flexible duct: 3,000 mm (120 in.).
 - .4 Do not pass flexible ductwork through floors or fire walls.
 - .5 Install flexible ductwork as 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. Secure flexible duct to the rigid section using ties and sealant.
 - .6 Support flexible duct lengths greater than 2,400 mm (84 in.) at the midpoint with strap hangers.
- 3.1.11. 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.
- 3.1.12. 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.
- 3.1.13. 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.
- 3.1.14. 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.
- 3.1.15. 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.
- 3.1.16. Provide access ports at convenient locations in all main ducts and main branch take-offs with airtight covers and extension sleeves through insulation to allow air meter readings. Access ports shall be approved by the Engineer's Representative and the testing company before installation.

- 3.1.17. 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 turbulence).
- 3.1.18. 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.
- 3.1.19. Provide splitter dampers as shown on Standard Details.
- 3.1.20. Incorporate counterbalanced backdraft dampers where shown. Adjust counterweights to the minimum pressure required to relieve the system pressure. Incorporate gravity backdraft dampers where shown.
- 3.1.21. Provide access panels at all fire dampers, gravity dampers, motorized dampers, coils, heaters, humidifiers, fan bearings or similar equipment requiring occasional maintenance or inspection. Panels shall be 600 mm x 450 mm (24 in. x 18 in.) or full width of duct if less than 450 mm (18 in.) wide. Panels shall be of double wall construction and shall be internally insulated on insulated ducts. Frame shall be of structural angle with welded corners, gasketed to receive the panel. Panel shall be held in place with 4 window sash locks.
- 3.1.22. Paint visible internal surface behind each grille or register flat black.
- 3.1.23. Where duct is acoustically lined, duct dimensions shown are net, inside of lining, free area dimensions.
- 3.1.24. Provide internal acoustic duct lining in accordance with Section 20 05 48.00 – VIBRATION AND NOISE CONTROL.
- 3.1.25. Spin-in connections shall only be used downstream of variable volume boxes.
- 3.1.26. Ductwork shall be run parallel to the closest wall. Coordinate with piping and structural elements.
- 3.1.27. All exposed open ends of ductwork located less than 2000 mm (79 in) above the finished floor that do not have a diffuser, grille or register shall have a protective screen mounted in a suitable frame to connect the screen securely to the duct, wall and floor as applicable. The screen shall be installed and painted matte black and shall not be capable of passage of anything larger than a 15 mm (1/2 in.) sphere through the openings.
- 3.1.28. Supply air ductwork to variable volume boxes shall be rigid duct of size shown in schedules. If the length exceeds 3000 mm (10 ft.) or if there are 2-45 deg. elbows or 1-90 deg. elbow or more increase the supply air ductwork to the variable volume box one size. If the length exceeds 6000 mm (20 ft.) increase the duct by two sizes. Under no conditions shall the supply ductwork exceed 9000 mm (30 ft.) or have more than 3-90 deg. elbows or the equivalent. Transition to variable volume box inlet sizes a minimum of 4 duct diameters upstream of the terminal unit.
- 3.1.29. Where acceptable to Engineer's Representative, and where fans shut down upon detection of fire, static fire dampers may be used in lieu of dynamic fire dampers.

END OF SECTION

23 34 53.00 Room Ventilators

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:

- .1 Submit Shop Drawings of all room ventilators with catalogued components to be supplied. Include manufacturer's data sheets for, performance criteria, ratings, and physical dimensions and finishes.

1.3. WARRANTY

1.3.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Room ventilators shall be Penn Zephyr, Greenheck, Loren Cook Gemini, Soler & Palau or Twin City.

2.1.2. Centrifugal fans shall be mounted in a galvanized steel, acoustically insulated housing and shall be internally isolated. Fans shall be AMCA certified for both air and sound, UL labelled and CSA approved.

2.1.3. Arrange casing for in-line installation with access to both fan and motor through the casing.

2.1.4. Inlet and discharge shall be flanged for duct connections.

2.1.5. Discharge shall be complete with spring loaded backdraft damper.

2.1.6. Fans shall be hung on vibration isolating hangers.

2.1.7. Motors shall be prewired to terminal box located on the unit housing.

2.1.8. All discharge ductwork shall have 25 mm (1 in.) thick acoustic lining.

2.1.9. Model and make as follows:

EF-1.1: Greenheck SP-A200-QD, ceiling exhaust fan. 150 CFM airflow, 0.5 in.wg. external static pressure, 120V/1P/60Hz, 26.1. Controlled by occupancy sensor.

3. Execution

3.1. INSTALLATION

3.1.1. Install room ventilators where shown.

3.1.2. All ventilators on vibration isolation hangers shall have flexible connections on outlet.

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. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Continuous air slot in ceiling - under Division 9 - Finishes.

1.2.2. Door grilles - under Architectural Division - Grilles.

1.3. SUBMITTALS

1.3.1. 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.

1.3.2. Manufacturer's Data: Submit test results of type " "diffuser models to be used on the Project, including air pattern and noise levels for air quantities from 10 % to 110 % of the required maximum air flow.

1.4. WARRANTY

1.4.1. Provide a warranty in accordance with the requirements of Section 20 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Diffusers, registers and grilles shall be Price, Nailor, Krueger, or Titus 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 ASHRAE 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.

2.3. RETURN, EXHAUST AND TRANSFER GRILLES

- 2.3.1. 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.
- 2.3.2. Return registers shown as type "K" shall be standard return grilles with horizontal fixed bars set at approximately 45 deg. for wall returns and set straight for ceiling return. Key operated damper shall be mounted behind. E.H. Price 530, Nailor 6100 Series, Krueger S80.
- 2.3.3. Door transfer grilles unless otherwise specified shall have finely spaced blades for an attractive sight proof appearance and are designed for applications in doors or partitions with Sections as thin as 35 mm (1-3/8") with flat border and countersunk holes. E.H. Price type ATG1, Nailor 51DGD, Krueger 600.

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 through a ceiling or partition.
- 3.1.3. 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.
- 3.1.4. Install mounting frame tied into plaster and gypsum board ceilings to allow lay in type diffusers to rest on the frame.
- 3.1.5. Diffusers for installation in lay-in ceiling shall lay on inverted T-bars.
- 3.1.6. Caulk around edges of linear diffusers in installations with imperfect walls.

END OF SECTION