Galang Consulting Services

www.GCSEngineering.ca

2275 Lake Shore
Boulevard West, Suite
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M5X 1Y1

MECHANICAL SPECIFICATIONS

FOR

HASTINGS AFFORDABLE HOUSING

TO

BRIAN LUEY ARCHITECTS

DATED

2024 07 15

ISSUED FOR TENDER

Contact Person: **Ian Simpson**
Phone:
Email: **Ian.Simpson@GCSEngineering.ca**

GCS Project No. 23006

PART 1 - GENERAL

1.01 GENERAL

.1 Submit Shop Drawings, Product Data and Samples as specified herein.

.2 Designate in the Construction Schedule, or in a separate coordination schedule, dates for submission and dates that reviewed Shop Drawings, Product Data and Sample will be required. Give due consideration for review time required by the Consultant, with a minimum of fifteen (15) working days required. The submission of Appendix 'B' will be considered an acceptable submittal schedule.

.3 All shop drawings will be submitted directly to our office, at TBA; with a copy of the transmittal sent to the Architect. All shop drawings will be returned through the Architect's office. In order to expedite the process, GCS requests that all shop drawings be submitted electronically in pdf format. Upon GCS's review stamped shop drawings will be returned electronically in pdf format.

.4 Prepare a schedule of shop drawings, not later than four weeks after the award of the Contract, indicating drawing submission and equipment delivery dates. Refer to specification and to the attached Shop Drawing Submittal Schedule for equipment requiring shop drawing submission.

.5 All data and dimensions on shop drawings, product data and sample information to be based on units (Imperial or Metric) as shown on the contract documents.

.6 Shop Drawings with errors or omissions and deviations will be returned "Not Reviewed".

.7 The Contractor's responsibility for deviations in submission from the requirements of Contract Documents is not relieved by the Consultant's review of submittals, unless a deviation on the submittal is noted as such in writing and has been accepted by the Consultant.

.8 Keep one (1) reviewed copy of each submission on site.

.9 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data sheets (MSDS) in accordance with Division 01.

1.02 SHOP DRAWINGS

.1 Review and stamp Shop Drawings, Product Data and Samples prior to submission to the Consultant. Confirm that necessary requirements have been determined and verified and that each submittal has been checked and coordinated with requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project, will be returned without being examined and shall be re-submitted when completed.

.2 Shop Drawings being submitted where the size, capacity or voltage are different from the specified piece of equipment, the specified data and alternate data must be highlighted (e.g. spec. pump P-4 20 HP, 1500 GPM, 575V, the alternate is 15 HP, 1470 GPM, 575V, 3PH) on the front cover sheet.

.3 Submit drawings in a clear and thorough manner:

.1 Identify details by reference to drawing No. and detail, schedule or room numbers as shown on Contract Documents.
.2 Include manufacturer installation instructions and details.
.3 Minimum sheet size and larger sheets to be multiples of 8½" x 11".

.4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated. Indicate cross references to design drawings and specification.

.5 Adjustments to shop drawings by the Consultant do not change the cost of the work. If adjustments affect the cost of Work, advise through normal channels in writing prior to proceeding with the Work.

.6 Make changes in shop drawings as directed by the Consultant. Resubmit and note any revisions other than those requested.

.7 If only minor adjustments are made, shop drawings to be returned and fabrication and installation of work to proceed.

.4 Determine and verify:

.1 Field measurements.
.2 Field construction criteria.
.3 Catalogue numbers and similar data.
.4 Conformance with Specifications.

.5 Co-ordinate each submittal with requirements of the Contract documents.

.6 Each Shop Drawing will be stamped by the Consultant in the following format:

☐ NOT REVIEWED	☐ REVIEWED
☐ RESUBMIT	☐ REVIEWED AS MODIFIED
☐ NOT SPECIFIED BY GCS, REVIEWED FOR MEP ONLY	

.7 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with this Subcontractor submitting same, and such review shall not relieve this Subcontractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the contract documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication.

.8 Products not specified by GCS are reviewed to confirm compliance with services provided only. Any changes required between provided services and shop drawing requirements will be identified for coordination between trades.

.9 Shop drawings shall be accompanied by a complete copy of the attached “Shop Drawing Submittal Sheet” Section 25 05 01, Appendix ‘A’.

.10 “Resubmit” Shop Drawings or Shop Drawings requiring additional information will have to be forwarded or returned to our office, at TBA in a timely fashion to allow time for review again, along with revised scheduling or delivery date changes as a result of having to provide additional information or resubmission.

.11 Shop drawings must bear the stamp and signature of the submitting sub-contractor as well as the general contractor to indicate that the shop drawings or catalogue cuts are in conformance with all requirements of the drawings, that they have coordinated this equipment with other equipment which is related and/or connected and that they have verified all dimensions to ensure the proper installation of equipment including recommended service space and without interference with the work of other trades. Ensure that mechanical and electrical co-ordination is complete before submitting drawings for review. Incomplete or improperly submitted shop drawings will be returned as “Resubmit”.

.12 Begin no fabrication or work which requires submittals until return of submittals reviewed by Consultant.

.13 Quality assurance Submittals:

.1 Make all submittals in accordance with Section 20 05 05.
.2 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.14 Submit manufacturer installation instructions.

.15 All submittals MUST be submitted using the same units (IP/SI) as shown on equipment schedules and drawings.

1.03 PRODUCT DATA

.1 Where specified, Manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data is acceptable provided there is conformance with the following:

.1 Clearly identify pertinent products or models.
.2 Show performance characteristics and capacities.
.3 Show dimensions and clearances required.
.4 Show wiring or piping diagrams and controls.

.2 Manufacturer's standard schematic drawings and diagrams may require modifications to drawings and diagrams to provide information applicable to the Work.

.3 Provide information specifically applicable to the Work.

1.04 SAMPLES

.1 Samples to be labelled, of sufficient size and quantity to clearly illustrate:

.1 Functional characteristics integrally related parts and attachment devices.
.2 Full range of colour, texture and pattern.

.2 Field Samples and mock-ups:

.1 Erect, at the project site and in location acceptable to the Consultant.
.2 Fabricate each sample and mock-up complete and finished.
.3 Remove mock-ups at conclusion of Work or as specified by the Consultant.

1.05 CLOSE OUT SUBMITTALS

.1 Make all submittals in accordance with Section 20 05 05.

1.06 CO-ORDINATION/INSTALLATION DRAWINGS:

.1 Follow the requirements of section 20 05 05.

1.07 SUBMISSION REQUIREMENTS

.1 Submit promptly to approved schedule and in sequence to prevent submission delay in the Work.

.2 Submission requirements:

.1 Shop Drawings: Acceptable submissions are: Submit shop drawings electronically as agreed to during the kickoff meeting with the Consultant.
.2 Product Data: Submit a copy for each O & M Manual.
.3 Samples: Submit as specified, or as requested during the shop drawing review period.

1.08 RESUBMISSION REQUIREMENTS

.1 Make corrections or changes to the submittals noted by the Consultant and resubmit.

.2 Shop Drawings and Product Data:

.1 Revise drawings or data, and resubmit as noted on the initial submittal.
.2 Indicate any changes which have been made other than those noted by the Consultant.

.3 Samples: Submit new samples as required for initial submittal as soon as possible after notification of the rejection of the original submission and mark “resubmitted samples”.

1.09 DISTRIBUTION

.1 Distribute reproductions of Shop Drawings and copies of Product Data which carry the Consultant’s stamp to all parties as specified by Division One General Requirements.

.1 Job site file
.2 Project record document file
.3 Other affected contractors
.4 Subcontractors
.5 Supplier or fabricator (as applicable)
.6 Operations Manual

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 20 05 01

SHOP DRAWING SUBMITTAL SHEET

Project: _____ Date: _____

Project No. _____ Submittal No. _____

Section: _____

Equipment Description _____

_____

_____

Contractor: _____

Sub-Contractor: _____

Suppliers Name: _____

Manufacturer: _____

Catalogue No.: _____

Variations From

Tender Documents _____

_____

_____

_____

Engineer: Galang Consulting Services
2275 Lake Shore Boulevard West,
Suite 315
Toronto, Ontario
M5X 1Y1

MECHANICAL GENERAL REQUIREMENTS SECTION 20 05 01 – APPENDIX 'B' PROJECT: Insert project name GCS Project No. xxxxx	**SHOP DRAWING SUBMITTAL SCHEDULE** DIVISION 20, 21 22, 23 & 25								Date:
SECTION	DESCRIPTION	MANUFACTURER	SHOP DRAWING				DELIVERY		COMMENTS
			SUBMITTED		RETURNED				
			SCHED	ACTUAL	SCHED	ACTUAL	SCHED	ACTUAL	
20 05 10	Valves Expansion Tanks Expansion Compensators Strainers Thermometers and Gauges Fire Stopping Products Air separators Specialties Access doors								
20 05 20	Bases, Isolators, Silencers								
20 05 25	Insulation								
20 05 30	Variable Frequency Drives								
20 05 35	Motor Starters								
20 05 70	Water Treatment Equipment								
20 05 75	Fire Resistive Insulation								
21 05 05 21 12 01	Sprinkler Design Layouts Hose Cabinets Fire Department Connections								
21 13 00	Valves Sprinkler Heads Dry Valves Pressure and Flow Switches Pressure Gauges Compressor								
21 23 00	Extinguishers								
21 30 00	Fire Pumps								
22 10 10	Domestic Water Booster Pumps Domestic HW Recirc Pumps Sump Pumps								
22 30 05	Domestic Hot Water Heaters DHW Storage Tanks								
22 42 01	Drains and Specialties Water Hammer Arrestors Backflow Preventers								

MECHANICAL GENERAL REQUIREMENTS SECTION 20 05 01 – APPENDIX 'B' PROJECT: Insert project name GCS Project No. xxxxx		**SHOP DRAWING SUBMITTAL SCHEDULE** DIVISION 20, 21 22, 23 & 25							Date:
SECTION	DESCRIPTION	MANUFACTURER	SHOP DRAWING SUBMITTED SCHED	SHOP DRAWING SUBMITTED ACTUAL	SHOP DRAWING RETURNED SCHED	SHOP DRAWING RETURNED ACTUAL	DELIVERY SCHED	DELIVERY ACTUAL	COMMENTS
	Backwater Valves Hose Bibs Water Meters Trap Seal Primers Mixing Valves Rainwater Harvesting System								
23 21 23	Pumps								
23 23 00	Refrigeration Piping								
23 33 10	Dampers								
23 34 00	HVAC Fans								
23 35 16	Engine Exhaust Systems								
23 37 20	Louvres, Intakes & Vents								
23 44 00	Filters								
23 51 00	Breeching Gas Vents and Stacks								
23 52 00	Heating Boilers								
23 55 01	Duct Heaters								
23 57 00	Heat Exchangers								
23 65 10	Condensers, Coolers & Cooling Towers								
23 72 00	ERVs								
23 73 10	Air Handling								
23 74 10	HVAC Split Systems								
23 81 40	Air & Water Source Unitary Heat Pumps								
23 82 36	Finned Tubed Heaters Baseboard Heaters Cabinet Heaters								
23 82 39	Unit Heaters								

MECHANICAL GENERAL REQUIREMENTS SECTION 20 05 01 – APPENDIX 'B' PROJECT: Insert project name GCS Project No. xxxxx		**SHOP DRAWING SUBMITTAL SCHEDULE** DIVISION 20, 21 22, 23 & 25							Date:
SECTION	DESCRIPTION	MANUFACTURER	SHOP DRAWING SUBMITTED SCHED	SHOP DRAWING SUBMITTED ACTUAL	SHOP DRAWING RETURNED SCHED	SHOP DRAWING RETURNED ACTUAL	DELIVERY SCHED	DELIVERY ACTUAL	COMMENTS
25 01 01	Controls: Written Sequences of Operation and Control Schematic Drawings, Wiring Diagrams, Components Description, Thermostats, Control Components.								

PART 1 - G ENERAL

1.01 GENERAL REQUIREMENTS

.1 Comply with requirements of Division One, General Requirements and all documents referred to therein.

1.02 APPLICATION

.1 This Section applies to and is part of all Sections of Division 20, 21, 22, 23 and 25.

.2 Perform All Work specified herein by experienced and licensed personnel.

1.03 DEFINITIONS

.1 Wherever the term "The Consultant" is used in the Division 20, 21, 22, 23 and 25 Drawings and Specifications it means MCW Consultants Limited, Queen's Quay Terminal, 207 Queen's Quay West, Suite 615, Toronto Ontario, Canada M5J 1A7 (Phone 416-598-2920).

.2 Wherever the term "install" (and tenses of "install") is used in the Division 20, 21, 22, 23 and 25 Drawings and Specifications it means install and connect complete.

.3 Wherever the term "supply" is used in the Division 20, 21, 22, 23 and 25 Drawings and Specifications it means supply only for installation by other subtrades or under separate contract.

.4 Wherever the terms "Provide" or "Provision of" are used in relationship to equipment, piping, other materials and systems specified for the Work of Divisions 20, 21, 22, 23 and 25, it means "Supply, Install and Connect and make operable to specified performance". Wherever the terms "Provide" or "Provision of" are used in connection with services such as testing, balancing, start-up, preparation of Drawings and commissioning for any part of the Work of Divisions 20, 21, 22, 23 and 25, it means procure, prepare, supervise, take responsibility and pay for these services.

.5 Wherever "Drawings and Specifications" are referred to, it means "the Contract Documents".

.6 Wherever the terms "Authorities" or "Authorities having jurisdiction" are used in the Division 20, 21, 22, 23 and 25 Drawings and Specifications it means any and all agencies that enforce the applicable laws, ordinances, rules, regulations or codes of the Place of the Work. Refer to Division One.

.7 Wherever the term "Work" is used in the Divisions 20, 21, 22, 23 and 25 Drawings and Specifications it means all equipment, permits, materials, labour and Services to provide a complete Mechanical installation as described and detailed on the Drawings and in the Specifications.

.8 Wherever the term "Performance" is used in the Divisions 20, 21, 22, 23 and 25 Drawings and Specifications in relation to specified equipment, it means the specified capacity of that equipment as it applies to provide air, steam or water flow, heating and/or cooling within the specified conditions of operation including air, steam and water pressures, physical space limitations and noise levels.

.9 Wherever the term "Acceptable" is used in the Divisions 20, 21, 22, 23 and 25 Drawings and Specifications it means acceptable to the Consultant.

1.04 WORK INCLUDED

.1 Sections of Divisions 20, 21, 22, 23 and 25 are not intended to delegate functions nor to delegate Work and supply to any specific trade. The Work of Divisions 20, 21, 22, 23 and 25 includes all labour, materials, equipment, permits and tools required for a complete and working installation as described in the Divisions 20, 21, 22, 23 and 25 Specifications and Drawings and is not necessarily limited to items in the following Sections:

20 05 01	Shop Drawings, Product Data and Samples
20 05 05	Mechanical Work General Instructions
20 05 10	Basic Mechanical Materials and Methods
20 05 20	Mechanical Vibration Control
20 05 25	Mechanical Insulation
20 05 30	Variable Frequency Drives
20 05 35	Motor Starters – Low Voltage
20 05 70	Water Treatment
20 05 75	Fire Resistive Insulation

FIRE SUPPRESSION

21 05 05	Common Work Results for Fire Suppression
21 12 01	Standpipe & Hose Assembly
21 23 00	Fire Extinguishers
21 30 00	Fire Pumps

PLUMBING

22 05 00	Work Results for Plumbing
22 10 10	Plumbing Pumps
22 30 05	Domestic Water Heaters
22 42 01	Plumbing Specialties & Accessories
22 42 03	Plumbing Washroom Fixtures

HEATING, VENTILATION AND AIR CONDITIONING

23 05 00	Common Work Results for HVAC
23 05 33	Heat Tracing
23 23 00	Refrigerant Piping
23 31 13	Ductwork
23 33 00	Air Duct Accessories
23 33 10	Dampers
23 33 46	Flexible Ducts
23 33 53	Duct Liners
23 33 55	Acoustic Silencers
23 34 00	HVAC Fans
23 37 13	Diffusers, Registers & Grilles
23 37 20	Louvres, Intakes & Vents
23 44 00	HVAC Air Filtration
23 55 01	Electric Duct Heaters
23 73 10	Air Handling
23 74 10	HVAC Split Systems
23 81 40	Air & Water Source Unitary Heat Pumps
25 01 01	Building Automation System (BACNET)

1.05 REGULATORY REQUIREMENTS

.1 Comply with requirements of all Municipal, Provincial and Federal Bylaws and Ordinances as well as requirements of Utilities such as Ontario Gas Utilization Code

.2 Do not reduce quality of any part of the Work specified and/or shown on the Drawings by following regulatory requirements.

.3 In general and as applicable, perform all Work of Divisions 20, 21, 22, 23 and 25 to comply with physical and chemical properties, characteristics and performance requirements of recognized associations and agencies as listed herein and in the following:

ACCGH AMCA ADC ANSI ARI ASCII ASHRAE ASME ASTM AWWA CGA CGSB CIRI CSA
CTI EIA FCC FM ISA IAO MMC MTC NBCC NFPA OBC OFM MOEE OML OWRA TSSA UL ULC

1.06 STANDARDS

- American Conference of Governmental Industrial Hygienists
- Air Moving & Conditioning Association
- Air Diffusion Council
- American National Standards Institute
- Air Conditioning & Refrigeration Institute
- American Standard Communication Information Interchange
- American Society of Heating, Refrigeration and Air Conditioning Engineers
- American Society of Mechanical Engineers
- American Society for Testing and Materials
- American Water Works Association
- Canadian Gas Association
- Canadian General Standards Board
- Canadian Industrial Risk Insurers
- Canadian Standards Association
- Cooling Tower Institute
- Electronic Industry Association
- Fire Commissioner of Canada
- Factory Mutual
- Instrument Society of America
- Insurers Advisory Organization
- Marsh McLennan Insurance Protection Consultants
- Ministry of Transportation and Communication
- National Building Code of Canada
- National Fire Protection Association
- Provincial Ontario Building Code
- Local Fire Codes or Standards Ontario Fire Marshall
- Ontario Ministry of Environment And Energy
- Ministry of Labour and Workmen's Compensation Requirements
- Ontario Plumbing Code
- Technical Standards & Safety Authority
- Underwriter's Laboratories Inc.
- Underwriter's Laboratories of Canada

.1 Provide new materials and equipment of proven design and quality. Provide current models of specified equipment manufactured in Canada or the United States of America, unless specified otherwise with published ratings certified by recognized North American testing and standards agencies.

.2 Provide Canadian made materials and equipment to maximize Canadian content in the Work.

.3 Comply with ASHRAE/IES 90.1 Standards in the supply and installation of all parts of the Work.

.4 Comply with Regulations Amending the Energy Efficiency Regulations P.C. 2004-965, 1 September 2004 for the following equipment:

.1 Gas Fired Water Heater - To meet the requirements of CSA – P.3-04.
.2 Large Air Conditioner, Heat Pumps and Condensing Units - To meet the requirements of CAN/CSA –C746 (current edition).

.5 Conform to the best modern practices of workmanship and installation methods and employ only skilled tradesmen working under the direction of fully qualified personnel.

.6 Materials and products provided and used must be in accordance with Division 01 to suit sustainable requirements.

1.07 PERMITS, FEES & INSPECTIONS

.1 Apply for, obtain, and pay for all permits, licenses, inspections, examinations and fees required for Work of Division s 20, 21, 22, 23 and 25. Also submit, if required by the Authorities, information such as heat loss calculations, and other data that may be obtained from the Consultant. Should the Authorities require the information on specific forms, fill in these forms by transcribing thereto the information as provided by the Consultant.

.2 If the municipality is structured as a "single permit jurisdiction", the Contractor will apply, pay for and obtain the municipal building permit. In this case, the Division s 20, 21, 22, 23 and 25 Subcontractor has no financial obligation for permit application except for permits not covered in the "single permit".

.3 Arrange for inspection of all Work by the Authorities having jurisdiction over the Work. On completion of the Work, present to the Consultant the final unconditional certificate of acceptance of the inspecting Authorities.

.4 Arrange and pay for inspection of all Work by TSSA for Gas Piping Systems. On completion of the Work, present to the Consultant the final unconditional certificate of acceptance of the inspecting Authorities.

.5 In case of conflict, codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the Drawings and Specifications by applying any of the codes referred to herein.

.6 Before starting any work, submit the required number of copies of Drawings and Specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Consultant immediately of such changes. Prepare and submit any additional drawings, details or information as may be required.

1.08 CONTRACT DRAWINGS

.1 The Drawings for Mechanical Work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and pipe runs. The Drawings do not intend to show Architectural and Structural details.

.2 Do not scale Drawings. Obtain information involving accurate dimensions from dimensions shown on Architectural and Structural Drawings, and by site measurement.

.3 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (pipes or ducts around beams and columns and other structural elements).

.4 Alter, at no additional cost, the locations of materials and/or equipment as directed that do not necessitate additional material.

.5 Install ceiling mounted or exposed components (e.g. diffusers, sprinkler heads, grilles) in accordance with reflected ceiling drawings or floor plans.

.6 Confirm on the site the exact location and mounting elevation of outlets and fixtures as related to Architectural and Structural details.

1.09 EXAMINATION OF THE SITE AND DOCUMENTATION

.1 Prior to submitting tender, carefully examine conditions at the site that could affect the Work of this Division. Refer to and examine all Contract Documents.

.2 Verify that materials and equipment can be delivered to the Place of the Work and that sufficient space and access is available to permit installation thereof in locations shown on the Drawings.

.3 Verify location and elevation of existing services (water, electrical, sanitary, storm sewers, equipment, ductwork and piping) which may affect the Tender and Work of this Division. Repair any damage to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.

1.10 CO-ORDINATION DRAWINGS

.1 The Mechanical Trade Contractor shall take the lead role in preparation of electronic CAD interference/coordination model. Use all other disciplines electronic drawings as basis for preparation of interference/coordination model. Position all Mechanical Trade and Sub-trade services to accommodate the work of other Construction Trades.

.2 The tender documents including, the CAD files are not complete, nor fully coordinated. The model is not to be considered sufficiently detailed to build from.

.3 Continuously update the interference/coordination model to accurately reflect all instructions issued by the architect and consultants in whatever format these instructions are issued. Assume for Bid submission purposes, that an updated CAD file will not be issued with each instruction.

.4 Prior to commencement of work, submit for Consultant review the Mechanical Trade Contractor shall fully develop their own interference/coordination model using models from all other Construction Trades, and fully coordinate the installation prior to fabrication or installation of any services on site. All sub-trades whose work is affected by the information presented on each of these interference/coordination models shall sign-off on the drawings and thereby agrees to coordinate their parts of the work. Submit the completed interference/coordination model for review using the same procedures as specified for Shop Drawings.

.5 Coordinate equipment placement to ensure that all components will have adequate access for operation, service and maintenance prior to commencement of Work. Services shall be laid out in an organized manner, including running services in parallel or at right angles from one another where these are exposed. Adequate access points shall be provided to service, maintain and operate the equipment as required.

.6 Use the project's Architectural CAD model as the starting point for the creation of interference/coordination model. The contractor's drawings will show angles, braces, supports, and similar equipment that are not in the design model. Use the electrical contractor's model and not the electrical design files; use the structural steel contractor's model and not the structural design files.

.7 Prepare interference/coordination model in conjunction with other Construction Trades, wherever a potential conflict due to the positioning of Mechanical Trade Contractor equipment, piping, ductwork or other Work exists.

.8 Dimension proposed location of Mechanical Trade Contractor Work with respect to building elevations and established grid lines.

.9 Prepare fully dimensioned details of all shafts, duct spaces and pipe spaces. Show sleeving, recessed and formed holes required in concrete for Mechanical Trade Contractor Work. Include information pertaining to access, clearances, tappings, housekeeping pads, drains and electrical connections.

.10 Base information used to prepare interference/coordination model on reviewed Shop Drawings.

.11 Provide field interference/coordination model showing the position of various services when required by Consultant.

.12 The Mechanical Trade Contractor shall be responsible for the full coordination of all mechanical services with new construction, and all new services from all Construction Trade disciplines.

.13 Submit a list of access doors and panels showing proposed type, size and location. The interference/coordination model shall incorporate Architectural details including reflected ceiling plans prior to submission.

.14 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. If any conflicts are identified submit alternate proposal to the consultant for review prior to proceeding with any work.

.15 All shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

.16 The Contractor and their Sub-trades shall take complete responsibility for remedial work that results from failure to coordinate the work prior to fabrication, purchasing and/or installation. Pay for the cost of alterations to other work required by the alterations work made necessary due to a lack of preparing a comprehensive interference/coordination model.Prepare drawings in conjunction with all trades concerned, showing sleeves and openings for passage through structure, and all inserts, equipment bases, sumps, pits and supports, and relate these to suitable grid lines and elevation datum.

1.11 EMBEDDED MECHANICAL SYSTEM'S DRAWINGS

.1 Prepare embedded mechanical system's drawings, showing size and location of elements including any conduit and inslab services required.

.2 Prepare insert setting drawings for work to be cast into concrete and/or mortared into masonry elements.

.3 Submit embedded mechanical system's drawings to the structural engineer for review.

1.12 SLEEVING DRAWINGS

.1 Prepare sleeving drawing in conjunction with all affected Trades. Showing sleeves and openings for passage through structure, and all inserts, equipment bases, sumps, pits and supports, and relate these to suitable grid lines and elevation datum.

.2 Submit sleeving drawings to the structural engineer for review.

1.13 SHOP DRAWINGS

.1 Conform to requirements of section 20 05 01.

1.14 RECORD DRAWINGS

.1 Meet the requirements of Division 01 and the following.

.2 Suitably store and protect Record "As-Constructed" or "As-built" Drawings on site and make available at all times for inspection.

.3 Record inverts of underground piping at building entry/exit and below floor slab at each branch, riser base, change in direction as well as at least three points on straight runs.

.4 Show locations of access doors and panels and identify the equipment and components that they serve.

.5 Transfer all Record Drawings information to the Mechanical Trade Contractor's CAD model prior to submission to Consultant for review.

.6 Submit Record "As-Constructed" or "As-built" Drawings for review in PDF format and hard copy for review. Submit reviewed Record "As-Constructed" or "As-built" Drawings in an editable CAD format with the O&M Manuals.

.7 The drawings for this Project have been prepared on a CAD system using AutoCAD. For the purpose of producing record (as-built) drawings, copies of contract drawings may be purchased from the Consultant based on the following rates plus H.S.T.:

For 1 to 10 CAD files	$ 550
For 11 to 20 CAD files	$ 650
For 21 to 50 CAD files	$ 850
For 51 to 100 CAD files	$ 1,350

For greater than 100 CAD files, charge $20.00 per file plus $500.

In using the drawings from the Consultant to produce record drawings, the contractor is deemed to have agreed to take full responsibility for any and all information on the drawings.

1.15 PRODUCT STANDARDS AND ALTERNATIVES

.1 Provide new material and equipment as specified and to acceptance of the Consultant. Manufacturers' names are listed to set a standard of quality, performance, capacity, appearance and serviceability. Acceptable alternative Manufacturers are also listed, and their products may be used in the Work subject to conditions stipulated in paragraph .3 of this Article.

.2 Where no other acceptable Manufacturers are indicated, provide only as specified. Requests for acceptance of manufacturers not listed must be submitted not less than seven working days prior to closing date of the tender. Submissions must bear proof of acceptance by the Consultant.

.3 Assume full responsibility for ensuring that when providing acceptable alternative Manufacturers, all performance, space, weight, connections (mechanical and electrical), power and wiring requirements, are within the scope of the item specified, and costs for any variances therefore are included in the tender. Equipment requiring greater than specified energy requirements and greater installation and service space requirements will not be accepted.

.4 All electrically operated equipment and electrical materials to bear the label of approval of CSA or be so stamped or have special approval of the Authorities. All material, wiring and devices to conform to the Canadian Electrical Code for the purpose for which they are to be used. All electrical equipment to be designed and manufactured in accordance with applicable EEMAC and ANSI specifications.

.5 All gas fired equipment to bear the label of the CGA or be so stamped.

.6 All plumbing products such as fixtures, faucets, flush valves and shower heads to bear the label of approval of the CSA or be so stamped.

1.16 TEMPORARY SERVICE

.1 Refer to Division 01 regarding temporary services, contractor's shop, storage and other such facilities. Temporary heat and ventilation is not included in the Work of Divisions 20, 21, 22, 23 and 25.

.2 Do not use any of the permanent Mechanical Systems during construction or unless specific written acceptance is obtained from the Consultant.

.3 The use of permanent facilities for temporary construction service such as for testing, commissioning and demonstration of operation will not affect in any way the commencement day of the warranty period. Refer to Division 01.

1.17 PATENTS

.1 Pay all royalties and license fees, and defend all suits or claims for infringement of any patent rights, and save the Owner and Consultant harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters patent or rights.

1.18 RIGHTS RESERVED

.1 Rights are reserved to issue any additional Detail Drawings, which in the judgement of the Consultant may be necessary to clarify the Work, and such Drawings shall form a part of the Contract.

1.19 EXPEDITING AND DELIVERIES

.1 Comply with requirements of Division 01. For equipment and materials purchased directly by the Owner, comply with requirements of Division 01.

.2 Continuously check and expedite delivery of equipment and materials. If necessary, inspect at the source of manufacture.

.3 Ensure that materials and equipment are delivered to the site at the proper time and in such assemblies and sizes so as to enter into the building and to be moved into the spaces where they are to be located without difficulty. Perform any cutting and patching involved in getting assemblies into place.

.4 Continuously check and expedite the flow of necessary information to and from all parties involved.

.5 Immediately inform the Consultant of any difficulties in delivery of equipment.

.6 Provide delivery records updated monthly.

1.20 SUPERINTENDENCE

.1 Maintain at this job site, at all times, qualified personnel and supporting staff with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.

1.21 TRIAL USAGE, TESTS AND COMMISSIONING

.1 Include, as part of the Work, trial usage of Mechanical Systems and equipment for the purpose of testing and commissioning and assisting Owner's staff in learning operational and maintenance procedures.

.2 Assist in trial usage over a length of time sufficient to confirm specified equipment capacities and operating characteristics. Maintain full responsibility for all mechanical equipment and systems required to temporarily operate during trial usage. Warranty period commencement for any equipment operated during trial usage will not occur until all Mechanical Work is substantially complete

.3 Provide all testing required on Mechanical System components and equipment where, in the opinion of the Consultant, specified performance is not being achieved.

.4 Integrated Systems Testing of Fire Protection and Life Safety Systems.

.1 With reference to Integrated Systems Testing (IST), please note that the 3rd party agent will be retained under a cash allowance and is not to be carried under this contract.

.2 This contractor shall include the cost to participate and function test the respective fire protection and life safety systems as per the Integrated Testing Plan (ITP).

1.22 COMPLETION

.1 After successful completion of tests and adjustments, remove temporary covers, and strainers, and obstructions to flow. Drain, flush and refill piping systems as often as required until all piping is clear of all debris.

.2 Provide a clean set of filters on each air handling system, heat pump, fan coil unit and unitary heater.

.3 Provide new filter elements in pump seal filters.

.4 Leave Mechanical work in specified working order.

.5 Provide spare components as specified in Section 21 13 00 and Section 25 01 01.

1.23 WARRANTIES

.1 Comply with requirements of Division 01.

.2 Provide all required labour, parts and components required to service all installed items for a warranty period of at least one (1) year unless otherwise stated longer in individual specification sections.

.3 Include for all costs for cutting and patching, removal of equipment and restoration materials and work and repairs to other equipment affected in performance of warranty work.

.4 All warranties commence from the date of Substantial Performance of the Work, unless stated differently in individual specification sections.

.5 Provide warranty certificates showing the name of the firm giving the warranty, dated and acknowledged. Where a specific piece of equipment has an extended warranty or one differing from the base warranty requirements, provide a separate warranty certificate.

.6 Refer to individual specification sections in Division 20, 21, 22, 23, 25 for further warranty requirements.

1.24 INSTRUCTIONS TO OWNER'S STAFF

.1 Instruct the Owner's designated staff on all aspects of the operation of systems and equipment.
Advise the Consultant at least one week in advance of the schedules of all instruction sessions.

.2 Obtain the services of Subtrade and Manufacturers' representatives to provide information and instructions on each part of the Mechanical Work and on items of equipment.

.3 Submit documentation of training to the Consultant immediately following final inspections, stating for each system or item of equipment:

.1 Date and time instructions commenced for each system.
.2 Duration (hours) instructions were given for each system.
.3 Names of Owner's staff receiving instructions.
.4 Other parties present (Manufacturer's representative, consultants, etc.).
.5 Signatures of each of the Owner's staff in attendance.

1.25 OPERATING AND MAINTENANCE MANUALS

.1 Refer to Division 01 Close-Out Submittals and Close-Out Procedures.

.2 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and submit documentation for review to Consultant eight (8) weeks prior to substantial completion.

.3 Provide 3 copies of Operating and Maintenance Manuals in hardcopy and Electronic PDF format copies on Optical media or USB storage device. Mount or connect digital copy to hard copy binders.

.4 Provide the following on substantial performance of the work:

.1 One set of valve charts set in glazed frames mounted on the project as directed by the Consultant.
.2 Air and water balancing report.
.3 As constructed drawings including building automation system shop drawings.

.5 Three manuals assembled in three ring binders with index tabs, each containing:

.1 This Subcontractor's name, address and telephone/fax numbers.
.2 Suppliers and Subtrades names and telephone numbers.
.3 Equipment data sheets (dimensions, capacities, electrical characteristics, wiring diagrams).
.4 Maintenance, operating and lubricating instructions for each item of equipment
.5 As-built Wiring diagrams for each item of equipment.
.6 Copies of valve charts for the project.
.7 Shop Drawings and Product Data: provide final copies of all shop drawings and product data.
.8 A complete set of checked shop drawings for all equipment provided by this Division.
.9 Warranties: include one copy each of the Contractor’s warranty, Manufacturers’ warranties longer than one year, the bond, and any service contract provided by the contractor. Provide section index.
.10 Certifications by Inspection Agency: collect and include copies of the following inspection certification reports:
.1 Plumbing and Gas Standards
.2 Building Standards and Fire Prevention
.3 Boilers and Pressure vessel
.4 Utility Companies
.5 Other Reports Required by Authorities
.11 Certificates for:
.1 Boiler start up and commissioning

.2 Chiller and refrigeration system start up and commissioning
.3 Water treatment
.4 Rooftop HVAC Equipment start-up and commissioning
.5 Rooftop Heating and Ventilation Equipment start-up and commissioning
.6 Control and Building Automation Systems commissioning
.7 Fuel oil pumping systems commissioning
.8 Variable speed electric drives commissioning
.9 Piping pressure tests (domestic water, fire protection heating/cooling piping) certifying system tested, pressure held, time of test and date and certification by the Consultant or commissioning agent.
.10 Extended warranties.

1.26 MECHANICAL LIST OF MANUFACTURERS, SUBTRADES & PRICES

.1 Submit with the tender the List of Manufacturers, Subtrades and prices appended to the Divisions 20, 21, 22, 23 and 25 Specifications.

.2 At the time of tender closing, list the names of Manufacturers and subtrades (one per item) carried as well as the total cost of Mechanical Work and any separate, unit and alternative prices where indicated.

.3 If specified or acceptable alternative Manufacturers are not listed or more than one Manufacturer per item is listed, or Manufacturers not specified are listed, the Consultant will have the option of making the selection of the Manufacturers.

.4 Substitution of listed Manufacturers or Subtrades after close of Tender will not be accepted.

1.27 MUNICIPAL AND UTILITY SERVICES

.1 Coordinate, arrange, and pay for all required municipal service and utility connections water, natural gas and sewers (storm and sanitary) as shown on the Drawings, complete with all required metering. Install all metering equipment as well as service connections in accordance with municipal and utility requirements. Pay for all inspection fees arising out of the installation of these services.

.2 Bear all costs and co-ordinate with Enbridge Gas to provide a natural gas service from the nearest street main into the building. Pay for all inspection fees, metering devices and any work performed by Enbridge Gas

1.28 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Protect on site stored or installed absorptive material from moisture damage.

.4 Packing, shipping, handling and unloading:

.1 Deliver materials to site in original factory packaging or unopened packages clearly labeled with, manufacturer's name, address, product identification, equipment tag identification/s and ULC markings.
.2 Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

.5 Storage and Protection:

.1 Store and protect all equipment and materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer in enclosed shelter.
.2 Repair any damage to the satisfaction of the manufacturer and the Consultant.

.6 Waste Management and Disposal:

.1 Separate waste materials for re-use and/or recycling in accordance with Division 01.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, & packaging material for recycling in accordance with Waste Management Plan (WMP).
.4 Separate for re-use and/or recycling and place in designated containers Steel, Metal and Plastic waste in accordance with Waste Management Plan (WMP).
.5 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
.6 Place materials defined as hazardous or toxic in designated containers.
.7 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.
.8 Ensure emptied containers are sealed and stored safely.
.9 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.29 CLEANING

.1 General

.1 Comply with General Conditions of the Contract, Supplementary Conditions and other Sections of Division 1.
.2 Conduct cleaning and disposal operations to comply with local ordinances and anti- pollution laws.
.3 Store volatile and toxic wastes in covered metal containers and remove from premises daily.
.4 Prevent accumulation of wastes which create hazardous conditions.
.5 Provide adequate ventilation during use of volatile or noxious substances.
.6 Use only cleaning materials and methods recommended by manufacturer of surface to be cleaned.

.2 Construction Cleaning

.1 Perform cleaning operations as specified in Division 1 and in accordance with manufacturer's recommendations.
.2 At all times, maintain the premises free from accumulation of waste material and waste caused by the Contractor’s work.
.3 In cases of disagreement or non-removal of waste material, the Owner may have waste removed from site at the Contractor’s own expense.
.4 Dumping of waste, debris, surplus materials, etc. on Owner’s property is strictly prohibited. Obtain permit and provide on-site dump containers for collection of waste materials and debris.
.5 Broom clean and keep dust free, daily, all rooms, surfaces and areas.

MECHANICAL LIST OF MANUFACTURERS

SECTION	MANUFACTURER	SUBTRADE	COMMENTS
20 05 20 Vibration Control			
20 05 25 Thermal Insulation for Equipment			
20 05 25 Thermal Insulation for Piping			
20 05 30 Variable Speed Drives			
20 05 70 Water Treatment			
21 12 01			
Fire Extinguishers & Cabinets			
Valves & Devices			
Hose Valves			
21 13 13			
Sprinklers			
Valves & Devices			
21 23 00 - Fire Extinguishers			
21 30 00 - Fire Pump			
22 10 10 – Plumbing pumps			
22 10 10 – Domestic Cold Water Booster pump			
22 10 10 – Non-potable water booster pump			
22 30 05 – Domestic Water Heaters and Tanks			
22 42 01			

SECTION	MANUFACTURER	SUBTRADE	COMMENTS
Plumbing Drains & Specialties			
Domestic hot water mixing valve (station)			
Rainwater Harvest System			
22 42 03			
Plumbing Fixtures			
Brass			
23 21 23 – Hydronic Pumps			
23 33 00			
Access Doors			
23 33 10 – Dampers			
Dampers			
Motorized dampers			
Fire Dampers, Combination Fire Smoke Dampers			
Flexible duct			
Duct liner			
23 33 55 Acoustic Silencers			
23 34 00 – HVAC Fans			
Centrifugal Fans			
Roof Exhaust Fans			
Ceiling Mounted Centrifugal Fans			
23 37 13 - Grilles, Reg. & Diffusers			
23 37 20 –Louvers, Intakes and Vents			
23 51 00 – breeching, chimney & stacks			

.6 Maintain roads and walks clean and free of dirt and mud due to work of this Contract. Provide ice and snow removal for walks which will be used exclusively by Contractor and/or Subcontractor's forces.

.3 Final Cleaning

.1 In preparation for Total Performance or occupancy, conduct final inspection of sight exposed surfaces and of accessible concealed spaces.

.2 Upon completion and verification of performance installation, remove all waste, equipment, tools, scaffolding, surplus materials, temporary protection, etc. and leave work in a clean and orderly condition.

.3 Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight exposed interior and exterior finished surfaces.

.4 Upon completion of project or as required, remove all temporary buildings erected, all temporary construction aids, barriers and enclosures, all temporary utilities, hoists, access road sand walks, etc., leaving site in clear, tidy and satisfactory condition pending acceptance from the Owner.

.5 Brush clean all surfaces and areas of the Work.

.6 Vacuum clean and remove debris from the inside of air handling systems, fans, ducts, coils and terminal units.

.7 Clean exposed surfaces of Mechanical equipment, ductwork and piping. Polish plated work.

.8 Comb all bent fins to proper configuration on all coils in air handling units, fan coil units, entrance heaters and on finned radiation elements.

.9 Replace all temporary air filters with specified filters on all heating, cooling and ventilating equipment.

.10 Upon completion of work of each trade, thoroughly clean work and leave in a condition acceptable to Consultant and Owner.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 20 05 05

SECTION	MANUFACTURER	SUBTRADE	COMMENTS
23 52 00 - Heating Boilers			
23 55 01 – Duct Heaters			
23 57 00 - Heat Exchangers			
23 65 10 - Fluid Cooler			
23 72 00 – Suite ERVs			
23 73 10 - Air Handling Units			
23 74 10 – HVAC Split Systems			
23 81 40 – Heat Pumps			
23 82 36 - Finned Tube Convectors			
23 82 39 - Unit Heaters, Entrance Heaters			
25 01 01 – Building Automation System			

UNIT PRICES

Unit prices include all labour, materials, products, equipment, services, and respective overhead, profit, taxes (not including GST) and disbursements and related charges and represent the actual cost or credit to the Owner.

The following is a list of unit prices applicable to both additions and deductions to/from the work.

MECHANICAL		INSTALLED PRICE		
		UNIT	ADD $/UNIT	DEDUCT $/UNIT
Low pressure ductwork		Lb.		
Medium pressure ductwork		Lb.		
Addition of one sprinkler head with drop tie-in to exiting system		each		
Cast iron drainage (buried)	3 in.	LFT.		
	4 in.	LFT.		
	6 in.	LFT.		
	8 in.	LFT.		
Copper Piping (suspended)	1 in.	LFT.		
	2 in.	LFT.		
	3 in.	LFT.		
	4 in.	LFT.		
Cast Iron Drainage (suspended)	3 in.	LFT		
	4 in.	LFT.		
	6 in.	LFT.		
Steel Piping	2 in.	LFT.		
	3 in.	LFT.		
	4 in.	LFT.		
	6 in.	LFT.		
	8 in.	LFT.		

LABOUR RATES

The following labour rates shall apply for calculating the cost of credit or extras on change notices. The rates shall include any employee benefits. The labour rates do not include overhead and profit.

Superintendent	$_____/hr.
HVAC Piping Trade Person	$_____/hr.
Plumbing & Drainage Trade Person	$_____/hr.
Sheet Metal Trade Person (Shop)	$_____/hr.
Sheet Metal Trade Person (Field)	$_____/hr.
Insulation Trade Person	$_____/hr.
Sprinkler Trade Person	$_____/hr.
Controls	$_____/hr.
Gas fitting	$_____/hr.
Welding	$_____/hr.
Apprentice	$_____/hr.
Labourers	$_____/hr.
other	$_____/hr.
	$_____/hr.

OTHER PRICES

We the undersigned have inserted below all separate, itemized and alternative prices requested. We agree that:

All prices submitted take into consideration and allow for changes and adjustments in other work as may be necessary to provide a finished and functional result, unless specifically indicated otherwise.

All prices include all labour, materials, products, equipment, services and respective overhead, profit, taxes (not including GST) and disbursements and related charges and represent the actual cost or credit to the Owner.

a) Separate prices are for work which is not included in the Tender Price listed on Tender Form but which may be added by the Owner for the price quoted hereunder.

b) Itemized prices are for work which is included in the Tender Price listed on Tender Form and which may be deleted by the Owner for the amount quoted hereunder.

c) Alternative prices are for work which may be substituted by the Owner for work which is included in the Tender Price (no price listed shall mean no change in cost) and that the Owner reserves the right to accept or reject any of the prices proposed hereunder.

SEPARATE PRICES

To be shown as an "Add" to the base tender price.

1. None. $_____

ALTERNATIVE PRICES

To be shown as a "Credit" or "Add" to the base tender price for all work of Division 15.

1. None. $_____

ITEMIZED PRICES

To be shown as a CREDIT to the base tender price.

1. None. CREDIT $_____

DATE: _____

NAME OF FIRM: _____

SUBMITTED BY: _____

END OF SECTION 20 05 06

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05 Mechanical Work General Instructions.

1.02 SUBMITTALS

.1 Submit shop drawings on access doors, valves, strainers, expansion tanks, thermometers and gauges, expansion compensators, piping restraints, grooved end components, motor starters and motor control centers.

PART 2 - PRODUCTS

2.01 ACCESS DOORS

.1 Provide rounded safety corners hinged access doors as constructed of primed 16 gauge steel as manufactured by William Brothers or Acudor equal to fire rating of wall or ceiling in which installed.

.2 Provide doors with minimum size of 300mm x 300mm (12" x 12"). Access doors to be sized of adequate size to permit service of equipment and/or resetting dampers. Provide minimum size of 600mm x 460mm (24" x 18") where personnel entry is required. Provide minimum size of 600mm x 750mm (24" x 30") where personnel entry is required for regular equipment maintenance.

.3 Provide for plaster surfaces recessed 16 ga. prime painted steel door and welded metal lath, ready to take plaster. Provide with concealed hinge and stainless steel studs with brass sleeves.

.4 Provide for tiled surfaces, recessed type 16 ga. primed steel (stainless steel for ceramic tile and shower areas) doors to suit type and dimension of tile used. Size door to be as close as possible to 300mm x 300mm (12” x 12”) by fitting to single or multiple tile dimensions. Provide with concealed hinges and stainless steel studs with brass sleeves.

.5 Provide, to suit wall surface or type of construction, other factory prime coated access doors of welded 16 gauge steel, flush type with concealed hinges, lock and anchor straps.

.6 Lay in type ceiling tiles, properly marked, may serve as access panels.

.7 Access doors in fire rated construction shall be ULC listed and labelled, meeting the requirements of Authorities having jurisdiction and rated to maintain the fire separation integrity.

2.02 PIPE AND FITTINGS

.1 Corrosion Prevention
  .1 Provide V line insulating couplings as supplied by H & G Specialities Limited, or accepted alternative dielectric couplings, for prevention of galvanic corrosion at specific points where connections are required between copper, brass or bronze and black or galvanized steel piping.
  .2 Other acceptable manufacturers EPCO, Watts.

.2 All fittings 50mm (2") and below connecting to equipment: Use unions, extra heavy duty pattern, having ground joints, brass seats and diagonal screws.

.3 Connections to equipment 65mm (2½") and above: Flanged, standard weight provided with ring gaskets.

.4 Cooling coil condensate: drainage grade copper tubing with copper drainage fittings with 50 50 solder.

.5 Condenser water (heat pump loop), glycol solution circuits, and Heating:
  .1 Piping:
    .1 Working Pressure up to and including 1035 kPa (150 psi): Schedule 40 ASTM specification A53 Grade A or B wrought steel black pipe with heavy cast iron **or** standard black malleable steel threaded fittings rated at 1380 kPa (200 psi WOG) for pipe sizes up to and including 50mm (2").
    .2 Working Pressure up to and including 1035 kPa (150 psi): Schedule 40 ASTM specification A53 wrought steel black pipe with schedule 40 black steel welding fittings rated at 1380 kPa (200 psi WOG) for pipe sizes 65mm (2½") and over.
    .3 Type L copper to ASTM B88 with 95/5 soldered wrought copper pressure fittings to ANSI B22.18 for piping system rated at 1035 kPa (150 psi WOG) for pipe sizes up to and including 50mm (2").
  .2 Fittings:
    .1 For pipe fittings up to and including 50mm (2”):
      .1 Up to 862 kPa (125 psi WSP) Soldered: Wrought bronze or cast copper, ASTM B32, solder joint fittings, ANSI/ASME B16.18 or B16.22.
      .2 Up to 862 kPa (125 psi WSP) Threaded: Banded black cast iron, ASTM A126, threaded, ANSI/ASME B16.4, Class 125, ASTM A126
      .3 1035 kPa (150 psi WSP) Threaded: Galvanized malleable iron, threaded, ANSI/ASME B16.3, Class 150.
      .4 1725 kPa (250 psi WSP) Threaded: Banded black cast iron, ASTM A126, threaded, ANSI/ASME B16.4, Class 250, and ANSI/ASME B1.20.1
    .2 For pipe fittings 65mm (2½") and up to 600mm (24”):
      .1 Welded: Black steel, butted welded, ASTM A234/A234M, ANSI/ASME B16.9, each stamped by manufacturer for conformance and working pressure.
      .2 Up to 862 kPa (125 psi WSP) Flanged: Cast iron flanged fittings, ANSI/ASME B16.1, Class 125.

.3 Flanges: Provide either flat-face or raised-face flanges as required to match flange faces on valves and equipment.
- .1 Up to 862 kPa (125 psi WSP) Threaded: Threaded cast iron flanges, ANSI/ASME B16.1, Class 125.
- .2 1035 kPa (150 psi WSP): Weld neck or slip-on steel flanges, ASTM A181/A181M, Class 60, ANSI/ASME B16.5, Class 150.
- .3 1725 kPa (250 psi WSP) Threaded: Threaded cast iron flanges, ANSI/ASME B16.1, Class 250.

.4 Flange Bolts:
- .1 Up to 862 kPa (125 psi WSP): ASTM A307, Grade B, square-head machine bolts with heavy hex-nuts.
- .2 Above 862 kPa (125 psi WSP): ASTM A193/A193M, Grade B7 bolts, with Grade 7 nuts.

.5 Unions for sizes up to 50mm (2”):
- .1 Up to 862 kPa (125 psi WSP) Soldered: Wrought bronze or copper, ground joint, solder end unions.
- .2 1035 kPa (150 psi WSP) Threaded: ASTM A197/A197M, ANSI/ASME B16.39, Galvanized malleable iron unions with ground joints, brass seat, threaded ends.

.6 Generator exhaust: Refer to Section 23 51 00.

.7 Sanitary Drainage Internal:
- .1 Buried:
  - .1 Cast iron pipe and fittings to CSA B70.
  - .2 Where buried and accepted by Authorities: PVC or ABS pipe and fittings to CSA CAN 3 B181.1 M85 (ABS) CAN 3 B181.2 M85 (PVC) B182.1, B182.2, (large diameter PSM PVC). B182.3, (large diameter IPS PVC).
- .2 Suspended:
  - .1 Cast iron pipe and fittings to CSA B70.
  - .2 DWV copper to ASTM B306 with 50 50 soldered cast brass drainage fittings to CSA B158.1 or wrought copper fittings to ANSI B16 29.

.8 Sanitary Drainage External:
- .1 Cast iron or approved ABS or PVC with solvent weld or ring gasket joints as specified for internal buried pipe.
- .2 Concrete to CSA Standard A257.

.9 Vent Piping:
- .1 DWV Grade copper to ASTM B306 76 with 50 50 soldered cast brass or wrought copper drainage fittings to CSA B158.1 and ANSI B16 29 respectively or cast iron pipe and fittings to CSA B70.

.10 Domestic Water and Non-potable Water:
- .1 System pressure rated for 380 kPa (200 psi).
- .2 Code and Standards:
  - .1 ASTM B88 Standard Specification for Seamless Copper Water Tube.
  - .2 ASME B16.15 Cast Bronze Threaded Fittings, Class 150 and 250
  - .3 ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
  - .4 ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.5 ASME B16.24 Cast Copper Alloy Pipe Flanges and Flanged fittings Class 150, 300, 400 and 600.
.6 CSA B242 Groove and Shouldered Type Mechanical Couplings
.7 AWS A5.8 Brazing Filler Material
.8 ASTM B32 Specification for Solder Metal
.9 ASTM B-312 Standard Specification for Stainless Steel Piping.

.3 Type L copper, hard drawn, marked certified for compliance with ASTM B88 Standard, with 95/5 soldered, wrought copper or cast bronze pressure solder fittings to ANSI B16.22 and ANSI B16.18 respectively.

.4 Brass or bronze threaded fittings to ASME B16.15. Brass or bronze flanges or flanged fittings to ASME B16.24. Flanged joints to AWWA C111 and bolts to ASTM A307 and nuts to ASTM 563. Silver brazing alloy to AWS Classification BCuP-5.

.5 Method of joint connection:
.1 Soldered for pipes up to 65mm (2 ½").
.2 Brazed for pipes 75mm (3") or higher
.3 Grooved fittings may be used for exposed area.

.6 Buried piping: soft temper type K with soldered fittings to the previously mentioned standards.

.11 Building Water Service:
.1 Building water service 100mm (4") and larger: Ductile iron ANSI Class 2 cement lined with Tyton joints: Approved PVC with ring gasket joints class 150 to CSA B137.3.
.2 75mm (3") and smaller: Type K copper soft temper to ASTM B88 with soldered pressure fittings to ANSI B22.18 or ANSI B16.18: (If more economical, use oversized Ductile Iron or PVC as previously specified).
.3 Where suspended between building entry point and water meter: Type L copper with wrought copper soldered fittings to ANSI B22.18. Use brass flanges, nuts and bolts at equipment connections.

.12 Soldered Fittings in Potable Water Systems: Provide lead, antimony, cadmium and zinc free solders composed of tin/copper/silver or nickel components that are acceptable to Authorities having jurisdiction.

.13 Sewage and sump pump discharge piping: Schedule 40 ASTM A53 hot dipped galvanized steel pipe with hot dipped galvanized cast iron drainage fittings, or copper Type L to ASTM B88 83 with pressure fittings to ANSI B22.18 or ANSI B16.18 with 50 50 solder. Where buried, use PVC class 150 to CSA B137.3.

.14 Storm drainage piping:
.1 Cast iron pipe and fittings to CSA B70 where buried or suspended.
.2 Where buried and accepted by Authorities: PVC or ABS with solvent weld or ring gasket joints to CSA B182.1 and B182.2.
.3 Where external to the building, concrete to CSA Standard A257. Where acceptable to the Jurisdiction having authority, IPEX PVC Ultra Rib pipe and fittings to CSA Standard B182.4 with maximum long term deflection of 7.5%.

.15 Natural gas piping: Provide as required by the Authorities having jurisdiction as follows:
.1 ASTM A53 Schedule 40 seamless wrought steel with schedule 40 threaded malleable fittings to ANSI standard B16.3; welded in concealed areas and X rayed if required by Authorities having jurisdiction.
.2 ASTM A53 Schedule 40 wrought steel seamless with schedule 40 wrought steel

butt welding fittings to ANSI B16.9. Welding procedures to comply with standards as required by the Authorities having jurisdiction.

.3 Connections to equipment: provide extra heavy duty pattern unions with ground joints, brass seats and threads to ANSI B1.20.1. Where flanges are required, provide standard weight type to ANSI B16.1 with neoprene gaskets.

.16 Victaulic couplings to CSA Standard B242 for fire protection, heating and condenser water is acceptable provided that this application meets the approval of the Municipal Authorities who have jurisdiction at the place of the Work.

.1 Rigid Couplings: Ductile iron to specification A536. In mechanical rooms use grooved couplings to be designed with angle bolt pads to provide a rigid joint. Victaulic style 107N or 07. In mechanical rooms use grooved couplings to be designed with angle bolt pads to provide a rigid joint. Victaulic style 107 and 07.

.2 Flexible Couplings – Ductile iron to specification A536. Flexible grooved couplings shall be used where system flexibility is desired. Noise and vibration reduction at mechanical equipment connections is achieved by installing three flexible couplings near the vibrations source in lieu of braided flex connectors. Victaulic Style 77 or 177.

.3 AGS “W” Series Couplings (350mm (14”) and Larger): Victaulic Style W07 (rigid) and Style W77 (flexible) two housings cast with a wide key profile and flat bolt pads for metal-to-metal contact, wide-width FlushSeal® gasket, and plated steel bolts and nuts.

.4 Gaskets: Water Services EPDM Grade "E", with green colour code identification, conforming to ASTM D-200 for water services up to 110°C (230°F) or Grade “EHP” EPDM, with red colour code identification, conforming to ASTM D-2000 for water services up to 120°C (250°F).

.5 Fittings Victaulic full flow fittings manufactured of ductile iron to ASTM A 536 Grade 65 4 12 or steel to ASTM A-53, Grade B, with grooved ends designed to accept Victaulic couplings.

.6 For pipe sizes 50mm (2") and smaller (for heating and cooling application only):

.1 Press fit fittings should only be used for system pressure up to 1031 kPa (150 psi).

.2 Press fittings by Viega Model Mega Press is acceptable for use in steel piping.

.3 Press fittings by Viega Model Pro Press is acceptable for use in copper piping.

.4 Material of press fit fittings to be same material as the piping.

.5 All products to be complete with CRN number and to be acceptable by the Authority Having Jurisdiction. Manufacturer to provide substantiation upon request by the Authorities.

.17 Victaulic products for domestic water services (hot and cold), to be rated for operating conditions of -34°C to +120°C (-29.2°F to 250°F) and 2067 kPa (300 psi).

.1 Couplings: ductile iron coated with copper alkyd enamel to ASTM A - 536. Flanges to be copper alkyd enamel coated to ANSI class 125 for cast iron and class 150 for steel. Couplings shall be “Installation Ready” stab-on couplings designed with angle bolt pads to provide a rigid joint, complete with EPDM gasket. Victaulic Style 607.

.2 Fittings: grooved copper to ASTM B-75 and grooved bronze castings to ASTM B-584 with copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).

.3 Gaskets: grade EHP EPDM to ASTM D-2000 (UL/ULC classified in accordance with ANSI/NSF-61 for hot (82°C) and cold (30°C) domestic water service).

.4 Acceptable Alternative: Gruvlok (Entire system by one manufacturer).

.18 Victaulic products for domestic water services (hot and cold), to be rated for operating conditions of -34°C to +120°C (-29.2°F to 250°F) and 3450 kPa (500 psi).

.1 All products to be approved for use by the Authorities Having Jurisdiction.

.2 Couplings: heavy ductile iron [stainless steel 304L] ASTM A–536, grade 65-45-12.
Couplings shall provide a rigid joint, complete with Victaulic Style 89.

.3 Gaskets: grade E EPDM gasket. UL Classified in accordance with ANSI/NSF 61 for cold
+73°F/+23°C and hot +180°F/+82°C potable water service and ANSI/NSF 372.

.4 Sizes 50 - 300mm (2” to 12”), rated minimum 4140 kPa (600) psi on Schedule 40S, Type
304 or 316 stainless steel pipe.

.5 Acceptable Alternative: Gruvlok (Entire system by one manufacturer).

.19 Condensing Appliances Drain Piping:

.1 Use materials approved by the authority having jurisdiction. In the absence of other authority, 316 Stainless Steel, PVC and CPVC pipe must be CSA or ULC certified and comply with ASTM D1785 or D2845.

.2 For pipe sizes 50mm (2") and smaller (for heating and cooling application only):

.1 Press fit fittings should only be used for system pressure up to 1031 kPa (150 psi).

.2 Press fittings by Viega Model Mega Press is acceptable for use in steel piping.

.3 Press fittings by Viega Model Pro Press is acceptable for use in copper piping.

.4 Material of press fit fittings to be same material as the piping.

.5 All products to be complete with CRN number and to be acceptable by the Authority Having Jurisdiction. Manufacturer to provide substantiation upon request by the Authorities.

.20 Victaulic products for domestic water services (hot and cold), to be rated for operating conditions of -34°C to +120°C (-29.2°F to 250°F) and 2067 kPa (300 psi).

.1 Couplings: ductile iron coated with copper alkyd enamel to ASTM A - 536. Flanges to be copper alkyd enamel coated to ANSI class 125 for cast iron and class 150 for steel. Couplings shall be “Installation Ready” stab-on couplings designed with angle bolt pads to provide a rigid joint, complete with EPDM gasket. Victaulic Style 607.

.2 Fittings: grooved copper to ASTM B-75 and grooved bronze castings to ASTM B-584 with copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).

.3 Gaskets: grade EHP EPDM to ASTM D-2000 (UL/ULC classified in accordance with ANSI/NSF-61 for hot (82°C) and cold (30°C) domestic water service).

.21 Victaulic products for domestic water services (hot and cold), to be rated for operating conditions of -34°C to +120°C (-29.2°F to 250°F) and 3450 kPa (500 psi).

.1 All products to be approved for use by the Authorities Having Jurisdiction.

.2 Couplings: heavy ductile iron [stainless steel 304L] ASTM A–536, grade 65-45-12.
Couplings shall provide a rigid joint, complete with Victaulic Style 89.

.3 Gaskets: grade E EPDM gasket. UL Classified in accordance with ANSI/NSF 61 for cold
+73°F/+23°C and hot +180°F/+82°C potable water service and ANSI/NSF 372.

.4 Sizes 50 - 300mm (2” to 12”), rated minimum 4140 kPa (600) psi on Schedule 40S, Type
304 or 316 stainless steel pipe.

2.03 PIPING AND FITTINGS FOR POTABLE WATER SYSTEM IN RESIDENTIAL APPLICATION

.1 Cross-Linked Polyethylene (PEX) tubing and fittings for potable water distribution system shall only be used in Residential Building Application.

.1 PEX-a piping shall be manufactured in accordance with ASTM F876, ASTM F877 and CAN/CSA-B137.5. The tube shall be listed to ASTM and CSA by an independent third party agency and meeting the requirements of the local Authorities Having Jurisdiction. Tubing and fittings to meet the hydrostatic pressure ratings from Plastic Pipe Institute TR-3 for
82.2C (180F) at 690 kPa (100 psi).

.2 Fitting Materials: Fittings shall be metal fittings with stainless steel clamps and shall be cold expansion type certified to ASTM F2098 for use in 690 kPa (100 psi) with operating temperature up to and including 82 C (180 F).

.3 Pressure rating to ASTM F876:

Rated Temperature C (F)	Pressure Rating for water kPa (psi)
23 (73.4)	1104 kPa (160)
82 (180)	690 kPa (100)
93 (200)	552 kPa (80)

.4 PEX-a tubing and fittings to be listed for potable water application and meeting the requirements of NSF 61.

.5 PEX-a tubing, [manifold] and fittings shall be listed to a Maximum 25 flame spread/ 50 smoke developed per the requirements of CAN/ULC-S102.2.

.6 PEX-a tubing penetrating a fire separation shall be sealed per CAN/ULC-S115. PEX tubing contained within a fire separation shall be listed per CAN/ULC-S101.

.7 PEX piping material complies with NSF/ANSI/CAN 61 health effects requirements when tested at temperatures up to and including Commercial Hot (180°F).

.2 In suite Piping & Fittings

.1 The use of PEX-a piping is limited inside residential in-suite only.

.2 The use of PEX-a piping is limited for sizes from 13mm (½”) to 50mm (2”). Piping to be SDR 9.

.3 Provide PEX-a sleeve for in-slab piping application. Sleeve to be certified product by the PEX-a piping manufacturer.

.4 Manifolds: Multiple valved outlets, lead free copper, certified PE manifold. Number of outlets to be determined based on total number of fixtures in each suite. Use one outlet per fixture. Run pipe from manifold to fixture unit without any branch/tee.

.3 Plumbing Riser Application
.1 The use of PEX-a piping for main riser application is NOT allowed.
.2 The use of PEX-a piping is limited in secondary plumbing riser application ONLY where system pressure is below 552 kPa (80 psi). Do not use PEX piping in water main, water header and piping in public areas. PEX piping and fittings only be allowed in riser application when the vertical height of risers is not more than 27 m (89 feet).

.2 The use of PEX-a piping is limited for sizes from 13mm (½") to 50mm (2"). Piping to be SDR 9.

.3 Pipe manufacturer to provide all required pipe supports, guides, anchors and thermal compensators meeting the Manufacturer's Installation Requirements. Submit calculations when required.

.4 Warranties
.1 The assembly of manufacturer's tubing and fittings shall carry a twenty-five (25) year non- prorated warranty on maintaining a leak-proof seal.
.2 Warranty shall provide for repair or replacement of any tube, fittings or connection, which are proven to be defective and pay for consequential damages.

.5 Acceptable Manufacturers: Uponor, IPEX and Veiga.

2.04 VALVES

.1 All valves to have minimum certified rating of 1380 kPa (200 psi) or 2070 kPa (300 psi**)** WOG. Refer to Section 23 05 05 for fire protection service valves.
.2 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
.3 Manufacturer:
.1 Provide valves of same manufacturer throughout, where possible.
.2 Provide valves with manufacturer's name and pressure rating clearly marked on body (per MSS-SP-25).
.3 Product shall carry valid CRN (Canadian Registration Number) issued by respective Provinces.
.4 Valve Materials:
.1 Bronze: to ASTM B62 (406ºF/208ºC) or B61 (550ºF/288ºC) as applicable
.2 Brass: to ASTM B283 C3770
.3 Cast Iron: to ASTM A126, Class B (353ºF/178ºC) at 125 PSIG.
.4 Forge Steel: to ASTM A105N (800ºF/427ºC)
.5 Cast Steel: to ASTM A216WCB (800ºF/427ºC)
.5 Testing and Design:
.1 MSS-SP-80 - Bronze, Gate & Check Valves.
.2 MSS-SP-110 - Ball Valves.
.3 MSS –SP-70, 85, 71 - Cast Iron Gate, Globe & Check Valve.
.4 MSS-SP-72 - American Valve
.5 MSS-SP-67 – Kitz, Butterfly Valves.
.6 API 602 – Forge Steel Valves (Design)
.7 API 598 – Cast Steel Valves, Forge Steel Valves (Testing)

.8 API 609 – WKM High Performance BFV

.6 Gate valves:

.1 50mm (2") and smaller with bronze body and rising stem: Jenkins #810, Crane #428, Newman Hattersley #T607, Red and White #293.

.2 Valves for copper ends: Jenkins #813J, Crane #1334, Grinnell #3000, Toyo 299 or Newman Hattersley #T607, Kitz #44.

.3 Gate valves 65mm (2½") and up: Iron body, bronze trim, OS&Y, rising stem, Jenkins #454J, Crane #465 ½, Toyo #421A, Grinnell #6060A or Newman Hattersley #504, Kitz #72.

.4 For valves 150 mm (6") and greater where mounted overhead, provide O. S. & Y. valves with chain wheel operation - length of chain to be determined on site.
For pressure higher than 1035 kPa (150 psig) and up to 1725 kPa (250 psig):

.1 Up to 50mm (2"):

.1 1034KPA (150psig) / 300 WOG Rating.

.2 Bronze Body to ASTM B62, Solid Wedge Disc, Bronze Trim.

.3 Kitz 64 or 46, Nibco T-133 or 134.

.4 65mm (2½") and Over:

.5 Class 150, Carbon Steel A216WCB Body, Bolted Bonnet, OS&Y, ½ Stellite Trim (Trim #8), Graphite Packing.

.6 Kitz 150 SCLS (Flanged), Kitz W150 SCLS (Butt Weld).

.7 Ball valves:

.1 Up to 50 mm (2"):

.1 Brass and/or bronze body, full port, PTFE seats, double O-Ring design or PTFE packing, chrome plated solid bronze ball, lever handle.

.2 1034 kPa (150 psig) / 4137 kPa (600 psig) WOG rating.

.3 Kitz 58 (threaded) or 59 (solder), Crane 9201 (threaded) or 9202 (solder), Toyo 5044E (threaded) or 5049A (solder), Watts FBV-4 (threaded) or FBVS-4 (solder), Apollo 77F-100 (threaded) or 77F-200 (solder), Nibco T-FP600A (threaded) or S- FP600A (solder), Victaulic Series 722.

.2 For pressure higher than1035 kPa (150 psig) and up to 1725 kPa (250 psig):

.1 Up to 50mm (2"):

.1 1724 kPa (250 psig) / 4137 kPa (600 psig) WOG Rating

.2 Forged brass body, full port, PTFE seats, PTFE packing, stainless steel ball and stem, lever handle

.3 Kitz 68PM or approved equal**.**

.3 It is preferable that ball valves be used in place of gates valves for sizes 12 to 50 mm (1/2" to 2").

.8 Globe valves:

.1 50mm (2") and smaller: Grinnell #3240, Jenkins 106B, Crane #7, Toyo #221, or Newman
Hattersley #13, Kitz #9.

.2 Valves 50mm (2") and smaller for copper ends: Grinnell #3240SJ, Jenkins #1068AP, Crane #1312, Red and White #212, Newman Hattersley Fig. 13 with adapters, Kitz #10.

.3 Valves 2½" and greater, iron body, bronze seat and disc: Jenkins #234J, Crane #351, Red & White #400A, Newman Hattersley #731.

.4 For pressure higher than1035 kPa (150 psig) and up to 1725 kPa (250 psig:
.1 Up to 50mm (2”):
.1 1034KPA (150psig) / 300 WOG Rating.
.2 Bronze Body to ASTM B62, Solid Wedge Disc, Rising Stem.
.3 Kitz 09 or 10, Nibco T-235Y or S-235Y.
.2 65mm (2½”) and Over:
.1 Class 150, Carbon Steel A216WCB Body, Bolted Bonnet, OS&Y, ½ Stellite Trim (Trim #8), Graphite Packing.
.2 Kitz 150 SCOS (Flanged), Kitz W150SCOS (Butt Weld).

.9 Butterfly valves:
.1 Flanged:
.1 Enameled cast iron lug type body, stainless steel disc, blow-out proof stainless steel stem, EPDM seat
.2 Bi-directional tight shut-off to 1100 kPa (150 psi)
.3 Bi-directional dead-end service to 345 kPa (50 psi)
.2 Grooved end:
.1 65 – 300 mm (2 ½” – 12”):
.1 Enameled ductile iron body, stainless steel disc, blow-out proof stainless steel stem, EPDM seat
.2 Rated to 2068 kPa (300 psi) and bi-directional dead-end service capable to full rated pressure.
.3 Standard of acceptance: Victaulic Vic-300 MasterSeal
.2 350 – 600 mm (14” – 24”):
.1 PPS coated ductile iron body, PPS coated ductile iron disc, EPDM disc/seal, blow-out proof stainless steel stem, PPS coated
.2 Rated to 2068 kPa (300 psi) and bi-directional dead-end service capable to full rated pressure.
.3 Standard of acceptance: Victaulic Vic-300 AGS]
.3 Stainless steel 50 – 200 mm (2” – 8”):
.1 Stainless steel body and disc conforming to ASTM A351 Grade CF8M. Grade “E” EPDM seat, UL Classified in accordance with ANSI/NSF 61 for cold +73°F/+23°C and hot +180°F/+82°C potable water service and ANSI/NSF 372.
.2 Rated to 2068 kPa (300 psi) and dead-end service capable to full rated pressure.
.3 Standard of acceptance: Victaulic Series 461.
.4 Copper ends 65 – 150 mm (2-1/2” – 6”):
.1 Body material shall be bronze with copper tube dimensions, aluminum bronze disc with grade “CHP” fluoroelastomer seat. Suitable for water service with temperature range of -34C to +110C (-30F to 230F).
.2 UL Classified in accordance with ANSI/NSF 61 for cold +73°F/+23°C and hot +180°F/+82°C potable water service and ANSI/NSF 372.
.3 Rated to 2068 kPa (300 psi) and dead-end service capable to full rated pressure.
.4 Standard of acceptance: Victaulic Series 608N
.3 Handles and operators:
.1 Up to and including 100mm (4"): lever with infinite adjustment.
.2 150mm (6") and over: wheel/gear operated.
.3 Provide chain operator where mounted overhead.

.4 It is preferable, except for gas and steam services, that butterfly valves be used in place of gate valves for sizes 65 mm (2½“) and greater.
.5 As manufactured by Challenger, Centerline, Keystone, DeZurick, Crane, Jenkins, Bray**,** Victaulic

.10 Swing check valves - other than at pump discharge:
.1 50mm (2") and smaller: Grinnell #3320, Jenkins #4092, Crane #37, Toyo #236, Newman
Hattersley #47, Victaulic Series 712, Kitz #22.
.2 65mm (2½") and larger: Iron body, brass trim, flanged: Grinnell #6300A, Jenkins #587, Crane #373, Toyo #435JA, Newman Hattersley #651, Kitz #78.
.3 At pump discharge use wafer type check valve as manufactured by Grinnell #300, Victaulic Series 716H/716 or W715, Streamflo, Checkrite or M & G #1515WM5S with 316 stainless steel disc.
.4 For pressure higher than1035 kPa (150 psig) and up to 1725 kPa (250 psig):
.1 Up to 50mm (2”):
.2 1034KPA (150psig) / 300 WOG Rating
.3 Bronze Body to ASTM B62, Bronze Trim, Y-Pattern Swing Type.
.4 Kitz 29 or 30, Nibco S-433-B or T-433-B.
.5 65mm (2½”) and Over:
.6 Class 150, Carbon Steel A216WCB Body, Bolted Cover, ½ Stellite Trim (Trim #8), Stainless Steel Inserted Flexible Graphite Gasket.
.7 Kitz 150 SCOS (Flanged) , Kitz W150SCOS (Butt Weld)
.8 Silent Check:
.9 Class 150, Cast Steel ASTM A216WCB Body, 316 S.S. Trim and Spring Loaded Center Guided Disc.
.10 Mueller Steam Specialty: 101 MDT, 105MDT (Globe Style)**.**

.11 Domestic water valves:
.1 Gate valves 50mm (2”) and under, soldered
.1 For pressure up to 150 psig, MSS SP-80, Class 150,bronze body, solid wedge bronze disc, rising stem, screw in, or union bonnet.
.2 Kitz 43, Crane 1334, Jenkins 813J, Newman Hattersley T608 and Nibco S-131
.2 Gate valves 50 mm (2”) and under, threaded
.1 1000 kPa (150 psi), to MSS SP-80, Class 150, bronze body, solid wedge disc, rising stem, screw in, or union bonnet.
.2 Kitz 42, Crane 431, Jenkins 281OJ, Newman Hattersley T608 and Nibco T-131
.3 For pressure higher than1035 kPa (150 psig) and up to 2070 kPa (300 psig), MSS SP-80, Class 300, bronze body, solid wedge disc, rising stem, union or screw in bonnet.
.4 Kitz 37, Crane 634E, Jenkins 228OUJ, Newman Hattersley #C1174 and Nibco T- 174A
.3 Gate valves 65mm (2½”) and over flanged
.1 850 kPa (125 psi), to MSS SP-70, Class 125, cast iron body with flat faced flange, bronze or bronze faced solid wedge disc with bronze seat rings, rising stem, OS & Y, bolted bonnet.
.2 Kitz 72, Crane 465 ½ , Jenkins 454J, Newman Hattersley #504 and Nibco F-617- O.
.3 1000 kPa (150 psi), to ASTM A216 grade WCB, Class 150, cast steel body with raised faced flange, flexible Type 416 stainless steel disc and hard faced seat rings, rising stem, OS & Y, bolted bonnet.
.4 Kitz 150 SCLS, Crane 47XUTand Jenkins J1009B8F
.5 For pressure higher than1035 kPa (150 psig) and up to 2070 kPa (300

psig), ASTM A216 grade WCB, Class 300, cast steel body with raised faced flange, flexible Type 416 stainless steel disc and hard faced seat rings, rising stem, OS & Y, bolted bonnet.

.6 Kitz 300 SCLS and Crane 33½ XU-F and Newman Hattersley #C1482.

.4 Globe valves 50mm (2") and under, soldered

.1 850 kPa (125 psi), to MSS SP-80, 300 CWP, bronze body, renewable composition PTFE disc, threaded over bonnet, lock shield handles as indicated.

.2 Kitz 10, Crane 1334/1320, Jenkins 813J and Nibco S-235-Y.

.5 Globe valves 50 mm (2") and under, threaded

.1 1000 kPa (150 psi), to MSS SP-80, Class 150, bronze body, renewable composition PTFE disc, union bonnet, lock shield handles as indicated.

.2 Kitz 09, Crane7TF, Jenkins 106BJ, Nibco T-235-Y and Newman Hattersley 13.

.6 Swing check valves 50 mm (2") and under, threaded

.1 850 kPa (125 psi), to MSS SP-80, Class 125, bronze body, bronze swing disc, regrindable seat, screw-in cap

.2 Kitz 22, Crane 37, Jenkins 4073J, Newman Hattersley 47 and Nibco T-413

.7 Swing checks 65mm (2½") and over, flanged

.1 850 kPa (125 psi), to MSS SP-71, Class 125, cast iron body with flat faced flange, renewable bronze seat rings, bronze faced iron or bronze disc, bolted cap.

.2 Kitz 78, Crane 373, Jenkins 587J, Newman Hattersley 651 and Nibco F-918

.8 Swing check valves 50 mm (2") and over, grooved:

.1 2065 kPa (300 psig), ductile iron body with spring-assisted disc.

.2 Victaulic series 719, NPS 2 ½ to 4 and Victaulic series 779, NPS 4 to 14

.9 Ball valves up to 50 mm (2"):

.1 1000 kPa (150 psi), two piece bronze body and chrome plated bronze ball, PTFE seat rings, solder joint or NPT to copper adapters, full port.

.2 Kitz 58 and 59, Crane 9302 and 9322, Jenkins 201J and 202J, Nibco S-FP-600 and T-FP-600 and Newman Hattersley 1969F and 1999.

.12 Balancing cocks:

.1 50mm (2") and smaller: DeZurick series 425. 65mm (2½") and larger: Flanged DeZurick Series 100. Both types to be complete with memory stops.

.13 Gas valves, CGA approved - lubricated plug type: 12 to 50 mm (½" to 2"): Newman Hattersley 70M.
65 mm (2½") and greater, flanged: Newman Hattersley #171M.

.14 Corporation stops and site service valves:

.1 Corporation Stops 2" to 12": Cambridge Brass "Century" brass body ball valve with connections to suit piping. Ball to be stainless steel with teflon seats. Provide cast iron housing with threaded cover to suit depth of bury.

.2 Valves 2” to 12” FM, UL and ULC approved: Kennedy Valve mod. 4701 to AWWA standard C509. Flanged epoxy coated cast iron body, non-rising stem, 2” operating nut and post plate complete with Clow Canada Series 900-S/900-C adaptor flange/restrainer where connection to PVC pipe is required. Provide extension stem and cast iron housing complete with cover to suit depth of bury. Valves as manufactured by Clow are also acceptable.

.15 Balancing Valves: Where specified at items of equipment and where shown on schematic piping diagrams, provide S.A. Armstrong Ltd. Model CBV1 and CBV11 or Victaulic/Tour & Andersson Series 78K, 786, 787, 788 or 789 circuit balancing valves. Each valve to have features as follows:

.2 Screwed or flanged bronze or cast iron 1725 kPa (250 psi) bodies with maximum operating temperature of 121°C (249.8°F) with tamperproof balance setting, positive shut-off and drain.

.3 Other acceptable Manufacturers: Tour and Anderson, ITT and Newman-Hattersley.

.16 Pump Discharge Control Valves: Unless stated otherwise, provide S.A. Armstrong Ltd. Flo-Trex combinations check, balancing and shut-off valves at discharge of pumps. Newman Hattersley, Watts and Grinnell valves are also acceptable.

.17 Tri-Service Valve Assembly: Install Victaulic Tri-Service Valve Assembly at pump discharge for shutoff, throttling, and non-slam check service consisting of Vic®-300 MasterSeal™ butterfly valve and Series 779 venturi check valve with flow measurement capabilities, installed with Victaulic couplings (style to be determined by system requirements), 2065 kPa (300 psi) CWP rating.

2.05 HANGERS AND PIPING SUPPORTS

.1 Hangers:

.1 Provide adjustable Clevis type equal to Grinnell Fig. 65 for pipe sizes up to and including 65mm (2½"). For pipe sizes 75mm (3") and over, provide adjustable Clevis type equal to Grinnell Fig. 260. Use rod sizes as recommended by the manufacturer. Provide Grinnell FM approved Fig. 104 split swivel or Fig. 69 swivel type hangers on fire protection piping. On copper piping, provide copper plated type hanger or separate piping from hanger with an approved insulating tape or plastic coating. Grinnell adjustable ring type fig. 97 and fig. 97c (coated) are acceptable on copper piping up to 65 mm (2½”). Where insulation covers hanger, refer to Section 20 05 25.

.2 Provide oversized hangers to pass over insulation on all cold water piping. Refer to detail drawings and Section 20 05 25.

.2 Piping supports:

.1 For roof mounted piping, provide pipe roller supports with clamps as manufactured by Portable Pipe Hangers installed to Manufacturer’s specifications. Use PPH model SS-8R or PP10 with roller for piping up to 65mm (2½”) and use model PS-1-2 for pipes over 75mm (3”) and up to 200mm (8”). For refrigeration piping and conduilts, use PPH model PS1-2. For pipes over 75mm (3”), use PPH-RB18 with clamps, base and all other applicable support. Supports to be aluminium with stainless steel clamps and rollers. Membrane pads to be close-cell extruded polystyrene insulation equal to Dow Chemical Roofmate.

.2 For roof mounted gas piping: On stable flatbed roof, use pipe supports by Quick Block with oversized stainless steel clamps for roof mounted gas piping up to 125mm (5”). Supports for gas piping must be CGA certified & listed and meeting the requirement of gas code B149.1.

.3 For pipe risers, provide supports equal to Grinnell Fig. 40, black carbon steel, sized to carry the operating weight of the piping.

2.06 INSERTS

.1 Use only factory made, threaded or toggle type inserts as required for supports, and anchors, properly sized for the load to be carried.
.2 Use factory made expansion shields where inserts cannot be placed, but only as accepted by the Consultant and for light weights.
.3 Do not use explosive activated tools except with written acceptance of the Consultant.

2.07 SLEEVES

.1 Piping: Machine cut schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel; refer to detail drawings.
.2 Ductwork: At fire dampers refer to detail drawings: Other locations formed to accommodate duct size or access opening as required.

2.08 AIR VENTS

.1 Provide air vents as manufactured by Maid O Mist No. 7 series or Braukmann. Where system pressure exceeds 345 kPa (50 psig) provide air vents with 1035 kPa (150 psig) rating.

2.09 EXPANSION TANKS

.1 Provide in sizes as shown in equipment schedules prepressurized diaphragm type expansion tanks meeting current ASME and CSA code requirements designed for a maximum working pressure of 1035 kPa (150 psi) or as indicated in equipment schedules. Expansion tanks constructed of mild steel with painted finish and complete with all necessary tappings in combination with Filtrol valve and automatic vent.
.2 Acceptable Manufacturers: O’Connor, Clemmer, Amtrol, Expanflex.

2.10 ANCHORS, GUIDES AND EXPANSION COMPENSATORS

.1 Provide hangers, supports, anchors, guides, expansion compensation and restraints for all vertical piping risers and horizontal piping for all services including but not limited to, heating, cooling, domestic water (all), drainage (all), fuel oil, gas, fire protection.
.2 Mechanical contractor is to review **all** structural drawings and in particular refer to the “structural Deformation” drawing for building movement and or shrinkage. If this drawing is not available the contractor must obtain this information direct from the structural consultant.
.3 Design Standards: Expansion Joint Manufacturer Association, ASTM B31.1, ASTM B31.9, ASHRAE and Manufacturers Standardization Society.

.4 All vertical risers for all services including but not limited to, heating, cooling, condenser (heat pump loop), domestic water (all), drainage (all), gas, fire protection subjected to thermal expansion and/or contraction including building movement and building contraction shall be supported by spring isolators and central anchors designed to insure loading within design limits at structural support points. The riser design must be prepared and submitted for approval by the same isolation vendor supplying the HVAC mechanical equipment isolation and must include the initial load, initial deflection, change in deflection, final load and change in load at all spring support locations. In order to minimize load changes, the initial spring deflection must be at least 4 times the thermal movement. The isolation vendor shall provide and design all brackets at riser spring and anchor locations where standard clamps lack capacity or do not fit. The contractor must install and adjust all isolators under the supervision of the designing isolation vendor or his representative. The submittal must also include anchor loads when installed, cold filled, and at operating temperature. Include calculated pipe stress at end conditions and branch off locations as well as installation instruction. The support spring mounts to be Type SLF, anchors Type ADA, telescoping guides Type VSG, all as manufactured by Mason Industries, Inc.

.5 Hangers, supports, anchors, guides, expansion compensation, spring isolators and restraints to be designed and selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. The Mechanical Contractor is responsible to engage a Professional Engineer for the design of all hangers, supports, anchors, guides, expansion compensation, spring isolators and restraints systems based on piping material used and final layout of piping risers. The Mechanical Contractor is also responsible to provide detailed shop drawings showing calculations and equipment details of all anchors, guides and compensation for all systems with potential for thermal expansion/contraction and/or loads due to weight or thrust including heating and cooling mains, fan coil or heat pump risers and domestic water risers. These shop drawings to bear the signed seal of a Professional Engineer licensed to practice in the appropriate discipline and place of work. These shop drawings to include all details of construction including but not limited to the following:

.1 Static and dynamic forces at each anchor.
.2 Manufacturer’s cut sheets for anchors.
.3 Thermal compensation calculations.
.4 Manufacturer’s cut sheets for compensation equipment.
.5 Manufacturer’s cut sheets for guides.
.6 Amount of expansion per floor and amount of expansion between each anchor based on Actual temperature of pipe when anchors were installed.
.7 distance between floors.

.6 Make adjustments as necessary to satisfy the requirements of Structural Division.

.7 No anchors to be installed prior to shop drawings being reviewed and approved by Structural Division.

.8 Expansion compensation supplier to be responsible for site review/inspection of all devices and verification that all compensation devices are in the neutral position after anchoring and verification that any temporary spacing device, locking tabs, etc. have been removed prior to any heating or cooling system start up. Upon completion of review/inspection the mechanical contractor to issue a detailed report to the Consultant, including photos and including location of each device, signed by supplier confirming that each compensation device has been reviewed.

.9 Anchors, guides, expansion compensation shown on the drawings are for information only. Mechanical Contractor to be responsible to provide all elements of the system as described above.

.10 Selection of compensators to meet the pressure rating of each system. Compensators in domestic water application to meet the requirement of NSF 61. Bellows type expansion compensators **not** to be used for compensation on fan coil or heat pump risers. Provision to be made for seismic protection in seismic zones. Acceptable manufacturer: Mason Industries.

.11 Provide proper protection of all branch lines which are subject to the temperature difference and/or movement of vertical risers. Proper support, spring hangers and/or stainless steel braided hoses may be used for the protection of the piping systems.

.12 Professional engineering design services for detailed design of anchors, compensation and guides from the following companies will be accepted:

Tecoustics Ltd.
5036 South Service Road Burlington,
ON L7L 5Y7
(905) 681-6077
Pressure Vessel Engineering Ltd.
120 Randall Drive
Suite B Waterloo, ON
(519) 880-9808

2.11 STRAINERS

.1 Provide where shown on the drawings, strainers as manufactured by Kitz, Mueller or Spirax Sarco:
- .1 50 mm (2“) and smaller:
  - .1 863 kPa (125 psig) / 1379 kPa (200psi) WOG rating
  - .2 Cast bronze body, screwed cap, Y-pattern, threaded or soldered ends.
  - .3 Kitz 15 (threaded)/16 (soldered), Mueller 351M (threaded)/353 1/2MM (soldered)
- .2 65 mm (2½“) and greater:
  - .1 Class 125
  - .2 Cast iron body, bolted cover, Y-pattern, flanged ends.
  - .3 Kitz 80, Mueller 758

.2 For pressure higher than 863 kPa (125 psig) and up to 1724 kPa (250 psig):
- .1 50mm (2”) and smaller:
  - .1 1724 kPa (250psig) / 2758 kPa (400 psig) WOG Rating
  - .2 Cast iron body, screwed cap, Y-pattern, threaded ends.
  - .3 Mueller 11M
- .2 65mm (2½”) and greater:
  - .1 Class 250
  - .2 Cast Iron body, bolted cover, Y-pattern, flanged ends.
  - .3 Mueller 752

.3 Unless noted otherwise, provide an integral strainer for pressure relief valves, pressure regulating valves and backflow preventers.

.4 Strainer baskets:

.1 Type 304 stainless steel or Monel,
.1 2" and smaller strainer size:
.1 20 mesh perforations for water [0.838mm (0.033") perforations for steam]
.2 2 ½" to 4" strainer size:
.1 1.57mm (0.062") perforations for water [1.14mm (0.045") perforations for steam]
.3 5"-10" strainer size
.1 3.17mm (0.125") perforations for water [1.14mm (0.045") perforations for steam]
.4 10" and larger size
.1 3.17mm (0.125") perforations for water [1.57mm (0.062") perforations for steam]
.5 For pump suction service, provide 3.175mm (0.125") perforations.

.5 Combination strainers and pump inlet diffusers, with screens as specified above, manufactured by S.A. Armstrong Ltd. (Suction Guide), Victaulic (Style 731) or Taco Model SDO are also acceptable.

2.12 THERMOMETERS AND GAUGES

.1 Pressure Gauges:
.1 Gauges where indicated on the drawings: Winters model P1S-100 Series to ANSI B40.100 grade "1A" level with SI and Imperial scales 115mm (4½") complete with ball valves and PSN B snubbers. Scale: To meet operating pressure ranges. 0-700 kPa (0-100 psi].
.2 Provide brass, bronze or copper fittings only.
.2 Thermometers
.1 Provide bi-metal dial type thermometers complete with stainless steel separable wells as shown on the Drawings and as manufactured by Trend (Winters). Model 32 adjustable angle 75mm (3") diameter with external reset. Range: 0°C to 50°C (32°F to 122°F) for chilled and condenser water and 10°C to 150°C (50°F to 302°F) for hot water with both Celsius and Fahrenheit scales.

.2 Gauges and thermometers as manufactured by Trerice and Ashcroft will also be accepted.

2.13 DIELECTRIC COUPLINGS

.1 Provide dielectric isolation between pipes of dissimilar metals with suitable couplings, insulating dielectric unions, insulating flanges, or insulating gaskets between flanges.

2.14 WIRING

.1 Electric power wiring for equipment (connection of motors through starters and disconnects) provided by mechanical trades is specified in Division 26. Electrically operated equipment: to CSA Standard and bear Certification label.
.2 Provide motor control wiring (at any required voltage) between starter panels and control components to all requirements specified for similar wiring in Division 26.

.3 Provide wiring of items supplied by equipment manufacturers such as filter advance motors and control, high level alarms, low water cut offs, anti-vibration lock outs, flow switches, remote and local thermostats for unitary heating equipment and rooftop HVAC units, sump pump alternators, level controllers, water treatment equipment, and oil/grease interceptor alarms, and control wiring between starters and control panels (e.g. air cooled condensers, cooling towers and condensing units). Also provide wiring for communications interface panels, sensors, oil pumps, purge pumps and oil heaters supplied with water chillers. Refer also to Section 25 01 01.

2.15 ELECTRIC MOTORS

.1 CSA labelled, and except where specifically noted, all motors below 560 Watt (3/4 HP): 120 volt, single phase, 60 cycle. 560 Watt (3/4 HP) and over: 208 or 575 volt 3 phase, 60 cycle refer to Electrical Drawings and Mechanical Equipment Schedules for exact details. Motors to meet NEMA standards for maximum sound level ratings under full load. Service factor on all motors to be 1.15.

.2 Motor bearings: to be permanently lubricated ball type for motors up to and including 3725 W (5 hp). Bearings for all motors over 3725 W to be self-aligning greaseable ball bearings sized to provide life of at least 50,000 hours under belt driven service.

.3 Single Phase Motors: Provide permanent split capacitor type. Motors 14.9 kW (20 hp) and greater: Provide thermistor over temperature protection for each winding, wire in series, with leads terminated in the motor junction box.

.4 All motors over 186 W (1/4 HP) to be TEFC. All motors over 1 HP to be high efficiency type with ratings based on statistically valid Quality Control procedures conforming to ANSI/IEEE 112 (Ref. 10), Test Method B (dynamometer), using NEMA MG1 (MG1-12.54 and MG1-12.55) (Ref.11), and conforming to efficiency ratings as defined in Table 10.4.1.A (a) under SB-10 of Ontario building Code. Motors to be approved under the Canadian Electrical Safety Code.

.5 For motors used with variable frequency drives, provide Class H motor winding insulation and be inverter duty type manufactured to NEMA Standard MG-1 part 31 “Definite purpose inverter-fed motors”. Ensure that drive Manufacturer reviews motor shop drawings prior to releasing order.

.6 Acceptable electric motor manufacturers: Westinghouse, CGE, Reliance, Brook-Crompton, Marathon, US Motors, WEG and Siemens.

2.16 MOTOR STARTERS – LOW VOLTAGE

.1 Electric motor starters for all motorized mechanical equipment are to be provided by Division 20, 21, 22, 23 and 25. Refer to Section 20 05 35 Motor Starters – Low Voltage for the requirements of motor starters.

2.17 MOTOR CONTROL CENTERS – LOW VOLTAGE

.1 Motor Control Centers for motorized mechanical equipment are to be provided by Division 20, 21, 22, 23 and 25. Refer to Section 20 05 35 Motor Control Centers – Low Voltage for the requirements of Motor Control Centers.

2.18 AIR SEPARATORS

.1 The Air Separator shall be designed, constructed, and stamped in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors.
.2 The Air Separator shall be rated for 862kPa (125 ps**i)** maximum working pressure.
.3 The Air Separator shall have a maximum temperature rating of 350°F (177°C).
.4 The Air Separator body shall be made of cast iron or carbon steel.
.5 The Air Separator body shall be three times the nominal inlet/outlet pipe diameter.
.6 The Air Separator shall include threaded blow down connection to allow for sediment to be regularly cleaned out of the unit.
.7 The Air Separator shall include a threaded air removal connection on top of the unit so an air vent or expansion/compression tank can be connected, allowing collected air to be removed from the unit. Provide automatic air vent at each air separator.
.8 The Air Separator shall be available with either NPT end connections (50mm thru 75mm sizes only), flanged end connections, or grooved end connections. Flange end connections should be designed according to ANSI Standards.
.9 Unless otherwise indicated, air separators are to be line sized.
.10 Acceptable manufacturers: Xylem Bell and Gossett, Armstrong, Taco, or equal.

2.19 MECHANICAL IDENTIFICATION

.1 Equipment Nameplates
  .1 Provide apparatus (including electric motors) with proper nameplates affixed thereto, showing the size, name of equipment, serial number and all information usually provided, which also includes voltage, cycle, phase and horsepower of motors and the name and address of the Manufacturer.
  .2 Nameplate wording shall also include equipment tag information, generally to be as per drawings (i.e. EF-1, AHU-1, etc.), and is to include equipment service and building area/zone served.
  .3 Nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.
.2 Valve Tags
  .1 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:
  VALVE V12 200 mm (8")
  CHILLED. WATER NORMALLY OPEN

.3 Pipe Identification

.1 Standard pipe identification to be Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:

.1 for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;

.2 for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.

.2 Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
Non-potable Water	green	NON-POTABLE WATER
chilled drinking water	green	CH. DRINK WTR.
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
irrigation water	green	IRRIGATION WATER
ground water	green	GROUND WATER
fire protection standpipe	red	F.P. STANDPIPE
fire protection sprinklers	red	F.P. SPRINKLER
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
glycol heating supply	yellow	GLY. HTG. SUPPLY
glycol heating return	yellow	GLY. HTG. RETURN
glycol heating drain	yellow	GLY. HTG. DRAIN
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Heat pump loop supply	Yellow	HEAT PUMP SUPPLY
Heat pump loop return	Yellow	HEAT PUMP RETURN

.4 Duct Identification

.1 Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background. Supply, return and exhaust ducts shall all be properly identified.

PART 3 - EXECUTION

3.01 INSTALLATION

.1 Install equipment, ductwork, conduit and piping in a workmanlike manner to present a neat appearance and to function properly to the acceptance of the Consultant. Install ducts and pipes parallel and perpendicular to building planes. Install piping and ductwork concealed in chases, behind furring, or above ceiling. Install exposed systems grouped to present a neat appearance. Comply with manufacturer's installation instructions.

.2 Install gauges and thermometers to permit easy observance from floor level.

.3 Install all equipment and apparatus with adequate space allowance for wiring, maintenance, adjustment and eventual replacement.

.4 Install control devices to guarantee proper sensing. Shield elements from direct radiation and avoid placing them behind obstructions.

.5 Include in the Work all requirements of Manufacturers shown on shop drawings.

.6 Install all ceiling mounted components (Diffusers, Grilles,) in accordance with reflected ceiling Drawings.

.7 Leave space clear and install all work to accommodate future materials and/or equipment and to accommodate equipment and/or materials supplied by other trades. Verify spaces in which work is to be installed. Install pipe and ductwork runs to maintain maximum headroom and clearances and to conserve space in shaft and ceiling spaces.

.8 Confirm on the site the exact location of equipment and fixtures. Confirm location of equipment supplied by other trades and mechanical requirements thereof.

.9 Where FMP “flow measurement port” is shown on the Drawings, make installation as described on the Detail Drawings and in a location as shown on the schematic piping drawings. Install the flow measurement port in straight run of pipe at least 3 m (10 ft. +/-) downstream from any valve, thermometer, tee, elbow or any other pipeline device.

3.02 EQUIPMENT CONNECTIONS

.1 Install piping connections to pumps and all other equipment without strain at the pipe connections. Remove, where requested by the Consultant, bolts in flanged connections or disconnect piping after the installation is complete to demonstrate that the piping has been so connected.

.2 Provide shut off valves on supply and return piping connections on all items of equipment.

.3 Provide flexible connectors on supply and return piping connections on all based mounted pumps.

.4 Corrosion Prevention: Install dielectric couplings as specified in Part I at:

.1 Connections to copper/aluminum perimeter convectors, radiant ceiling panels

and coils with copper connections in steel piping systems.

.2 Connections between copper and steel pipe.

.3 Connections to cooling coil condensate drains.

.4 Steel Valves used in a copper or copper alloy piping system. In this case, use brass or bronze valves whenever possible.

.5 Connections to expansion tanks and domestic hot water tanks in copper piping systems.

.6 In either steel or copper piping systems, do not put short black steel nipples and individual black steel fittings between brass or bronze components such as valves use only copper, brass or bronze components. Use a minimum of eight times the mass of steel pipe or components between any two brass, bronze or copper fittings or components.

.7 Do not use copper alloy (brass and bronze) fittings and valves in place of specified dielectric couplings.

.8 Hot water and stream boilers: Connections to the boilers are to be swing joints. Provide a minimum of 600mm (24”) piping for swing joints.

.5 Generators:

.1 Install and connect the flexible piping and muffler supplied by Division 26. Make installation in accordance with detail drawing.

.2 Install and connect the gas vent supplied by Division 23. Make installation in accordance with the manufacturer’s instruction.

.3 Provide all supports, guides, bellow type expansion joints, pressure relief valves, guy sections, guy tensioners, roof thimbles, roof flashings, storm collars, flip top terminals and other necessary accessories and devices as required to provide a complete system per manufacturer’s instruction.

.4 Generator exhaust system from muffler discharge to the termination point, including all accessories, shall be from one manufacturer.

3.03 DRAINS

.1 Pipe all discharge from relief valves and drains from equipment, outside air plenum/louvre, chemical pot feeders and tanks to nearest floor drain or suitable receptacle.

.2 Provide 20mm (¾") ball valves with hose ends, caps and chains at strainers, all piping system low points, pumps, coils and at each piece of equipment.

.3 Provide deep seal traps (150mm trap seal) on all air handling equipment condensate drains and on floor drains located within air handling unit plenums. Provide trap seal primers on all floor drain traps and gang traps.

3.04 PIPING SYSTEM INSTALLATION

.1 Install all piping in accordance with the best practices of the trade.

.2 The piping shown on the drawings is diagrammatic for clearness in indicating the general run and connections and may or may not be, in all instances, shown in its true position. Take responsibility for the proper erection of systems of piping in every respect suitable for the work intended and as described herein.

.3 Keep plugged or capped all openings in pipe or fittings during installation.

.4 Install piping to avoid any interference with the installation or removal of equipment, other piping and ducts.

.5 Install all valves, strainers and specialties to permit easy operation and access. On

horizontal piping, install valves in an upright position. Where there are space constraints mount valves at a 45 deg. off vertical maximum. Install strainers to provide easy strainer basket removal.

.6 Install systems to provide thorough drainage and air elimination.

.7 During welding or soldering procedures, provide a fire retardant cloth, mat or blanket to protect the structure, and adequate fire protection equipment at all locations where work is being done. Close off shaft or confined areas with a fire retardant mat or cloth to prevent sparks or pieces of hot metal from falling down the shaft or area way.

.8 Provide long turn pipe fittings having not less than pipe wall thickness. Provide line size tees.

Where branch lines are more than two sizes smaller than the main, weldolets may be used.

.9 Where steel piping is required to be buried, apply two coats of Densopaste (Denso of Canada Ltd.) primer to all buried surfaces after assembly and testing. Hot or cold applied tape as manufactured by Tapecoat, selected for the application and applied to manufacturer's instructions, is also acceptable.

.10 Where it is necessary to offset piping to avoid obstructions, use 45 degree rather than 90 degree elbows.

.11 Provide suitable cleanouts on every other change in direction and slope all condensate drip drains.

.12 Make all threaded pipe joints on water piping using a thread paste or teflon tape suitable for the service for which the pipe is to be used. Use of hemp or similar materials on threaded joints will not be permitted.

.13 For Grooved Couplings and Fittings: Comply with manufacturer's installation instructions for all products. Ensure that grooved pipes are in compliance with the current manufacturer's specifications and recommendations.

.1 Ensure that the "A" dimension, i.e. the area from the pipe end to the front edge of the groove is free from indentations, scores, seams, projections or roll marks.

.2 Use only lubricants which are nontoxic and non-injurious to the gasket material.

.3 Upon completion of assembly, the bolt pads of each coupling must be fully drawn together, except for HP 70 (Victaulic) couplings in sizes to 100mm (4").

.4 All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

.5 The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. .

.6 A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation as requested by the Consultant. Contractor shall remove and replace any improperly installed products.

.14 Natural Gas Piping: Install in accordance to relevant Codes. Provide vents to atmosphere for all safety switches and regulators as required by Code. Provide approved type pipe supports under roof mounted piping and install all supports according to Code and manufacturer's instruction. Refer to the Gas Code for spacing requirements.

.15 Install all piping requiring insulation with sufficient clearance to apply, seal and finish the insulation.

.16 Provide sufficient space between piping to install valves arranged in straight rows or equally spaced steps. Valve wheels, handles and operators to be easily accessible and operable.

.17 Do not install horizontal piping within masonry walls. Any piping installed in this manner will not be accepted.

.18 Use only non-ferrous metals in high humidity areas.

.19 Do not suspend any equipment, piping, ducting or any other mechanical components from formed hollow steel decking.

.20 Sanitary and storm piping: Provide all necessary restraining devices for all vertical and horizontal piping in major piping offsets or where turn of direction occurs. Restraining devices are to be an engineered product and designed solely for restraining application. Installation of restraining devices to be provided according to manufacturer's requirement.

.21 Underground sanitary and storm piping: Underground sanitary and storm piping required to be hung under structure slab are to be cast iron piping meeting the requirements of the Authorities having jurisdiction.

.22 PEX Piping:

- .1 Installer must be licensed plumbing contractor, trained and certified by PEX tube manufacturer.
- .2 Follow the most current version of manufacturer's installation requirements for all installation.
- .3 Prior to submitting shop drawings, it is the responsibility of the PEX manufacturer to review and verify that all piping sizes shown on the drawings are within manufacturer's recommended velocities. Increase tubing sizes as required at no additional cost.
- .4 Expansion and Contraction Provision:
  - .1 Hanger spacing:
    - .1 10 mm (3/8") or smaller – 800 mm (32") with 10mm 3/8") rod.
    - .2 25 mm (1") to 50 mm (2") – 1200 mm (48") with 10mm 3/8") rod.
  - .2 Riser support:
    - .1 Follow manufacturer's installation requirements.
    - .2 As a minimum, install riser clamps at the base of each floor and at the top of every other floor for cold water lines.
  - .3 Install mid storey guides between each floor.
  - .4 Provide anchor points at a minimum of every 20m (65 feet) or to manufacturer's recommendation whichever is most stringent for systems on continuous runs without jogs,
  - .5 Provide thermal expansion compensators per manufacturer's installation instruction.

.5 Site Verification of Conditions: PEX manufacturer to verify that site conditions are acceptable for installation of the domestic water piping. Do not proceed with installation until unacceptable conditions are corrected.

.6 Tubing manufacturer to provide periodic field inspections to certify that installation of piping meets manufacturer's requirements. Submit field verification reports to Consultants.

.7 Before closing of wall enclosure where risers are located, provide inspection of fire stopping of wall/ floor assembly by qualified professional certifying that the installation meets the requirements of PEX piping manufacturer and the fire stop manufacturer.

.8 Provide access door for all manifolds.

.9 Do not store PEX piping outdoor where exposed to the sunlight. Make every precaution in protecting piping against UV.

.10 Do not use in any application where tubing are exposed to direct sunlight.

.11 Do not allow tubing to come in extended contact with pipe thread sealing compounds, fire wall penetration sealing compounds or petroleum-based materials or sealers.

.12 Do not install tubing less than 300 mm (12") vertically or 150 mm (6") horizontally from source of high heat such as heating appliance or light fixtures.

.13 Pressure test to be carried out with water at 100 psi or equal to the expected working pressure of the system whichever is higher.

.14 If disinfection of Potable Water system is required by the Authorities Having Jurisdiction and the conditions are not specified, the following procedures can be used:

.1 Duration:

Chlorine Concentration (ppm)	Disinfection Period (hours)	Authority
50 to 100	3	AWWA
50	6	ICC

.2 Pre-mix the solution before injection into the system.

.3 Thoroughly flush all lines of the system at the end of the disinfection period.

.23 Victaulic Piping:

.1 Victaulic Certified Contractor Training:

.1 The grooved coupling manufacturer's (the "manufacturer") factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. All contractor field personnel installing Victaulic couplings must have completed the Victaulic Certification Program. This shall be at the expense of the installing contractor

.2 Victaulic Inspection Services:

.1 A Victaulic factory trained representative shall periodically visit the job site and review the installation for best practices. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic Inspection Services prior to the completion of the project. The installing Contractor shall correct any identified deficiencies.

.2 Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic Inspection Services prior to the completion of the project. Any Victaulic product that has not been corrected or was not examined will not be considered as part of the successful completion of Victaulic Inspection Services.

.3 Application:

.1 Upon completion of the manufacturer's inspection of the installation and any identified corrections, the manufacturer must provide the owner or purchaser with a warranty on manufacturer's products and their installation. The manufacturer shall provide a letter confirming that upon review, all products were adequately installed and the system meets their installation requirements. The manufacturer must determine the number of fittings that need to be reviewed in order to provide this sign-off documentation. This letter shall be included as part of the close-out documentation.

.24 Provide a stainless steel drip pan under all piping installed in: electrical, communications, security, CACF rooms or any room in which valuables can be damaged (ex. Locker Rooms). Drip pans to be sloped and piped to the nearest funnel floor drain.

3.05 CONTROL COMPONENTS

.1 Install all pipe line devices required by the Section 25 01 01 sub-contractor such as flow switches, valves and separable wells for temperature controllers and sensors.

3.06 DIRT ACCUMULATION IN CONTROL VALVES

.1 Remove any dirt accumulated under seats of automatic control valves during the first year's operation. Replace damaged valve parts at no additional cost to the Owner.

3.07 FIELD WELDING

.1 Included in the scope of work, make arrangements and pay for registration and inspection by TSSA, for the following pressure piping systems:

.1 Steam piping including condensate piping at pressure 100 kPa (15 psig) or higher
.2 Service water piping at design temperature above 121°C (250°F) or at design pressures at and above 1070 kPa (160 psig)
.3 Chilled water and cooling water at design temperatures above 65°C (150°F) or design pressures above 1725 kPa (250 psig)
.4 Fuel oil piping at pressure 690 kPa (100 psig) or higher
.5 Compressed air, greater than 19mm (¾"), at pressures and over 100 kPa (15 psig)
.6 Medical gas piping system
.7 Other piping system as required certification by the Authorities Having Jurisdiction.

.2 Piping standards to ASME B31.1 Code for Pressure Piping, for registered pressure piping system.

.3 Welding to be carried out using approved procedures by welders certified for pressure piping by TSSA.

.4 Arrange and pay for services of an Inspection Company specializing in making and interpreting x- rays of pipe welds. Examine a minimum of 10% of welds in piping carrying steam at 700 kPa (100 psi) or over using random selection procedure.

.5 Only persons holding current welding certificates for the applications required for the Work to be permitted to do any welding. Perform all welding to Standards specified by Authorities. Do not weld to structural members of the building.

3.08 HANGERS

.1 Hanger rods may be attached to beam or joist clamps, brackets, or concrete inserts. Explosive actuated tools are not permitted. Do not weld to structural steel unless accepted by the Consultant.

.2 Install hangers to the following table.

STEEL PIPE	
Nominal Pipe Size	Distance Between Supports
Up to 32mm (1¼")	2,400mm (8 ft.)
40mm (1½") - 65mm (2½")	3,000mm (10 ft.)
75mm (3") and over	3,600mm (12 ft.)

COPPER TUBING	
Nominal Pipe Size	Distance Between Supports
Up to 20mm (¾")	1,800mm (6 ft.)
20mm (¾") - 25mm (1")	2,400mm (8 ft.)
32mm (1¼") - 50mm (2")	3,000mm (10 ft.)
65mm (2½") and over	3,600mm (12 ft.)

3.09 AIR VENTS

.1 Provide air vents on water piping at all high points in the system and at each piece of equipment.
Provide ball valves on automatic vents.

.2 Provide automatic air vents on piping mains except where a possibility from water damage would occur, in which case, use manual vents.

.3 Provide manual air vents at each piece of equipment.

.4 For all vents, except for screw driver operated type at convectors and unitary heating equipment, provide 9mm (⅜") copper drains to nearest floor drain.

3.10 EXPANSION JOINTS

.1 Install expansion loops, joints and compensators in accordance with the Drawings and manufacturer's instructions in regard to proper length, anchoring and guiding, pre compression, removal of spacers and testing.

3.11 ANCHORS, GUIDES AND EXPANSION COMPENSATORS

.1 Install all hangers, supports, anchors, guides, expansion compensators and restraints per manufacturer's recommendations and per the requirements of the Professional Engineer responsible for the provision of the detailed shop drawings for hangers, supports, anchors, guides, expansion compensation and restraints.

.2 Manufacturers to provide field verification of the installation during construction phase and provide sign off letters upon completion of installation.

3.12 PROTECTION

.1 Cover openings in equipment and cover equipment where damage may occur from

weather. Cover temporary openings in ducts and pipes with polyethylene sheets, until final connection is made. Cover all items cast into concrete floors or walls such as floor drains and cleanouts prior to pour, with heavy plastic tape or duct tape.

.2 Cover and seal, with polyethylene sheeting, all equipment, coils and motors in place during construction to prevent entry of dust, paint and debris.

3.13 RIGGING OF EQUIPMENT

.1 Provide all rigging, hoisting and handling of equipment as necessary in order to place the equipment in the designated area in the building.

.2 Direct this work by qualified personnel normally engaged in rigging, hoisting and handling of equipment.

3.14 CONCRETE

.1 Except as specifically indicated on the Mechanical Drawings or where indicated on the Architectural or Structural Drawings as provided by other Sections, provide all concrete work required for mechanical work (bases, curbs, anchors, thrust blocks, manholes, catch basins) in accordance with requirements of Division 3. Provide reinforced concrete housekeeping pads (equipment bases) at least 100 mm (4") high under all floor mounted equipment. Provide 150 mm (6”) high bases under equipment with cooling coils to provide sufficient clearance for deep seal condensate traps.

.2 Provide in good time, all inserts, sump frames, anchors etc., required to be built into forming for mechanical services.

3.15 METALS

.1 Steel construction required solely for the work of Mechanical trades and not shown on Architectural or Structural Drawings: Provided by Divisions 20, 21, 22, 23 and 25 to the acceptance of the Consultant. Prepare and submit installation drawings on any steel construction for acceptance of the Consultant. Provide one coat of primer on all steel supports located outdoors.

3.16 CUTTING AND PATCHING

.1 Give timely notice concerning required openings. In work already finished the Contractor will perform all cutting and patching at the expense of Divisions 20, 21, 22, 23 and 25. Obtain the approval of the Consultant before doing any cutting.

.2 Provide all cutting and patching for mechanical services penetrating walls, floors and roofs as shown on the Drawings. Cut only to suit dimensions required and for minimum clearances.

.3 Seal around services passing through cut openings with materials commensurate with the fire rating of the wall, floor or roof. Ensure sealing is weatherproof for openings through exterior walls and roofs. Before sealing, provide prime coat of paint on all repaired surfaces.

3.17 LINTELS

.1 Lintels for openings in masonry to conform to requirements given on structural drawings and as required by By laws.

.2 Pay all costs for lintels over openings required solely by the mechanical trades.

3.18 FLASHING

.1 Flash all mechanical parts passing through or built into an outside wall, roof or a waterproof floor.
.2 Provide copper flashing for sleeves passing through exterior walls or water proof floors.
.3 Provide counter flashing on stacks, ducts and pipes passing through roofs to fit over flashing or curb.

3.19 INSTALLATION OF ROOF MOUNTED EQUIPMENT

.1 Flashing of equipment bases and curbed openings for ductwork or roof mounted fans and flashing of roof drains and plumbing vents is specified in Division 7. Equipment bases and curbs for openings to be supplied and set in place by Division 20, 21, 22, 23 and 25. Refer to the Detail Drawings.

3.20 INSERTS, SLEEVES AND ESCUTCHEONS

.1 Provide all sleeves required for ductwork, piping and access openings unless they are specifically shown on Architectural and Structural Drawings.
.2 Place inserts only in portion of the main structure and not in any finishing material.
.3 Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.
.4 Provide the following for pipe sleeves:
  .1 Through interior walls, exterior walls above grade, interior non waterproof floors: Machine cut schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel.
  .2 Through walls below grade, waterproof floors, floors in janitor's closets, equipment rooms, and kitchens: machine cut medium cast iron, DWV copper or copper sheet extended 100mm (4") above the floor and cut flush with the underside.
.5 Provide the following for ductwork:
  .1 Where fire dampers are not required in poured walls; removable wood box out of required size. In block or brick walls; masonry to be built around ducting.
  .2 Where fire dampers are required; 18 gauge galvanized steel or heavier sleeves complete with steel angle framing both sides installed in accordance with requirements of Authorities. See also detail drawings.
  .3 Through Equipment Room floors, provide 100mm (4") high concrete curbs for ductwork and any piping so spaced that sleeving is impractical.
.6 Seal all sleeves as follows:
  .1 Through fire rated walls and floors and within mechanical assemblies (ducts): Stop insulation flush with all wall and floor surfaces and seal space between duct or pipe and sleeve with ULC approved and listed fire stopping material as manufactured by Double AD Distributors Ltd. (416) 292-2361 or M. W. McGill and Associates Ltd. “Fire Bloc” (416) 291- 8393 or Dow RTV Silicon Foam or “Metacaulk” as distributed by EMCO Ltd. (416) 742- 6220.

  .2 Provide fire stopping and smoke seals where ducts, pipes or conduits penetrate fire separations. Materials to be supplied, worker training to be arranged, and

installation to be supervised, by a specialist firm with at least 10 years experience in this field.

.3 Approved and listed products from 3M and Hilti Fire Stop are acceptable.

.4 Through all non-fire rated walls and floors stop insulation, where applicable, at wall and floor surfaces. Ram pack ULC labelled mineral wool materials around piping and ductwork. Apply an approved caulking compound over the ram packed material on both sides.

.5 Through foundation walls: Use either of the two following methods:
- .1 Cooperate with the Waterproofing trade and apply an approved caulking compound over ram packed mineral wool on both sides. Over this, on both sides, apply a layer of glassfab tape embedded in two coats of an approved mastic compound.
- .2 Provide Link-Seal Model S mechanical seal mechanism with stainless steel bolting, EPDM seal element and composite pressure plates as supplied by Power Plant Supply Company (905) 845-7951. Follow Manufacturer's instructions in all aspects of installation procedure.

.6 Cover sleeves and openings around exposed piping in all finished areas with chrome plated escutcheons. Cover exposed duct sleeves in finished areas with an 18 gauge galvanized steel collar fixed to wall or floor.

3.21 ACCESS PANELS AND DOORS

.1 Install all concealed Mechanical equipment requiring adjustment or maintenance in locations easily accessible through access panels and doors. Install systems and components to result in a minimum number of access panels.

.2 Access doors are required in walls, ceilings and ductwork for the following:
- .1 Fire dampers and motorized dampers (for inspection, repair and resetting). Provide access doors on both upstream and downstream sides of automatic dampers.
- .2 Duct mounted coils (duct access upstream and downstream sides for cleaning).
- .3 Fan inlets and outlets (for inspection of impellers and vanes).
- .4 Unitary heating/cooling equipment, such as heat pumps and fan coils, in ceiling spaces.
- .5 Duct mounted smoke detectors (for inspection of in-duct sensors).
- .6 Control valves and temperature control components.
- .7 Expansion compensators, guides and anchors.

.3 Indicate access panels on "As built" drawings and note at each location the items (i.e. equipment or valve no.) that access is being provided for.

.4 Supply the Division 8 Subtrade with panels, doors or the frames therefore, complete with all pertinent information for installation.

.5 Prepare detail drawings showing location and type of all access doors in co-ordination with other trades before proceeding with installation and submit for review.

.6 Size access doors to provide adequate access and be commensurate with type of structure and architectural finish.
.7 Ensure proper rating of doors in fire separations.
.8 Provide lamacoid labels (white on black), screwed in place, on all access doors and access tiles listing items or equipment which access is being provided for.

3.22 EXCAVATION AND BACKFILL

.1 Perform all excavation, bedding, backfill and related work within the perimeter foundation walls required for Mechanical Work in accordance with requirements of Division 2 except as supplemented by this Article. Ensure all services are buried a minimum of 1.0 meter (3 feet) where piping is located outside the building perimeter walls.
.2 The balance of backfilling to be performed by Division 2 Subtrade after receiving clearance from Divisions 20, 21, 22, 23 and 25.
.3 Grade the bottom of the pipe trench excavation as required.
.4 In firm undisturbed soil, lay pipes directly on the soil and shape soil to fit the lower ½ segment of all pipes and pipe bells. Ensure even bearing along the barrels.
.5 In rock and shale excavate to 150mm (6") below and a minimum of 200mm (8") to either side of the pipe. Fill back with a bedding of 10mm ($13/32$") crushed stone or granular 'A' gravel.
.6 Prepare new bedding under pipe in unstable soil, in fill, and in all cases where pipe bedding has been removed in earlier excavation, particularly near perimeter walls of buildings, at manholes and catch basins. Compact to maximum possible density and support the pipe by 200mm (8") thick concrete cradle, spanning full length between firm supports. Install reinforcing steel in cradle and construct piers every 2400mm (8 ft.) or closer, down to solid load bearing strata. Provide a minimum of one pier per length of pipe. Use the same method where pipes cross.
.7 Where excavation is necessary in proximity to and below the level of any footing, bed with 14,000 kPa (2000 psi) concrete to the level of the highest adjacent footing. Proximity is determined by the angle of repose as established by the Consultant.
.8 Provide support over at least the bottom one third segment of the pipe in all bedding methods.
.9 Do not open trench ahead of pipe laying and bedding more than weather will permit. Break up rocks and boulders and remove by drilling and wedging. Do not use blasting unless specifically approved by the Consultant.
.10 Perform all, or required portions of backfilling as specified in **Division 3** in 150mm (6") layers with clean selected materials acceptable to the Consultant.
.11 Backfill and compact to the following standard Proctor percentages:

Sodded area	85%
Under paving	95%
Under Floor slabs	100%

.12 Dispose of excavated material as directed by the Contractor.

3.23 PAINTING

.1 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment before painting. Finish painting is specified in Division 9. This Division is not required to prime coat or paint ductwork or piping.

.2 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.24 MECHANICAL WORK IDENTIFICATION

.1 Identify new exposed piping and ductwork in locations as follows:
- .1 At every end of every piping or duct run;
- .2 Adjacent to each valve, strainer, damper and similar accessory;
- .3 At each piece of connecting equipment;
- .4 On both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;
- .5 At 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;
- .6 At least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.

.2 Unless otherwise specified identify new concealed piping and ductwork in locations as follows:
- .1 At points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;
- .2 At maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;
- .3 At each access door location;
- .4 At each piece of connected equipment, automatic valve, etc.

.3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location. Where equipment is locally switched (e.g. Room exhaust fans) provide identification plate at switch.

.4 Paint new natural and/or propane gas piping with primer and 2 coats of yellow paint in accordance with local governing code requirements and requirements of Division 09. Identify piping at intervals as specified above.

.5 Provide an identification nameplate for each motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter provided as part of mechanical work, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of mechanical work.

.6 Co-ordinate with Section 25 01 01 Building Automation System subcontractor and obtain list of automatically operated equipment and provide warning identification on lamacoid plate for each item as follows:

"Warning: This equipment may start at any time. Do not service without disconnecting power."

.7 For electrically traced mechanical work, identification wording is to include

"ELECTRICALLY TRACED".

.8 Tag valves and prepare a valve tag chart in accordance with following requirements:

.1 Attach a valve tag to each new valve, except for valves located immediately at equipment they control;

.2 Prepare a computer printed valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);

.3 If an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;

.4 Frame and glaze one copy of chart and, unless otherwise directed, affix to a wall in each main Mechanical and/or Equipment Room;

.5 Include a copy of valve tag chart in each copy of operating and maintenance instruction manuals;

.6 Hand an identified USB of valve tag chart to Owner at same time O&M Manuals are submitted.

.9 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:

.1	HVAC piping valves and equipment:	Yellow
.2	Fire protection valves and equipment:	Red
.3	Plumbing valves and equipment:	Green
.4	HVAC ductwork dampers and equipment:	Blue
.5	Control system hardware and equipment:	Orange

3.25 EXPOSED WORK

.1 Wherever any mechanical work (plumbing, heating and sprinkler piping, ductwork, and associated thermal insulation) is exposed in finished areas, co-ordinate the work with the Consultant prior to installation. If unsatisfactory installation results due to not following this procedure, perform remedial work to the Consultant's acceptance.

.2 For purposes of the foregoing, finished areas do not include parking garages and equipment rooms.

3.26 PIPING SYSTEM TESTS

.1 Do not insulate piping systems until completed, perfected, and proven tight.

.2 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment.

.3 Test piping system in sections as required by the progress of work.

.4 Test all heating and condenser water and domestic water piping hydraulically to a minimum pressure of 1100 kPa (150 psi) or 2070 kPa (300 psi), or 2760 kPa (400 psi) based on system pressure rating or 1.5 times the normal working pressure, whichever is the greater, and prove tight for a period of 8 hours. Testing with nitrogen is also acceptable provided a pressure of 1.25 times values specified previously is used. Test natural gas piping as required by codes and authorities.

.5 All plumbing, heating and cooling mains and branches are to be flushed and cleaned without fixtures and appliances connected.

.6 All tests must be recorded. Submit recorded data to the Consultant.

3.27 AIR AND WATER BALANCING AND TESTING

.1 Costs to perform air and water balancing to be included in the Tender for the Work of Division 20, 21, 22, 23 and 25.

.2 Provide the services of an independent firm specializing in air and water balancing, acceptable to the Consultant, to undertake this work as follows:

.1 Provide personnel to review working drawings, make site visits, prepare reports and take responsibility for measuring and adjusting all air supply, exhaust, return and transfer systems and water and other fluid pumping systems operate in accordance with specified requirements with tolerance of plus or minus 10%.

.2 Review and check working drawings to ensure that modifications, if required, are implemented prior to execution of work.

.3 Provide inspections during the course of construction and issue reports making whatever recommendations are necessary in the interests of achieving specified, heat transfer and air balance.

.4 When the work is adequately completed, inspect, check and test all pumps and fan systems. Also cooperate with controls systems Subcontractor to achieve required air quantities where modulating dampers etc., are installed.

.5 Provide assistance to the Consultant for on-site spot verification of air and water balance report.

.3 Air Balancing

.1 Perform air balancing in accordance with current NBCTA, NEBB or AACB procedural standards by adjusting fan speed. Use damper throttling only in systems where fan motor is less than 1 HP or where throttling results in no greater than one additional fan HP over a reduced RPM condition.

.2 Where ductwork is subject to static pressure in excess of 75mm (3 in.) WC, leak test 25% minimum of total installed duct area of all representative sections of the total system. All testing to conform to requirements of HVAC Duct Leakage Test Manual, 1985, Sections 5 and 6 and tested duct leakage class at a test pressure equal to the design duct pressure class rating to be equal to or less than leakage Class 6 as defined in 4.1 of Ref. 35.

.3 Where ductwork is subject to static pressure below 75mm (3 in.) WC, leak test all mains and major branches. All testing to conform to requirements of HVAC Duct Leakage Test Manual, 1985, Sections 5 and 6 and tested duct leakage class at a test pressure equal to the design duct pressure class rating to be equal to or less than leakage Class 6 as defined in 4.1 of Ref. 35.

.4 Provide Dial 1000 or Dial 2000 or acceptable alternative, duct pilot tube test opening enclosures for installation by the Section 23 31 13 Subtrade. Provide all required test opening locations and installation instructions to the Section 23 31 13 Subtrade.

.5 After inspection and tests, report all required replacement of sheaves and belts

and all required adjustments and ductwork modifications to achieve system performance as specified.

.6 After deficient items have been rectified, retest and issue a final report and certificate covering the following:
- .1 Specified and achieved total air quantities per system supported by curves for all fans over 150 l/s (300 cfm) capacity.
- .2 Specified and achieved individual air quantities per outlet with supporting schematic diagrams showing test points.
- .3 Nameplate and actual motor loading in amperes at actual voltage and installed overload heater size and manufacturer.
- .4 Specified and actual fan total static pressures with breakdown showing inlet and discharge pressures with data shown on fan curves.
- .5 Shelve and belt sizes and quantities per unit.

.7 Provide personnel, tools and materials to assist and work under the direction of the air balancing firm to perform the following:
- .1 Removal and replacement of ceiling tiles.
- .2 Installation of Pitot tube test opening enclosures.
- .3 Installation of dampers and baffles as required for specified air balance and elimination of stratification.
- .4 Provision of access openings and covers.
- .5 Provision of ladders and scaffolds
- .6 Removal and replacement of belt guards.
- .7 Removal and replacement and provision of required sheaves and belts as directed, and other items as necessary for complete and acceptable air balancing procedures.

.4 Water Balancing

.1 Perform hydronic system balancing by minor throttling for pumps that are less than 7.45 kW (10 HP) provided this results in a power draw of no greater than 10% of that required if the impeller were trimmed. For pumps greater than 7.45 kW (10 HP), the same limit applies but in no case is it to exceed 2.23 kW (3 HP). In either case where these limits are exceeded by throttling, the impeller is to be trimmed or replaced.

.2 Make adjustments to achieve specified temperature drops across all finned radiation sections and flows through coolers and coils. Also report all pump data such as suction, and discharge pressure, current draw at tested voltage and starter OL heater sizes and pump motor nameplate ratings.

.3 Provide pump curves indicating the operating point with superimposed power draw, RPM, impeller size, etc.

.4 Instruct piping system installers on proper locations of flow measurement ports.

.5 Report any required pump impeller adjustments to achieve specified performance.

.6 After adjustments, retest systems and issue final report confirming systems are operating in compliance with design.

.7 Provide flow measurement ports as shown on detail drawings and piping schematics in locations as directed by the water balancing specialist. Provide balancing valves where required as directed by the water balancing specialist.

.8 Provide any pump impeller modifications as recommended by the water balancing firm.

.5 Acceptable Air and Water Balancing Contractors:
- .1 Aerodynamics Inspecting Consultants Ltd.
- .2 Designtest & Balancing Co. Ltd.
- .3 Dynamic Flow Balancing Ltd.
- .4 VPG Associates Ltd.

3.28 WORK REQUIRED BY DIVISION 20, 21, 22, 23 AND 25 FOR COMMISSIONING

.1 A commissioning agent (CxA) will be appointed to fully commission the mechanical systems for this project.

.2 The Work of Commissioning is detailed in Division 1. Refer to Division 1 for Works required by this Division for Commissioning.

.3 As a minimum, the Works required by the Division 20, 21, 22, 23 and 25 for commissioning will be as follows:
- .1 Attend all meetings as required for commissioning.
- .2 Provide a complete set of all submittals for electrical equipment to the CxA
- .3 Provide assistance to the Commissioning Agent for verification of all air and balancing information.
- .4 Provide all necessary labour and material for performance verifications of all systems.
- .5 Correct all deficiencies found during Installation Verification Inspection, start-up and TAB to ensure all equipment and systems are fully functional and in complete and proper working order.
- .6 Prepare O&M manuals and supplementary information on all equipment as directed by CxA and assemble in binders tabbed and indexed. Supplementary information may include, but is not limited to, such items as equipment maintenance schedule, vendor and maintenance contact lists. Submit to CxA when requested.
- .7 Return to site with the GC and CxA approximately 10 months after the start of the warrantee period to review system operation and to address operational issues.

.4 Allow sufficient labour and material to provide all necessary documentations as required by the Commissioning Agent.

.5 Perform all other requirements for Division 20, 21, 22, 23 and 25 as requested by CxA or Division 01.

3.29 DETAIL DRAWINGS, LEGENDS AND EQUIPMENT SCHEDULES

.1 Refer to legends and equipment schedules and detail drawings on the drawings. Comply with requirements of the detail drawings. Refer also to the appropriate Sections of this Division for additional information and requirements on scheduled equipment.

END OF SECTION 20 05 10

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05 Mechanical Work General Instructions and Section 20 05 10 Basic Mechanical Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide all equipment, bases, isolators, floating floors, silencers, properly selected to provide sound and vibration control for all motor driven equipment.

1.03 QUALITY ASSURANCE

.1 Execute work of this section in accordance with the manufacturer's instructions by workman only experienced in the installation of vibration isolation systems and equipment.

.2 Provide vibration and noise control products as manufactured by Vibro-Acoustics.

.3 Alternative Acceptable Silencer Manufacturer: BVA Systems, Vibron, E H Price Ltd., IAC, Kinetics or VAW Systems.

.4 Ensure isolators and restraining devices which are factory supplied with equipment meet the requirements of this Section.

.5 Silencers licensed to bear AMCA Certified Ratings Seal. Ratings based on tests and procedures performed in accordance with and complying with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to acoustical and aerodynamic performance. Dynamic Insertion Loss and Pressure Drop: Silencer dynamic insertion loss and pressure drop based on tests and procedures performed in accordance with ASTM E477 testing procedures

.6 Provide all equipment to control noise and vibration such that the average noise criteria curves for the conditioned occupied space, do not exceed NC35 and vibration is below the level of perception for these.

.7 Provide the inspection and supervision services of the vibration and noise control equipment Manufacturer to ensure that during construction all equipment is installed as required to achieve specified performance.

.8 Meet seismic requirements of the current National Building Code for the Place of the Work.

.9 Silencers and any finishes to be ULC labelled and listed for flame spread rating of less than 25 and smoke development classification of less than 50.

1.04 SUBMITTALS

.1 Submit shop drawings on all required equipment inertia bases, vibration isolators, silencers and floating floors detailing geometry and construction, dynamic insertion losses, pressure drops and regenerated noise.

.2 Provide certified test data or calculations as prepared by a registered Professional Engineer attesting to conformance with the requirements of this section.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

.1 Provide all vibration isolation equipment as manufactured by one approved supplier.

.2 Provide isolators as follows:

.1 Type 1 pad isolator: Neoprene steel neoprene pad isolators, manufactured from "Bridge Bearing Quality Neoprene" as defined by CSA Standard CAN 3 S6 M78 section 11.10. Select type 1 pads for a 2.5 mm (0.1") static deflection or greater. Compression to be limited to 25% of unloaded thickness.

.2 Type 2 rubber floor isolators: Rubber neoprene in shear isolators designed to meet specified seismic requirements. Select isolators for a 6 mm (0.25") minimum static deflection, and bolt to structure. Provide protection of the rubber element to prevent oil coming in contact.

.3 Type 3 spring floor isolation: Open spring mounts complete with levelling devices, adjustable side dampers, ribbed neoprene sound pads capable of deflecting 1.25 mm to
2.55 mm (0.05" to 0.10") at operating load, and zinc chromate plated hardware. With snubbers correctly adjusted, the isolator shall meet seismic requirements in accordance with appropriate CISC handbook of steel construction design methods.

.4 Type 4 spring hangers: Open spring type within zinc chromate plated frame with neoprene grommet (1.25 mm deflection) mounted over the retaining washer for placement under the support rod adjustment nut; to have a single stable position when loaded; to allow a ±150 angular misalignment.

.5 Isolators and seismic restraints to meet the requirements of the current National Building Code. Use horizontal force factor SP 10 for mechanical equipment, and SP-15 for equipment containing toxic or explosive materials including steam (these requirements generally mean 0.8 g and 1.4 g respectively for maximum impact loads transmitted to the structure).

2.02 VIBRATION ISOLATION - GENERAL

.1 Provide vibration isolation on all motor driven equipment with electric motors of 0.37 KW (0.5 H.P.) and greater power output and on piping and ductwork as specified herein. For equipment less than
0.37 KW, provide neoprene grommets at the support points.

.2 Provide seismic restraining devices for resiliently mounted equipment.

.3 Ensure isolation systems have a natural frequency no higher than 10 – 15 % of the lowest forcing frequency unless otherwise specified.

.4 Provide horizontal limit springs or snubbers on all spring isolated fans (except vertical discharge) in excess of 1 kPa (4" water gauge) static pressure, and on hanger supported horizontally mounted axial fans.

.5 Provide, for equipment as designated in the Equipment Schedules and/or shown on the Drawings, concrete inertia bases or structural steel frames located between all vibrating equipment and vibration isolation elements. Structural steel frames will not be required if the equipment manufacturer certifies direct attachment capabilities. Provide inertia bases on centrifugal fans with static pressure in excess of 876 Pa (3.5") and/or motor in excess of 30 KW (40 HP) and on base mounted pumps over 8 KW (10 HP).

.6 On fans, as designated in the Equipment Schedules and/or on the Drawings, provide stabilizing springs to eliminate movement at flexible connections to 25% of fabric width

under steady state conditions and 40% at start up. Flexible duct connectors between all isolated fans and non isolated ductwork are specified in Section 23 33 00 Air Duct Accessories.

.7 Provide weatherproof coating (Rustoleum or Neoprene paint) on springs and frames on all isolation equipment exposed to outdoors.

2.03 GENERAL VIBRATION ISOLATION SCHEDULE

.1 Provide vibration isolation in accordance with the following schedule:

Item	Isolator Type	Deflection (mm)	Comments
In-Line pumps	Type 4	43	Refer to details in mechanical drawings
Vertical In-line Pumps	Type 2	2.5	Refer to details in mechanical drawings
Based Mounted Pumps	Type 3	50	Provide Inertia Base when motors are equal or larger than 7.5 kw (10 HP).
Boilers	Type 1	2.5	
Tanks and Heat Exchangers supported from the floor	Type 1	2.5	
Piping Suspended in Mechanical Rooms	Type 4	25	
Fluid Coolers	Type 3	65 minimum	Refer to Section 23 65 10 and Section 23 65 16 for further details.
Heat Pumps	Type 3	19	Part of unit
Base Mount Centrifugal Fans	Type 3	25	
Suspended Centrifugal Fans	Type 4	25	
Vane Axial Fans	Type 3 or 4	25	
Transformers	Type 1	6	A minimum of 25mm for a defection of 6 mm
Generators	Type 3	25	Type 1 under Type 3 isolators

2.04 SILENCERS

.1 Provide silencers as listed in the equipment schedules. Only silencers with duct to reverberant room insertion ratings will be accepted.

.2 Construction:

.1 ROUND: A minimum of 22 ga. G90 galvanized steel outer shell with lock formed mastic filled seams pre-fabricated, with 40 kg/m^3 (2 ½ lb/ft^3) density acoustic media packed under 10% compression and protection from air erosion by 22 ga. perforated galvanized steel liner, stream lined inlets and tapered diffuser outlets for maximum insertion loss and minimum pressure drop.

.2 RECTANGULAR: as above with acoustic media on all four sides whereby HTL to be externally applied and sealed to the silencer to assure quality controlled transmission loss. Construction of the HTL walls to be as required to obtain the specified room noise criteria (NC) level and to ensure noise "Break-out" is prevented.

.3 Interior baffles and bullet for standard rectangular straight, rectangular elbow and circular silencers shall be made of not less than 22 gauge and properly stiffened to ensure structural integrity; lock form quality, perforated steel, galvanized steel, Type G90.

.4 Construction: Sound attenuators capable of withstanding a differential air pressure of 8”
w.g. Airtight construction shall be provided by use of a duct sealing compound. HTL Casing: Silencer can be equipped with STC 45 High Transmission Loss casing to prevent breakout noise through side walls of unit.

.5 Where internal air velocities exceed 23 m/s (75 ft/s) provide additional Fiberglas cloth over perforated steel liner.

.6 Fire and smoke performance data derived from testing in accordance with ASTM E84, NFPA 255, UL-723 and ULC S102 testing methods. Incombustible filler material exhibits the following fire hazard classification values:
.1 FLAMESPREAD - 20
.2 SMOKE DEVELOPED - 20

2.05 PIPE LINE VIBRATION ISOLATORS

.1 Provide standard spool type single arch units constructed of high strength fabric and elastomer, reinforced with metal rings or wire complete with elastomer, rubber or steel flanges capable of 12 mm (½“) transverse deflection and operating at 860 kPa (125 psi) pressure.

.2 Acceptable Manufacturers: Flexonics, Hydro-Flex, Spanflex Pathway.

PART 3 - EXECUTION

3.01 INSTALLATION

.1 Obtain all relevant equipment information and provide shop and installation drawings for all vibration isolation elements and steel bases. Include details of attachment to both the equipment and the structure to meet the specified forces involved. Do not perform any work or order any materials or equipment prior to review of shop and installation drawings by the Consultant and Acoustic Consultant.

.2 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm (2") to other structures, piping, equipment, etc.

.3 Space isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment or specifically designed for increased forces on the supports. If improved supports are proposed, include design calculations with shop drawings, for approval.

.4 Isolate all floor or pier mounted equipment on Type 3 isolators unless otherwise specified.

.5 Use the lowest RPM scheduled for 2 speed equipment.

.6 Under equipment mounted on Type 3 mounts, provide neoprene/steel/neoprene (Type 1) pads, adjacent to the springs selected for the manufacturer's optimum loading, and shimmed to be just clear of the base of the equipment under operating conditions. Bolt these pads to the floor slab, maintaining the top of the bolt below the top of the pads. These pads are to minimizing rocking of the equipment in the event of an earthquake and can be deleted if other provision is designed into the isolator to control rocking.

.7 For equipment mounted on slab on grade including chillers and pumps, mount on Type 1 neoprene/steel/neoprene sandwich pads unless otherwise specified.

.8 Use Type 4 spring hangers for a minimum static deflection of 25 mm (1") for all ceiling hung fans, air handling units and emergency generator exhaust silencers.

.9 Provide Type 4 resilient hangers on all piping connected to a vibrating source if the piping is supported from walls or ceiling slabs adjoining occupied spaces, and if the piping is in excess of 40 mm (1.5") diameter. Provide the hangers for a distance of 4 m plus 0.03 X (pipe diameter mm) from the vibrating source - e.g. for 250 mm pipe, required distance is 4 m plus 0.03 X 250 = 11.5
m. Use Type 1 pads under pipe pedestals on slab on grade. Bolt down equipment mounted on neoprene pad isolators using neoprene grommets.

.10 Spec note: use item J. if there is a concern about transmitting vibration noise from the mechanical room to the floor below – e.g. for high-end residential or hotel projects or as suggested by Acoustic Consultant.

.11 Provide Type 4 isolators for all piping in the mechanical room over 38mm in diameter; the first three points of supports with the same static deflection as the equipment, the remaining support points with at least 25mm deflection.

.12 Unless noted otherwise, provide flexible connectors for chillers, fluid coolers and all pumps with motors higher than 3.7 kW (5 HP).

.13 To limit noise transmission to the structure, generator(s) should be mounted on spring isolators with neoprene pads in series and all exhaust piping up to and including the mufflers resiliently suspended using spring isolators with fibreglass or felt in series.

.14 Vertical in-line pumps shall be supported by spring hangers having a static deflection of at least 35mm plus an additional neoprene mount in the isolator. In addition, these pumps shall include a mason twin-sphere (or equivalent) expansion joint to reduce pipe and fluid-borne noise transmission near both the suction and discharge of these pumps. These flexible connectors should be located just beyond the first isolation hanger outside the pump drop-down piping. All condenser or chilled water piping penetrating walls on the mechanical level shall be clear at penetrations. Any penetrations that need to be fire-rated shall be sealed using an approved flexible fire-stopping system.

.15 Cooling towers and/ or closed circuit fluid coolers should be mounted on concrete piers extending above 1 m above the slab and should be isolated from these piers using springs plus neoprene pads in series. Individual spring mounts with a minimum static deflection of 50 mm plus double- layer ribbed or waffled neoprene pads below are preferred. If a manufacturer-supplied spring isolation rail is used in lieu of individual springs, double-layer rubber pads should be used between the I-beam that supports the rail and the top of each pier. Shop drawings for all noise and vibration control equipment shall be submitted for review and approval prior to installation.

.16 All boilers, including hot water boilers, are to be supported on 25mm thick neoprene-steel-neoprene pads, properly selected for the weight involved. All in-line heating pumps and associated piping are to be isolated using spring and neoprene isolation hangers having at least 25mm of static deflection. This applies to all heating pipes over 50mm in diameter on the mechanical level. Pipes 50 mm or smaller shall be isolated where clamped to shear walls using rubber or Armaflex sleeves.

.17 Domestic water booster sets are to be mounted on double-layer ribbed or waffled neoprene pads sized for 2/3 of the manufacturer's load rating. The DCW main riser offsets (i.e., horizontal pipes of 75mm or more) from the pump room to the main riser locations should include neoprene pads in the clevis hangers. Small in-line pumps throughout the building should include isolated pipe hangers for at least 3 points of support on either side of the pump. Pipe stands for small in-line pumps may be acceptable if the pipe stands are isolated using double-layer rubber pads, properly sized for the supported load. Pipe stands should not be used in conjunction with larger pumps.

.18 In residential projects, heat pump units within suites should be fully internally lined with fibreglass insulation. In case when heat pumps are configured with discharge grilles on the sides of the unit, directly opposite one another, an internal baffle is required to improve effective sound insulation between bedrooms and other living areas.

3.02 HOUSEKEEPING PADS

.1 Refer to Section 20 05 10 for the provision of housekeeping pads.

3.03 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 20

PART 1 - GENERAL

1.01 GENERAL DESCRIPTION

.1 Comply with requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05, Mechanical work General Instructions and Section 20 05 10, mechanical Basic Mechanical Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

.1 Supply and installation of Variable Frequency Drives.

1.03 QUALITY ASSURANCE

.1 Qualifications: Execute work of this section only by skilled licensed tradesmen regularly employed in the installation of variable frequency drives.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 to suit Health and Safety Requirements.

.3 Acceptable manufacturers: ABB, AC Tech, Allen Bradley, Danfoss (Graham), Siemens, Nidec, Schneider Electric factory assembled units.

1.04 SUBMITTALS

.1 Submit shop drawings on variable frequency controllers and starters in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WARRANTY

.1 Provide warranting as outlined in Section 20 05 05.

.2 Variable Frequency Drives will be accepted after start-up, a minimum of 10 hours of logged trouble- free operation, 10 hours of connected EMCS trouble-free operation, four hours of instruction to Owner's operating staff and submission of written verification attesting thereto by manufacturer's representative. The Consultant must also witness a portion of this procedure

.3 Include verification of acceptance certificates with the maintenance and operating manuals in the appropriate sections.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY CONTROLLERS

.1 General: Provide as indicated in the Equipment Schedules factory fabricated and tested pulse width modulating frequency controllers compatible with the motor horse powers listed for the variable volume air handling units, return air fans, pumps and/or cooling tower fans.

.2 Application:

.1 The load characteristics of the application are:

.2 Variable torque (e.g. fans).

.3 Operating speed range from 180 to Normal Motor RPM (refer to FAN MOTOR DATA table in item .18).

.3 Operating Conditions:

.1 Drive to accept power nominal AC voltage of 208V ±15%, three-phase, frequency 60 Hertz.

.2 Operating ambient condition to have a temperature range of 0 to 40°C with a relative humidity of up to 95% (non-condensing).

.3 Altitude: 0 - 215m (0 - 700 ft.) above sea level.

.4 AC Adjustable Speed Drive Systems:

.1 Adjustable frequency AC drives to convert 208V ± 15%, 3 phase, 60 Hertz utility input power to an adjustable AC frequency and voltage for controlling variable torque through speed of AC squirrel cage fan motors. Converters to be of the voltage source design with a pulse width modulated inverter section utilizing insulated gate bi-polar transistors (IGBT). The use of input/output transformers is not acceptable.

The drive controllers to be rated for 110% continuous of rated motor current and have capacity to provide speed control of motors throughout speed range specified.

.2 Controllers to include power conversion components, power control logic devices and regulator circuitry. Regulators to incorporate microprocessor technology for control of power semiconductors.

.3 Variable speed drive to be supplied in a NEMA 1 enclosure with drip hood if in sprinklered area and to be completely pre-wired and pre-piped for the specified control sequences, and require only field wiring from a power source to each motor and wiring of control points and safeties.

.5 The drive to contain the following, all interconnected and factory-wired to an identified terminal strip:

.1 Variable frequency controllers (VFC).

.2 Motor control components such as overload relays, fused control circuit transformers, pushbuttons, pilot lights and other items required to perform the specified sequences of operation.

.3 Terminals to which specified remote devices like start/stop; etc. may be wired to the Building Management System. Field wiring for these control devices to be the responsibility of Division 25.

.4 Through-the-door disconnect switch.

.6 Operating Characteristics:
- .1 The adjustable frequency drives to have the following features:
  - .1 ±1% frequency regulation.
  - .2 ±1% voltage regulation.
  - .3 0 to 66 Hertz operating frequency range.
  - .4 Active current limit function, adjustable 0 to 100% of controller rating.
  - .5 Maximum efficiency at full load and speed of 98%.
  - .6 Minimum incoming line power factor throughout the load speed range of 0.95.

.7 Drive Diagnostics:
- .1 Provide fault diagnostics to simplify troubleshooting. Each of the following points to be indicated by on LCD or LED screen:
  - .1 Lockout - (fault shutdown after three (3) restart attempts)
  - .2 Line Fault - (Line over/under voltage, phase loss/unbalance)
  - .3 Controller Overtemperature
  - .4 Motor I^2t Thermal Protection
  - .5 DC Bus Overvoltage
  - .6 DC Bus Undervoltage
  - .7 Auxiliary Power Supply Fault
  - .8 Output Fault - Phase A
  - .9 Output Fault - Phase B
  - .10 Output Fault - Phase C
- .2 Provide keypad accessibility to a non-volatile Fault History Memory which is not operator erasable. This memory to store the following data for each of the thirty (30) most recent drive shutdowns and include date, time and elapsed time meter:
  - .1 The fault which caused the shutdown
  - .2 Output frequency at time of trip
  - .3 Output voltage at time of trip
  - .4 Output load (power) at time of trip
  - .5 Whether the load was accelerating or decelerating

.8 Protective Functions:
- .1 Active limiting of fundamental current by frequency fold back on acceleration loads and frequency hold on decelerating loads.
- .2 Over current protection.
- .3 Short circuit protection.
- .4 Fast acting supply fuses.
- .5 Supply voltage phase loss.
- .6 DC intermediate bus under voltage.
- .7 DC intermediate bus over voltage.
- .8 Power section over temperature.
- .9 Power section faults.

.9 Adjustments:
- .1 Active current limit 0-100%.
- .2 Maximum frequency 40-100%.
- .3 Minimum frequency 0-50%.
- .4 Acceleration/Deceleration separately adjustable from 1 to 999 seconds.
- .5 All adjustments shall be programmable from the front panel of VFD. Potentiometer or dip switch adjustments are not acceptable.

.10 Auxiliary Contacts for Drive Logic Status:

.1 The following (NO, NC) contacts to be provided for the following logic conditions.
.2 Fault
.3 Start
.4 Motor contactor at the inverter output.
.5 Input card with auto/manual logic for isolation of analog input reference signals 4-20 mA.

.11 Output card providing isolated 4-20 mA output for drive signals including output frequency, active or total output current.

.12 Provide diagnostics for operator on-line status information. Each of the following status points shall be indicated on door mounted LCD screen:
.1 Power on
.2 Ready
.3 Run
.4 Jog
.5 Motor Accelerating
.6 Motor Decelerating
.7 Direction of rotation (forward or reverse) (if function enabled)
.8 Auto Mode (if function enabled)
.9 Manual Mode
.10 Stop
.11 Low Reference (missing or zero speed reference)
.12 External Trip (interlocks open)
.13 Current Limit
.14 Power Lost
.15 Fire Alarm Shut Down Contacts

.13 Provide the following control functions on the door mounted keypad:
.1 Run
.2 Stop
.3 Jog (enabled in Stop Mode only)
.4 Auto/Manual (if Auto Mode is enabled)
.5 Forward/Reverse (if function enabled)
.6 Accelerate (Manual Mode)
.7 Decelerate (Manual Mode)
.8 Direct Speed Set (Manual Mode)
.9 Load meter to indicate active current
.10 Frequency meter
.11 Manual frequency reference potentiometer

.14 Provide diagnostic to allow signal tracing of the logic and base or gate driver circuit boards plus additional fault diagnostics.

.15 Provide terminals for interlocking of up to six (6) external interlocks e.g. Firestat, Freezestat, etc.

.16 Provide the following to interface with the Energy Management Control System (EMCS):
.1 Dry contact closure or software connection from EMCS for run Command (Auto Mode).

.2 Isolated 4-20 mA (0-10 VDC, 0-5 VDC) signal from EMCS for speed control (Auto Mode).
.3 Dry contact or software connection (NO) output to EMCS to indicate:
.1 Inverter Ready
.2 Inverter Fault
.3 Inverter Running
.4 Isolated 4-20 mA or isolated 0-10 VDC output to EMCS, proportional to 0-110% speed.
.5 Isolated 4-20 mA or isolated 0-10 VDC output to EMCS, proportional to 0-110% load power.
.6 Provide for logic card or built in interface to BACnet) systems. Provide for PC connection to download setup parameters.

.17 Start-stop for manual operation of motor in by-pass starter mode.

.18 Provide for Remote Shut Down of Inverter Circuitry

The variable frequency drive shall be fitted with a low voltage relay having normally closed contacts in the solid state electronic circuitry of the inverter to allow the power down of the inverter from a remote stop button mounted in a remote disconnected switch. This shall protect the inverter solid state electronic circuits prior to the line power being shut off at the remote disconnect switch.

.19 AC Drive Quality Assurance:
.1 Power semiconductors (thyristors, diodes, etc.) to be tested for proper electrical characteristics (dv/dt, di/dt, etc.) on LEM testers.
.2 All chips (CMOS, TTL, LINEAR, etc.) to be given a 100% burn-in with applied voltage, and then functionally tested.
.3 All power capacitors active components to be functionally tested.

.20 Provide guarantee that harmonics generated will not exceed 10% THD. If necessary, provide line reactor or other filters to achieve this at no additional cost. External line reactors to be mounted in NEMA 1 enclosure.

.21 Provide load reactor, if drive to be located more than 50 feet from motor. Co-ordinate with contractors of Divisions 20, 22, 23 and 26 for location of the motors and drives.

.22 Provide call back within 30 minutes of receiving emergency call for service and provide on-site service within two (2) hours.
.1 All component parts must be maintained in Toronto based storage. Provide evidence of this in submission of shop drawings.

.23 Start-Up Service:
.1 Provide on-site commissioning (start-up) of the adjustable frequency drives by a qualified technician. Allow a minimum of half a day per system. Also include an allowance for a second visit to site of one-day duration to train operating personnel in the operation and maintenance of the drives.

PART 3 - EXECUTION

3.01 INSTALLATION OF VARIABLE FREQUENCY DRIVES

.1 Install variable frequency drive units in locations shown on the contract drawings to provide the best possible connection arrangement and accessibility for service.

Provide clearances on all sides of the equipment as required by authorities having jurisdiction or manufacturers, whichever is greater.

.2 Floor mounted units to be installed on a 100mm (4") thick concrete pad extending a minimum of 100mm (4") beyond foot print of drive unit. Pad to have all edges chamfered to avoid spalling.

.3 Install drive units in accordance with the manufacturer's instructions and all applicable building and Canadian Electrical codes.

.4 Co-ordinate the installation of variable frequency drives with the Division 26 Sub-Trade.

.5 Co-ordinate the installation and commissioning of drive units with the Energy Management Control Contractor (Division 25 Sub-Trade) and Air & Water Balancing Contractor.

.6 The Divisions 20, 21, 22, and 23 contractors shall notify the Division 26 contractor of the requirement to provide remote disconnects of all motors controlled through variable frequency drives to be fitted with a low voltage push button for inverter circuit isolation.

.7 The Division 20, 21, 22 and 23 contractors shall provide warning labels at remote disconnects stating that:

“Before shutting off main power, isolate the VFD inverter by depressing the low voltage push button”.
“Push button to be reset and disconnect closed prior to restart of variable frequency drive.”

3.02 VARIABLE FREQUENCY CONTROLLER TEST

.1 Follow manufacturer's instructions and have manufacturer's representative present to certify the installation.

.2 Check each item of equipment to ensure proper electrical connections, etc., and to verify proper operation.

.3 Upon completion of installation of equipment start-up, operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

.4 Start each piece of equipment controlled via frequency controller and by varying the control set point check that speed variation is linear throughout the full control range.

.5 Check that annunciator panel and alarms are functioning in accordance with the specifications, and that all signals between the variable frequency drive and EMCS are accurate.

3.03 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 30

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provision of all required equipment, piping, wiring, and chemicals for scale, corrosion, algae, and bacteriological control of heating, heat pump, glycol loops, condenser piping circuits. Provision of degreasing chemicals for degreasing of all heating, condenser, heat pump and glycol water system piping and equipment.

.2 Supervision of all degreasing procedures, initial fill/start-up, commissioning and monitoring of treated systems and training of Owner's staff in operating and maintenance procedures.

.3 Submission of a report, on completion of the Work specified in this Section of the Specifications, for the following:

.1 Results of degreasing and initial fill of treated systems.

.2 Results of treatment procedures for each system treated.

.3 Details of instructions given to the Owner's staff and names of persons receiving instructions.

1.03 QUALITY ASSURANCE

.1 Qualifications: Execute work of this section only by skilled tradesmen, technicians, and manufacturers regularly employed in the administration of water piping systems chemical treatment.

.2 Acceptable Manufacturers or Suppliers: Ashland, Drew Chemicals, Perolin-Bird Archer, GE-Betz, Klenzoid and Chem-Aqua.

.3 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01.

1.04 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples. Include product characteristics, performance criteria, and limitations.

.2 Certificates: submit certificates signed by manufacturer certifying that material comply with specified performance characteristic and physical properties.

.3 Close-out Submittals:

.1 Submit operation and maintenance data for incorporation into manual specified in Division 01.

.2 Include following:

.1 Log sheets as recommended by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WARRANTY

.1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 WATER TREATMENT

.1 Provide a water conditioning system to control corrosion, scaling, algae and bacteria in condenser, heating, glycol and heat pump piping systems. Provide thermofluid to prevent freezing up of piping circuits.

.2 Provide a water conditioning program complete with all required chemicals for a period of one year commencing with the start-up of the equipment and systems.

.3 Provide welding sockets where required or shown on the drawings and piping therefrom to equipment required for water treatment such as pumps, chemical storage tanks, and include all necessary piping, valves and accessories and control wiring.

.4 Use only chemicals and methods complying with local health codes that do not have a detrimental effect on non-metallic materials such as rubber, neoprene and plastics used in the piping systems. Provide nitrite/borate type inhibitors.

.5 Provide suitable corrosion test coupons installed in appropriate piping arrangements for each treated closed loop system representing the metals in the circuit. Control corrosion rates in steel piping at maximum depth of Pitting of 0.127mm (0.005") of penetration per year and a maximum corrosion rate for copper tubing of 0.025mm (0.001") per year.

.6 Provide pot type feeders on all closed piping systems for injection of chemical treatment complete with corrosion coupon rack. Pot feeders are to be welded steel and have a maximum pressure rating of 1380 kPa (200 psi) or 2070 kPa (300 psi) and a maximum temperature rating of 94°C (200°F). In and connections are to be 19 mm (¾") FNPT.

.7 Provide a low flow micron filter unit pipe line filter assembly with pressure gauge and an Arkon (ball type) flow indicator on the leaving side of each pot feeder.

.8 Provide a system of automatic purging and injection of chemicals for treatment of the condenser water circuit through a system of measuring water consumption with a contact meter to initiate an interval timer with adjustable on-off cycle time periods to control purging and chemical injection in sequence with chemical feeding by means of a diaphragm pump connected to a 170 l (45 gal.) polyethylene mixing tank. For algae control, provide a pot feeder located within the equipment room on the condenser water circuit.

.9 Do not use chemical treatment containing tin or tin compounds in any cooling tower or any other evaporative process circuits.

.10 Test equipment: Provide one metal test cabinet complete with light to hold all test apparatus. Provide all required chemicals, comparator, titration equipment and test tubes to provide a complete testing facility for the systems treated.

2.02 GLYCOL FEED SYSTEM

.1 Provide inhibited glycol solution using Dowfrost (propylene glycol) or Dowtherm SR-1 (ethylene glycol) as shown on drawings and schedules. Heat Transfer Fluid or acceptable alternative. All glycol solutions to be acceptable to Authorities having jurisdiction regarding environmental acceptability.

.2 Provide an Axiom Industries packaged glycol feed system Model SF100 consisting of a 208 litre (55 gal.) polyethylene tank with cover; pump suction hose with inlet strainer; pressure pump with thermal cut-out; integral pressure switch; integral check valve; cord and plug; pre-charged accumulator tank with EPDM diaphragm; manual diverter valve for purging air and agitating contents of storage tank; pressure regulating valve adjustable (35– 380 KPa; 5 – 55 psig) complete with pressure gauge; built-in check valve; union connection; 12 mm (½") x 900mm (36") long flexible connection hose with check valve; low level pump cut-out. Pressure pump shall be capable of running dry without damage. Power supply 115/60/1 0.7 A. Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.

.3 Operational Controls: low level switch and light, contact head water meter, system pressure switch, alarm bell with reset, hand-off-auto switch, motor rated switches for pump and mixer and SPST relay. Include RIA10-1-SAA – Low Level Alarm Panel c/w Remote Monitoring Dry Contacts and Selectable Audible Alarm.

.4 The entire system to be factory prepiped and prewired with numbered terminal strip for wiring of remote items such as the pressure switch and the contact head meter.

.5 System operation: pump to operate automatically or manually as selected by HOA switch and be interlocked with the tank low level switch. The contact head meter will initiate the alarm bell when a predetermined amount of make-up has been added. A separate alarm contact is provided to connect into a remote alarm device.

2.03 JUDO FILTER

.1 General

.1 Model: JPF-A/TP Automatic Time and Pressure Differential Actuated Backwash Operation.
Size as shown on drawings.

.2 Construction: Upper housing made of high-grade polymer-based materials and bottom housing made of high-grade cast-iron coated with Rilsan. Equipped with a clear sight-glass, soiling, and backwash functions. Filtration through a stainless steel filter sieve size of 100 microns. Backwash process using a patented point-rotation-system without any interruption of the water supply. Simultaneous cleaning of the sight-glass during the backwash process. Automatic backwash, generated by a time actuated relay, with the following adjustable range from 1 to 2,000 hours and a differential pressure control setting adjustable from 1-36 psi differential. Electronic control enclosure with computer display for system diagnostics equipped with led display indicators for operation, alarm fault buzzer and manual over-ride button for backwash start-up. 120/60 VAC (25W). Run three 3/4" (20mm) backwash flushing drain connections, for 5" (125mm) size filter and four 3/4" (20mm) drains for 6" (150mm) size filter, to nearest hub drain using an indirect connection. Horizontal pipe installation. Flanged connections to ASME B16.1. Provide 3 prong duplex box outlet with GFI.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 WATER TREATMENT

.1 Install test equipment cabinet as directed by the Consultant or as shown on the drawings.

.2 Chemical application rates are to be as required to maintain water quality guidelines in compliance with ASME and manufacturers' instructions (boiler, cooling tower etc.).

.3 Thoroughly flush and clean all water circulating systems and clean strainer baskets as often as necessary to ensure that scale, metal particles, etc. have been completely removed.

.4 As directed by the chemical treatment supplier, refill all systems and inject degreasants and circulate at temperatures and for periods as required to ensure that the systems are thoroughly cleaned. Flush systems and refill in preparation for administration of chemical treatment.

3.03 MONITORING AND INSTRUCTIONS

.1 Advise Divisions 20, 21, 22 23 and 25 Subtrades where drains and fill points are required in the piping systems to facilitate proper drainage and fill/injection of fluids.

.2 Carefully monitor the condition of all systems from initial fill to the point at which the systems are considered under stable operating conditions.

.3 Provide oral and written instructions to operating personnel for the maintenance and control of the water conditioning program.

.4 Submit a written report of system start-up showing water analysis and corrosion check test as part of documentation at the completion of the work.

.5 For the first year of operation, provide service calls once every thirty days and provide written reports to operating personnel showing details of each service call.

3.04 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 70

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

.1 Supply and installation of piping, ductwork, and equipment insulation.

1.03 QUALITY ASSURANCE

.1 Qualifications: Execute work of this section only by skilled tradesmen regularly employed in the application of insulation to piping, ductwork, plenums, tanks, pressure vessels, equipment casings and heating panels for building heating, cooling, ventilating and plumbing systems.

.2 Insulation, self-adhesive tape, adhesives and any insulation finishes to be ULC labelled and listed for flame spread rating of less than 25 and smoke development classification of less than 50.

.3 Acceptable Manufacturers:

.1 Insulation: Fiberglas Canada Inc., Knauf Fiber Glass, Manson, Roxul.

.2 Tape: Avery Dennison, Mactac, Tuck, Compac.

.3 Canvas: Fattal Thermocanvas, Alpa-Maritex 3451-RW, Clairmont Diplag 60.

.4 Lagging adhesive: Childers CP.50A-HV2, Fosters 30-36 asbestos free.

1.04 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previously defined.

.3 Insulation systems - insulation material, fasteners, jackets and other accessories.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Product data/Shop Drawings

.1 Provide manufacturer’s printed product literature and datasheets for insulation adhesives, coatings and finishes. Also include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) material Safety Data sheets (MSDS) in accordance with Division 01.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

.1 Provide warranties as outlined in Section 20 05 05 – Mechanical Work General Instructions

PART 2 - PRODUCTS

2.01 INSULATION

.1 Preformed: ULC Listed sectional glass fibre pipe insulation in compliance with ASTM C335 in sections 900 mm (36") long, split and ready for application with a maximum Thermal Conductivity of 0.033 W/mºC at 24ºC mean temperature and be capable of use on service from -40ºC to 260ºC and with factory applied vapour seal jacket of vinyl coated foil Kraft laminate with reinforcing of open mesh glass fibre.

.2 Preformed Foam: ULC Listed sectional DOW Trymer 2000 XP Polyisocyanurate Foam pipe insulation in compliance with ASTM C335 in sections 900 mm (36") long, split and ready for application with a density of 32.8 kg/m^3 (2.05 lb/ft^3) according to ASTM D1622, R-value of 0.93 m^2 ºC/W at 24ºC mean temperature, water absorption of not more than 0.7% by volume according to ASTM C272, be capable of use on service from -183ºC to 149ºC and with factory applied vapour seal jacket.

.3 Rigid board: 72 kg/m^3 (4.5 lbs/ft^3) density ULC listed glass fibre board with glass fibre reinforced aluminium foil vapour seal facing and maximum thermal conductivity of 0.035 W/mºC at 24ºC mean temperature.

.4 Blanket: 24 kg/m^3 (1.5 lbs/ft^3) ULC listed flexible glass fibre blanket with glass fibre reinforced aluminium foil vapour seal facing with thermal conductivity of 0.036 W/mºC.

.5 High temperature (over 200ºC): Preformed calcium silicate or Roxul 1200 mineral fibre piping insulation.

.6 Low temperature: 20 mm fire retardant closed cell Armaflex in sheet form or preformed for piping.

2.02 FINISHES AND PROTECTIVE COVERINGS

.1 Canvas: 170 g/m^2 with lagging adhesive, ULC labelled.

.2 Protective covering (aluminium): .020 Childers corrugated aluminium preformed covering complete with strapping and seals.

.3 For pipework, ductwork or equipment exposed to the elements, provide and external PVC jacket to the insulation which is to be a white UV resistant PVC jacket. Extra thick material is to be used on outdoor installations only. Normal thickness for indoor installation. 25/50 flame and smoke rated grade PVC shall be used.

.1 Finish is to be high gloss white.

.2 Minimum thickness to be 10mm

.3 Must be resistant to fungi and bacterial growth and comply with ASTM G 21 & G22.

.4 PVC must be in compliance with ASTM 1784 & CAN/CGSB 51.53.95.

.5 When installing PVC jacket, jacket must overlap a minimum of 50mm

.4 Polyvinyl Chloride (PVC) For use inside mechanical room only:
- .1 ULC labelled One piece moulded type to CAN/CGSB 51.53 with pre formed shapes as required.
- .2 Colours: [to match adjacent finish paint.
- .3 Minimum service temperatures: 20ºC.
- .4 Maximum service temperature: 65ºC.
- .5 Moisture vapour transmission: 0.02 perm.
- .6 Thickness: 6 mil.
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.
  - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Special Requirements:
  - .1 Outdoor: UV rated material at least 0.5 mm thick.

PART 3 - EXECUTION

3.01 APPLICATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.02 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork piping systems and equipment complete, witness and certify.
.2 Ensure surfaces are clean, dry, free from foreign material.

3.03 EQUIPMENT AND MISCELLANEOUS APPLICATIONS

.1 Water meter **,** domestic water booster pump casing**:** 25mm (1") thick blanket insulation. On steel or cast iron surfaces, apply one coat of Densopaste Primer prior to applying insulation. Apply flexible blanket insulation and seal all joints in vapour seal facing with self-adhesive foil tape. Finish with insulating cement and canvas.

.2 Heat exchangers and tanks: shell and tube type and hot water storage tanks: 50mm (2") thick rigid board or preformed. Insulation not required on plate type heat exchangers. Score and mitre to fit contours of equipment and secure with 12mm x 0.38mm (□" x 0.015") galvanized steel bands 600mm (24") OC. Point up all joints with insulating cement. Finish with specified canvas. Do not insulate over registration and nameplates.

.3 Stand-by generator exhaust piping or boiler breechings: 25mm (1") thick calcium silicate preformed pipe insulation or Roxul 1200 mineral fibre. Stand-by generator exhaust: from 150mm (6") of manifold connection including muffler and to 150mm (6") beyond roof or exterior wall surface; Secure with 12mm x 0.38 mm (1/□" x 0.015") galvanized steel bands at 300mm (12") OC. Flash over portions protruding through roof or wall with copper sheet. Provide schedule 40 steel pipe sleeves at wall or roof. Cover all insulation with preformed aluminium. Secure breeching insulation in place with 20mm x 0.38mm (3/4” x 0.015") steel bands 400mm (16") OC. Butt metal edges together and lace with 16 gauge galvanized wire. Finish with hydraulic cement.

.4 Drains and water supplies for wallhung handicapped lavatories: blanket type on exposed water supplies and drain under lavatory. Finish with canvas.

3.04 AIR UNIT CASINGS (INTERNAL)

.1 25mm (1") thick rigid board neoprene faced. Install insulation on weld pins and speed washers 300mm (12") OC. Cut pins flush with surface of insulation and cover all pins and joints with glass fab tape embedded in two coats of approved mastic compound. Use the first coat to embed the glass fab tape and the second coat as a finish. Refer to detail drawings.

3.05 DUCTWORK

.1 Installation
- .1 Exposed ductwork: rigid board Insulation
  - .1 Rectangular ductwork: Impale rigid board on weld pins and speed washers 300mm (12") OC with a minimum of two rows per side on any side greater than 300mm (12"). Cut pins flush with surface of insulation and cover with foil faced type. Cover all joints with foil faced self-adhesive tape. Finish with canvas.
  - .2 Round ductwork: Score and mitre rigid board to fit contours of duct and secure with 12mm x 0.38mm (2" x 0.015") galvanized steel bands 300mm (12") OC. Point up all joints with insulating cement and seal with foil faced self-adhesive tape. Finish with canvas.
- .2 Concealed ductwork:
  - .1 Blanket type insulation: Apply flexible blanket insulation with an approved adhesive brushed on in 100mm (4") wide strips 300mm (12") OC and at all joints. For rectangular ducts over 450mm (18”), blanket type insulation should be secured to the bottom side of the duct with mechanical fasteners spaced on 450mm (18”) centres. Care should be taken to avoid over-compressing the insulation with the retaining washer. Seal all joints and perforations with foil-faced self-adhesive tape.
  - .2 Ductwork over 1500mm (5’) in width or ductwork located in vertical shaft: Use rigid board insulation.
- .3 Ductwork exposed to outdoors: Impale rigid board on weld pins and speed washers 300mm (12") OC with a minimum of two rows per side on any side greater than 300mm (12"). Cut pins flush with surface of insulation and cover pins and joints with foil-faced self-adhesive tape. Finish with two applications of weather protective coating trowelled smooth.
- .4 Where ductwork is symbolized as external acoustic: apply over rigid board two coats of hard plaster at 9.53mm thick each, trowel smooth and finish with canvas.

.2 Application: Provide external ductwork insulation in thickness as listed below:
- .1 All supply air ductwork from fan discharge or unit outlet of air handling systems delivering air at temperatures less than 18ºC and greater than 30ºC. This includes supply air ductwork connected to discharge side of fan coil units, heat pumps, reheat coils and VAV terminals and air handling systems with cooling and/or heating coils and direct or indirect fired burner sections.
  - .1 Provide 25mm (1") thick for systems with 18ºC or less air supply temperature.
  - .2 Provide 40mm (1½") thick for systems with 30ºC or greater air supply temperature.
  - .3 Outdoor intake ductwork, ductwork conveying mixed outdoor/return air and mixed air plenums: 50mm (2") thick.
  - .4 Supply and return air ductwork located outdoors: 75mm (3") thick.
  - .5 Exhaust ductwork located outdoors: 50mm (2") thick.

.6 Exhaust ductwork located indoors for a minimum of 3 m (10 ft.) back from the discharge point to outdoors: 25mm (1") thick.
.7 Exhaust ductwork located indoors from ERV or heat wheel to the discharge point: 25mm (1" thick), except for residential suites.
.8 Where specifically noted on drawings that could be an exception to the foregoing.

.2 Exceptions: external duct insulation is not required where:
.1 Supply air ductwork installed exposed within conditioned space.
.2 Note: Supply air ductwork installed concealed in ceiling spaces, whether ceiling space used as return air plenum or not, is to be totally insulated.
.3 Ductwork is internally insulated and located indoors.
.4 Collars to registers, grilles and diffusers are 900mm (3 ft.) or less in length.
.5 Acoustic type flexible ductwork is used.
.6 Duct silencers with acoustic media on all four sides are installed.

.3 Where a supply or return duct is not protected by an insulated exterior wall or where the duct is exposed to an unheated space, provide a minimum of 75mm (3") of rigid board insulation with a minimum RSI 2.1 (R-12) insulation value.

.4 Where exhaust ducts containing air from heated space pass through or are adjacent to unheated spaces, provide a minimum of 75mm (3") of rigid board insulation with a minimum RSI 2.1 (R-12) insulation value.

3.06 PIPING APPLICATION SCHEDULE

Item	Conductivity Range W/mºC	Insulation Thickness & Type
Domestic hot water (Conditioned space)	0.032 – 0.041	25mm (1") pre-molded for pipe up to and including 31mm (1¼"). 40mm (1½") for 38mm (1½") pipe and greater. 50mm (2") for greater than water temperature higher than 60ºC (140ºF).
Domestic hot water (Non-conditioned space or outdoor)	0.032 – 0.041	40mm (1½") for runouts less than 50mm (2") pipe 65mm (1½") pre-molded for pipe up to and including 50mm (2"). 76mm (3") pre-molded for pipe from 65mm (2½") up to and including 100mm (4") 88mm (3½") for 125mm (5") pipe and greater.
Domestic hot water recirculation (Conditioned space)	0.032 – 0.041	25mm (1") pre-molded for pipe up to and including 31mm (1¼"). 40 mm (1½") for 40mm (1½") pipe and greater.
Domestic hot water recirculation (Non-conditioned space or outdoor)	0.032 – 0.041	40mm (1½") for runouts less than 50mm (2") pipe 65mm (2½") pre-molded for pipe up to and including 50mm (2").
Domestic cold water & Non-potable water	0.033	12mm (½") pre-molded 40mm (1½") pipe and below. 25mm (1") pre-molded for 50mm (2") pipe to 150mm (6") pipe. 31mm (1") pre-molded for 200mm (8") pipe and greater.

Item	Conductivity Range W/mºC	Insulation Thickness & Type
Heating system piping (Design operating temperature below 93 °C)	0.036 – 0.042	40mm (1½") pre-molded 31mm (1¼") pipe and below. 50mm (2") pre-molded for 40mm (1 ½") pipe and greater.
Heating system piping (Design operating temperature above 93 °C)	0.039 – 0.043	65mm (2½") pre-molded 75mm (3") pipe and below. 75mm (3") pre-molded for 100mm (4") pipe and greater.
Traced piping (where indicated)	0.033	Indoors: 25mm (1") minimum for applications not listed in this table. Outdoors: 50mm (2").
Condensate Horizontal drains from fan coil units, heat pumps, and cooling coils, suspended horizontal drains receiving cooling coil condensate, suspended horizontal drains from	0.033	25mm (1") pre-molded
urinals and water closets and roof drain receptors and horizontal rainwater leaders and fittings		
Condenser water piping for systems that operate summer and winter.	0.033	50mm (2") pre-molded outdoors 25mm (1") pre-molded indoors
Storm Line (Horizontal) Indoor	0.033	40mm (1½") pre-molded
Storm Line (outdoor)	0.033	50mm (2") pre-molded
Heat pump piping	0.033	Not required for standard water to air type.

Note: Refer to section 23 05 33 heat tracing for additional piping insulation requirement..

3.07 PIPING

.1 Apply insulation at temperature of approximately 8°C over clean, dry surfaces. Butt adjoining sections of insulation firmly together with the longitudinal seam of the jacket located on the bottom half of the pipe.

.2 Insulate and finish in the same manner and same thickness as piping, all valves, fittings and flanges on cold, hot, condenser and chilled water piping. Use PVC jacketed mitred sections of the specified pipe covering or preformed insulation to suit fitting. Do not insulate valves, strainers, unions and flanges on hot water service and where concealed, do not insulate any fittings; straight runs of pipe only. Insulate all fittings, valves, strainers, unions and flanges on domestic hot water service for health care facilities including old age homes and long term care buildings.

.3 Seal longitudinal lap joints with a suitable vapour barrier adhesive for cold and chilled water piping and a suitable cement capable of withstanding service temperature on hot water piping. Cover circumferential butt joints with a strip of the same material as the jacket and cement as indicated above. Cover all joints with foil faced self-adhesive tape on chilled and cold water piping.

.4 Concealed insulated items require no further finish than provided in factory applied jacket. Cover exposed insulation and all insulated equipment with canvas, field applied, adhered and lap sealed and finished off by a brush coat of approved sizing.

.5 Insulated piping exposed to outdoors: Apply aluminium protective covering over all insulated pipe and fittings. Seal all joints with approved sealants.

.6 Seal valves, fittings and flanges on cold and chilled water application in a manner as specified for circumferential joints. On strainers, insulate over blow-down valves and bushings or flanges required for strainer basket removal by providing a removable prefabricated Armaflex cover held in place with a stainless steel gear clamp. Do not insulate over blow-down valves and bushings or flanges for strainer basket removal on condenser water piping.

.7 Seal end joints and perforation with 100mm (4") vapour barrier strips applied with the same adhesives and cements as previously specified for cold and chilled water.

.8 On all domestic cold water piping:

- .1 Where oversized hangers are used, protect insulation with a sheet metal saddle installed over the vapour barrier. For piping 40mm (1½") and larger provide a section of rigid insulation or non-compressible material under the vapour barrier the same length as the saddle - see detail drawing.
- .2 Where oversized hangers are not used, apply 12 mm (1/2“) insulation with vapour seal over hanger and support rod for a distance of two pipe diameters up the rod from the attachment point at the ring, clamp or clevis.

.9 Apply blanket type insulation on piping using an approved adhesive and seal all longitudinal and transverse joints with foil faced tape. Insulate pipe hanger in similar manner for a distance of two pipe diameters up the rod beyond the attachment point at the ring, clamp or clevis.

.10 Insulation on piping where Victaulic couplings are used:

- .1 In concealed areas, provide insulation over couplings to same thickness as specified for piping.
- .2 In exposed areas, (except mechanical and service rooms) increase insulation thickness and provide one-half specified thickness over couplings to achieve the appearance of uniform diameter of pipe and fittings.
- .3 Where aluminum sheet cladding is required, increase insulation thickness as described in
  (2) above to achieve a standard and uniform diameter.

.11 On water to water heat pump circuits utilizing 50mm (2") insulation: At all ball valves, use 1" insulation to allow space for valve handle operation.

3.08 FINISHES

.1 PVC over insulated items where exposed indoors.
.2 28 ga. aluminium over all insulated piping exposed to outdoors and over insulation on stand-by generator exhaust piping and muffler.
.3 Weatherproof mastic, two coats trowelled smooth, over ductwork insulation where exposed outdoors.
.4 Breeching Insulation: Apply 13mm (1/2") coat of hydraulic setting insulating cement trowelled smooth over metal mesh.

3.09 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 25

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Requirements Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

.1 Supply all labour, material, methods and equipment to provide, where shown on the Drawings, 2-hour rated fire-resistive external insulation for ventilation supply and exhaust ductwork for zero mm **c**learance to combustible materials. Duct system to be installed totally without fire dampers.

.2 Related sections:

.1 Division 04 - Unit Masonry

.2 Section 07 84 00 - Firestopping

.3 Division 09 - Finishes

.4 Section 23 31 13 - Ductwork (regarding duct hangers)

1.03 REFERENCES

.1 Test standards and reports for evaluating and rating performance of fire-resistive shaft enclosures and zero mm clearance insulated duct systems.

.2 Underwriters Laboratories Canada (ULC):

.1 Reference ULC Guide No. 40 U21 'Fire Resistant Ducts', ULC list of Equipment & Materials Directory, 'Fire Resistance ratings.'

.2 Underwriters Laboratories of Canada, ISO 6944-1985, Fire Resistive Tests - Ventilation ducts.

.3 Zero clearance to combustibles: ULC Grease Duct Protocol test method, ULC Guide No.
440E9.

.4 Underwriters Laboratories of Canada, CAN4-S115-M85, 1- & 2 hour Through-Penetration Firestop tests.

.5 Underwriters Laboratories of Canada, ULC S102-M88, Flammability.

.3 NFPA 96, 1994 Edition, Ventilation Control & Fire Protection of Commercial Cooking Operations.

1.04 SUBMITTALS

.1 Submit ULC Listings substantiating performance requirements and code compliance along with manufacturer's installation instructions.

.2 Submit Manufacturer's product information and specifications.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WARRANTY

.1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 FIRE RESISTIVE DUCT INSULATION

.1 3M Fire Barrier Duct Wrap: lightweight, non-asbestos, high temperature, inorganic, ceramic fiber blanket totally encapsulated in foil scrim with a service temperature range to 1260°C (2300°F) as manufactured by 3M Fire Protection Products to the following:

.1 One and two-hour rated fire-resistive enclosure assemblies to ISO Standard 6944-1985.

.2 Fire Resistance Tests - Ventilation Ducts: ULC Guide No. 40U21. ULC listing Design No.'s FRD-3 & 5 (Ventilation ductwork) and FRD-4 (Kitchen exhaust ductwork).

.2 Materials: Fire resistive insulation; 40 mm (1.5") thick, 600mm or 1200mm (24" or 48") wide X 7600mm (25 ft.) long rolls, fully encapsulated with foil scrim marked with Manufacturer's logo and ULC markings.

.3 Tapes: high performance filament, 3M No. 898 25mm (1") wide. Aluminum foil tape: 75 mm (3") wide (for sealing cut blanket edges and seams).

.4 Banding material: Carbon steel banding for 1- hour rating: 12 mm (½") wide X 0.03 mm (0.015") thick. 304 stainless steel banding for 2-hour rating: 12 mm (½") wide X 0.03 mm (0.015") thick.

.5 Insulation pins and clips: Pins: 3 mm X 100mm or 125 mm (10 ga. X 4" or 5") long copper coated steel; clips: 40 mm (1.5") diameter galvanized steel speed clip.

.6 Through-penetration fire stop materials:

.1 Packing materials: 3M Fire Barrier Duct Wrap, 40 mm (1.5") thick or 64 kg/m^3 (4pcf) mineral wool.

.2 Sealant: 3M FB-2000 or FB-2000+ silicon fire stop sealant.

PART 3 - EXECUTION

3.01 FIRE RESISTIVE DUCT INSULATION (1 AND 2 HR. ENCLOSURE)

.1 Install fire resistive insulation to Manufacturer's instructions and referenced standards in direct contact with ductwork. Cover all duct surfaces with two layers for kitchen (grease duct) exhaust applications. Install fire resistive duct insulation for kitchen grease duct to ULC Design No. FRD-4, Guide No. 40 U21, (Fire Resistant Ducts) including a through-penetration firestop system.

.2 For ventilation air duct (I and 2 hr. enclosure), provide installation to ULC Designs No. FRD-3 and/or FRD-5.

.3 Apply fire resistive duct insulation in continuous unbroken covering from the point the duct enters a concealed space to its exit from the building as indicated on the Drawings. Provide fire resistive insulation for ventilation air duct in one layer of 40 mm (1.5") thickness for I hour application and in two layers of 40 mm (1.5") thickness per layer for a two hour application. For grease duct, regardless of fire rating, provide two layers as specified.

.4 Overlap both perimeter and longitudinal joints by 75 mm (3") per layer minimum.

.5 Apply filament tape as a temporary measure on both layers. Finish installation using steel bands on exterior layer at 265 mm (10.5") on centre and within 40 mm (1.5") of all overlapped seams.

.6 For duct widths greater than 600 mm (24"), weld insulation pins to bottom of horizontal ducts at a 300 X 300 (12" X 12") grid. Inductive welded insulation pins to be applied to one of wider sides of all vertical ductwork on a 300 X 300 mm (12" X 12") grid. Impale duct insulation over pins and secure with speed clips.

.7 At duct access doors (horizontal or vertical): Insulate with three layers of duct insulation with first layer the same dimension as access door. The two outer layers to overlap onto the outer layer of duct insulation by 40 mm (1.5") minimum beyond all sides of the access door opening. Install to Manufacturer's instructions.

.8 Fire Separations:

.1 For insulated kitchen exhaust (grease duct): where duct passes through a fire rated wall or floor penetration, duct to pass through with 75 mm (3") maximum clearance around fire resistive insulation. Longitudinal and transverse overlaps in insulation to be continuous through wall or floor penetrations. Fill spaces around duct insulation with heat resistive insulation or mineral wool firmly packed into opening on all sides to a depth of 100 mm (4") minimum and recess 6mm (¼") within surface of wall or floor. Seal with specified fire stop sealant over packing material to a depth of 6 mm (¼") flush with top and underside of floor and both sides of wall surfaces.

.2 For insulated ventilation duct, provide 75mm (3") maximum clear space around bare duct through opening. Fill space around bare duct where it passes through wall or floor with heat resistive insulation or mineral wool firmly packed into opening on all sides to full depth of floor or wall. Seal both sides with 6mm (¼") of fire stop sealant. Tightly butt fire resistive duct insulation to each side of wall or floor assemblies and seal with firestop sealant.

3.02 INSPECTIONS

.1 Arrange for the Fire Resistive Insulation Manufacturer's representative to inspect the installation and to submit a report attesting to compliance with the Manufacturer's installation requirements.

3.03 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 75

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

.1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Requirements Section 20 05 05 and Mechanical Basic Materials and Methods, Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

.1 Supply all materials, labour, equipment, design and working drawings to provide a complete fire protection system as described herein and shown on the drawings including, but not limited to the following:

.1 All piping including external fire department pumper connections, yard fire hydrants, post indicator valves and equipment.

.2 All fire hose cabinets and standpipe systems (Section 21 12 01).

.3 Sprinkler systems (Section 21 13 13).

.4 All fire extinguishers, cabinets and brackets (Section 21 23 00).

.5 Temporary standpipe during construction as required by Authorities.

.2 All necessary water flow tests for bidding and new water flow tests prior to system design.

.3 Perform general review of the installation of the fire protection systems in conformance with the Division C, subsection 1.2.2 of the Ontario Building Code and provide certification letters as required by the authorities having jurisdiction.

1.03 DELINEATION OF WORK

.1 Due to the sprinkler system Subtrade being a specialist installer, delineation of work for this Subtrade, as it interfaces with other Division 20, 21, 22, 23, and 25 subtrades, (in connection with water supplies, mains and valving), is described on the drawings.

1.04 SUBMITTALS

.1 Submittals: In accordance with Section 01 33 00 – Submittal Procedures and Section 20 05 05.

.2 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario

.3 Before commencing Sprinkler System installation, prepare and submit for acceptance, a complete design, hydraulic calculations and working plans to the Authorities and Consultant. All work with other trades, especially work by other Sections of this Division and Division 26 must be coordinated. Extra compensation to remedy interference problems with the Work of Divisions 20,22,23,25 and 26 Subtrades will not be considered.

.4 Submit shop drawings on pumps, hose cabinets, fire extinguishers, fire department pumper connections, compressors.

.5 Shop drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.6 Submit samples of sprinkler heads and guards.
.7 Closeout Submittals:
  .1 Provide operation and maintenance data for incorporation into manual specified in Division 01 closeout submittals and as outlined in Section 20 05 05.
  .2 Site records and Record Drawings: Refer to Section 20 05 05:
  .3 Provide co-ordination/interference drawings, as required per Section 20 05 05, Co-ordination Drawings.

1.05 QUALITY ASSURANCE

.1 Quality Assurance: In accordance with Section 01 45 00 – Quality Control.
.2 Health and Safety Requirements: Do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.
.3 Qualifications: Execute work of this Section only by skilled tradesmen employed by a qualified Fire Protection Contractor licensed in the province of Ontario regularly engaged in the installation of automatic sprinkler systems and other fire protection equipment and who is a member in good standing of the Canadian Automatic Sprinkler Association.
.4 Authorities and Agencies: Conform to requirements of Ontario Fire Code, NFPA 10, NFPA 13, NFPA 14, NFPA 20, the City of Toronto Building and Fire Department, the Ontario Building Code and the Owner's Insurance Underwriter.
.5 Arrange and pay for all inspections, examinations and tests required by all Authorities specified previously. Provide certificate, where given, to the Consultant.

1.06 APPROVALS

.1 Prepare not less than seven (7) sets of sprinkler/standpipe system installation drawings (sprinkler/standpipe shop drawings) and associated detailed system hydraulic calculations and submit directly to the Insurance Authority for review and approval. After obtaining the Insurance Authority approval submit the approved drawings and hydraulic calculations to the local Building and Fire Departments for their review and approval. The fully approved drawings and hydraulic calculations shall then be submitted to the Consultant for review.
Note: No fabrication or installation shall proceed on the sprinkler systems until all approvals have been obtained.
.2 Apply and pay for all permits, fees and inspections that are required for final acceptance of the Sprinkler Systems.
.3 Include in the Tender Price all costs associated with the review and approval by the Insurance Authority.
.4 All materials, equipment valves and devices installed and furnished under this Section shall be listed and approved for use in the Sprinkler Systems installation by the Authorities, Agencies, Codes and Standards named in this Section of the Specification.

1.07 MAINTENANCE

.1 Furnish spare parts in accordance with Division 01 close-out submittals as follows:
  .1 One set of packing for each pump.
  .2 One casing joint gasket for each size pump.
  .3 One glass for each gauge glass.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01 close-out submittals.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.08 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 MATERIALS, EQUIPMENT, VALVES AND DEVICES

.1 All materials, equipment, valves and devices provided under this section: ULC labelled, listed and approved as well as approved by the Authorities, Agencies Codes and Standards named in this Section. For reference use Underwriters' Laboratories approved fire protection equipment list (ULC).

.2 Fire Department Connections:

.1 Provide where shown, two Fire Department hose connections flush type Siamese National Fire Equipment Ltd. No. 229, with double clapper. Cast bronze with chrome plated finish and properly labelled and identified for "standpipe" and "sprinkler" services.

.2 Thread specifications: compatible with local fire department.

.3 Install connections approximately 1.5 m above finish grade, location as indicated.

.4 Install a 90-degree elbow with drain connection at the low-point near each fire department connection to allow for system drainage to prevent freezing.

.5 Other acceptable manufacturers: CFH, Stelpro, Wilson and Cousins.

.3 Supervised Valves:

.1 All sprinkler and standpipe system branch supervised valves: Butterfly type Grinnell #WC8292ULC/FM Dual approved, or acceptable alternative, complete with micro switch for wiring into the fire alarm annunciation system. Micro switch to be in the closed position when the valve is full open and to open when the valve stem moves away from full open position. Wiring to annunciator panel by Division 26,28.

.4 Backflow Prevention:

.1 Where standpipe and/or sprinkler systems are connected to a potable water supply, provide the following:

.1 A double check valve assembly to CSA B64.5 where no water treatment, antifreeze or other chemicals are used in the standpipe or sprinkler systems.

.2 A reduced pressure principle back flow preventer to CSA B64.4-M where chemicals, water treatment or antifreeze are used in the standpipe or sprinkler systems.

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PART 3 - EXECUTION

3.01 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Division 09.

.2 Prime and touch-up marred finished paintwork to match original.
.3 Restore to new condition, finishes which have been damaged.

3.02 PROTECTION AND CLEANING

.1 Protect equipment and system openings from dirt, dust and other foreign materials with materials appropriate to system.
.2 Clean exterior of all systems.

3.03 VALVE STATION AND COMPRESSOR STATION

.1 Arrange piping and equipment to provide adequate service accessibility and minimum space requirements.
.2 Provide all electrically connected and supervised equipment and devices such as supervised valves, pressure switches, flow switches, alarm valves, pumps, and compressor, in locations as indicated on the drawings. Co-ordinate locations of these devices with Division 26, 28.
.3 Co-ordinate and co-operate with Division 28 regarding required interconnections for alarm points.

3.04 FIRE HYDRANTS AND EXTERIOR WORK

.1 Bury all piping below the normal frost line. Refer to detail drawings.

3.05 ANCHORING

.1 Provide joint anchors, thrust protection, etc. at all critical points in the piping systems throughout the building designed to withstand hydraulic shock and stresses produced by the pumping system. Submit anchor and thrust block design for review by the Consultant.

3.06 LABELLING

.1 Refer to Section 20 05 10 and comply therewith.
.2 Label all sprinkler systems at the flow switch identifying the zone number. Co-ordinate zone numbers with Division 28 to match numbers on the fire alarm annunciator panel.
.3 Label all sprinkler and standpipe zone and riser isolation valves. Mount design information near the labelling point or at base of riser in a glazed frame.
.4 Label all piping throughout the building, i.e. "Sprinkler", "Inspector test".

3.07 PIPING

.1 Wherever pipe routing is indicated, it is shown for the purposes of coordinating installation details. Co-ordinate work of this section with all affected trades.

3.08 PROTECTION OF PIPING AGAINST FREEZING

.1 Provide freeze protection for sprinkler piping in unheated area per NFPA 13.
.2 Electric heat tracing system shall be sized and listed for use in fire protection system meeting the requirements of NFPA. Electric supervision of the heat tracing system shall be provided with positive confirmation that the circuit is energized. Co-ordinate with Divisions 26, 28.

.3 Refer to Sections 20 05 25 and 23 05 33 for material and installation specifications and details for all traced and insulated piping.
.4 All piping with electric heat tracing system is to be insulated with protective metal casing.

3.09 WATER SUPPLY

.1 Division 21 Contractor is fully responsible for consulting with all Authorities, obtaining pertinent water flow and pressure test information together with any other additional information prior to submitting his bid. If current water flow information is not available the bidding subcontractor is required to arrange with the local authorities and do all necessary flow tests. All cost involved in obtaining this information is to be at the expenses of the bidding Division 21 Contractor.
.2 Under all circumstances, the successful Division 21 Contractor is required to make all necessary arrangements and conduct new water flow tests prior to finalization of all design and pipe sizing. The cost of all such tests shall be included in the Tender Price. Copies of all new test results shall be submitted as part of the shop drawing for hydraulic calculations.
.3 No change to the Contract Price will be accepted due to a different water condition after a Contract has been awarded.

3.10 HYDRAULIC DESIGN

.1 Sprinkler systems up to and including floor level elevation ground floor design to use available street pressure. On higher levels: Design to incorporate a booster pump system.
.2 Limit pressure to fire hose cabinets to 448 kPa (65 psi) and 865 kPa (125 psi) to sprinkler system. Use approved pressure reducing valve stations as specified.
.3 Perform a hydrant flow test to determine flow characteristics on the street watermain. Confirm with the Authorities the allowable flow test data to be used in the design calculations.
.4 A minimum of 34.5 kPa (5 psi) pressure safety factor should be deducted from the water flow test results for the purposes of sprinkler and standpipe system design.

3.11 TESTS

.1 Cooperate and co-ordinate with Division 26, 28 for all testing on zoning.
.2 Pressure Tests:
  .1 Sprinkler systems; to NFPA 13 requirements.
  .2 Standpipe systems; for a period of two (2) hours without pressure loss at 345 kPa (gauge) higher than maximum service pressure, but not less than 1380 kPa (gauge).

3.12 TESTING AND VERFICATION

.1 Co-ordinate each test and provide at least two weeks advance notice to the Consultant and other inspection authorities. Inform the Consultant two weeks before testing, in writing, of special arrangements and co-ordination efforts necessary but not under his control.
.2 Acceptance Testing of the Fire Protection System shall be in accordance with Authority requirements. The applicable Test Certificate(s) shall be completed at the time of testing and submitted as previously described.
.3 Perform all tests in accordance with the Authorities' requirements, with N.F.P.A. standards, and Insurance Authority recommendations.

.4 At the completion of the installation of all systems equipment and devices and when the system is fully operable, test and verify the entire system.

.5 Notification of the Consultant and a demonstration of the proper functioning of the entire system is to be carried out after the testing and verification task is completed and all deficiencies are rectified.

.6 The purpose of a verification procedure is to confirm that all equipment operates as intended. Upon completion of the verification procedures, a certificate of verification shall be given to the Consultant. A copy shall be kept with the system documentation. An equipment schedule listing each device and showing confirmation that it was verified, shall also be provided.

.7 Certificate of verification is to be signed and sealed by a qualified engineer of the Contractor who witnessed the entire testing and verification procedure.

END OF SECTION 21 05 05

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05 Mechanical Work General Instructions and Section 20 05 10 Mechanical Basic Materials and Methods.

.3 Comply with requirements of Section 21 05 05 Common Work Results For Fire Suppression.

1.02 WORK PERFORMED BY THIS SECTION

.1 Supply all materials, labour, equipment, design and working drawings to provide a complete fire standpipe system as described herein and shown on the drawings including, but not limited to the following:

.1 All fire hose cabinets and standpipe systems

1.03 REFERENCES

.1 National Fire Protection Association (NFPA): NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

.2 Ontario Building Code (2016)

1.04 QUALITY ASSURANCE

.1 Qualifications: Installer - company or person specializing in standpipe and hose assembly with 5 years documented experience.

.2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.05 SUBMITTALS

.1 Provide submittals in accordance with Sections 20 05 01 – Shop Drawings, Product Data & Samples.

.2 Samples: Submit the following samples:

.1 Fire hose nozzles.

.2 Section of hose.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

.1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

.1 Design system to NFPA 14 and the Ontario Building Code requirements

2.02 MATERIALS, EQUIPMENT, VALVES AND DEVICES

.1 All materials, equipment, valves and devices provided under this section: ULC labelled, listed and approved as well as approved by the Authorities, Agencies Codes and Standards named in this Section. For reference use Underwriters' Laboratories approved fire protection equipment list (ULC).

2.03 PIPE, FITTINGS AND VALVES

.1 Pipe, fittings, hangers and accessories to NFPA 14 and the Ontario Building Code, Ontario Regulation 413/90, effective Oct. 1, 1990 and amended September 30, 1991 and to current amendments.
  .1 Where pressures exceed 865 kPa (125 psi), use ASTM A53 schedule 40 black steel pipe and 300 lb. threaded fittings or extra strong welded fittings.

.2 Pipe:
  .1 Ferrous: to NFPA 14.
  .2 Schedule 10 piping is **NOT** allowed.

.3 Fittings and joints to NFPA 14:

  .1 Ferrous: screwed, welded, flanged or roll grooved. Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.

.4 Valves:
  .1 ULC listed for fire protection service.
  .2 Up to NPS 2: Bronze, screwed ends, grooved, OS&Y gate.
  .3 NPS 2 1/2 and over: Cast or ductile iron, flanged ends, indicating butterfly valve.
  .4 Check valves: Spring actuated swing type, composition disc or seal.

.5 Pipe hangers: ULC listed for fire protection services.

.6 Drain valve: NPS 1, complete with hose end, cap and chain.

.7 Inspector's test connections: NPS 1 gate valve.

2.04 FIRE HOSE CABINETS

.1 National Fire Equipment Ltd. consisting of a 16 gauge steel factory prime coated tub with trim and door of 12 gauge steel and 5mm (3⁄16") clear float glass front, complete with 30 m Polyflex single jacket hose, water stop, pin rack, forged brass couplings attached, 40mm (1½") A156 pressure restricting regulating forged brass valve with hydrolater, 65mm (2½") A156 pressure restricting regulating brass angle hose valve with cap and chain, 40mm (1½") chrome plated Lexan straight stream fog nozzles and 11.37 1 (3 US gal.) copper, multi-purpose, ammonium phosphate type tested and charged extinguisher with ULC listing 3A10BC, 2.3 kg (5 lbs) capacity and one trinal spanner. Couplings for hoses shall conform to ULC-S513, CAN/ULC-S543. Provide 6mm (¼") Lexan fronts on doors, brass valves and couplings and unplated nozzles in parking garage areas.
.2 Cabinets to be surface mounted or recessed as indicated on drawings.
.3 Provide a minimum of 4 additional spanners for hose couplings.
.4 Hose stations are to be listed and Factory Mutual approved.
.5 Other acceptable manufacturers: CFH, Stelpro, Wilson and Cousins.
.6 Cabinets to maintain fire resistive rating of construction in which they occur.

2.05 PRESSURE GAUGES

.1 90 mm diameter, to Section 20 05 10.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and data sheet.

3.02 INSTALLATION

.1 Install and test to acceptance in accordance with NFPA 14.
.2 Install drain pipes and valves to drain parts of systems and so arranged that any one standpipe riser can be drained without shutting down any other parts of systems.
.3 For standpipe system, provide a 75mm (3") permanently installed drain riser adjacent to each standpipe equipped with pressure regulating devices as per NFPA 14 Section 5-11. The riser to be equipped with 75mm (3") x 63mm (2.5") tee with an internal threaded swivel fitting having National Hose Standard threads, as specified in NFPA 1963, Standard for Fire Hose Connections, with a plug, located at least every other floor.
.4 Install 90 mm diameter pressure gauge in accordance with Section 20 05 10 at top of risers and in accordance with NFPA 14.
.5 Hose Cabinets:

.1 Locate as shown on drawings with reference to Architectural wall elevations. Ensure valves are no greater than 1500mm (60") above finished floor or as required by Authorities. Also, confirm with Consultant.

.6 Protection of Standpipe:
.1 Provide protection of above ground standpipes and lateral piping per NFPA 14.
.2 All standpipes and lateral piping is to be protected by a degree of fire resistance per code.

3.03 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 21 12 01

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05 Mechanical Work General Instructions and Section 20 05 10 Mechanical Basic Materials and Methods.

.3 Comply with requirements of Section 21 05 05 Common Work Results For Fire Suppression.

1.02 WORK PERFORMED BY THIS SECTION

.1 Supply all materials, labour, equipment, design and working drawings to provide a complete fire protection system as described herein and shown on the drawings including, but not limited to the following:

.1 Sprinkler Systems:

.1 Wet sprinkler system for floors above grade; dry sprinkler system in ground floor and underground parking areas; dry sprinkler system in loading dock area.

1.03 REFERENCES

.1 National Fire Protection Association (NFPA):

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.
.2 NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection.
.3 NFPA 24, Standard for the Installation of Private Fire Service Mains and their Appurtenances.
.4 NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.

.2 Ontario Building Code

1.04 QUALITY ASSURANCE

.1 Qualifications: Installer - company or person specializing in sprinkler systems with 5 years documented experience.

.2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.05 SUBMITTALS

.1 Provide submittals in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

.2 Samples: Submit the following samples:

.1 Each type of sprinkler head.
.2 Signs.

.3 Extra Materials:

.1 Provide maintenance materials in accordance with Division 01 Close out submittals.

.2 Provide spare sprinklers and tools in accordance with NFPA 13.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Do delivery, Storage and Handling in accordance with Section 20 05 05 – Mechanical Work General Instructions.

1.07 WARRANTY

.1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 DESIGN REQUIREMENTS

.1 Design automatic wet pipe and dry pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area.

.1 Refer to the Drawings for Occupancy Classifications
.2 Dry System: Loading dock, garbage rooms: ordinary hazard Group II.
.3 Wet System: Ground floor and mechanical rooms; ordinary hazard Group II.
.4 Wet System: Level 2 and up; light hazard.

.2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.

.3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.

.4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

.5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

.6 Design systems for earthquake protection for buildings in seismic zones as noted.

.7 Location of Sprinkler Heads:

.1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.
.2 Uniformly space sprinklers on branch.

.8 Outside Hose Allowances: Include allowance in hydraulic calculations for outside hose streams as per NFPA 13.

.9 Water Supply: Refer to Section 21 05 05 for water supply details.

2.02 ABOVE GROUND PIPING SYSTEMS

.1 Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.

.2 Conceal piping in areas with suspended ceilings.

2.03 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous: To NFPA 13.
.2 Schedule 10 piping is **NOT** allowed.

.2 Fittings and joints to NFPA 13:

.1 Ferrous: Screwed, welded, flanged or roll grooved. Grooved joints (Victaulic) designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad- to-pad offset contact.
.2 Provide threaded] or grooved-end type fittings into which sprinkler heads, sprinkler head
riser nipples, or drop nipples are threaded.
.3 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to
bite into pipe when pressure is applied will not be permitted.
.4 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted
in pipe sizes 32 mm and larger.
.5 Fittings: ULC approved for use in wet pipe sprinkler systems.
.6 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by the same manufacturer.
.7 Side outlet tees using rubber gasketed fittings are not permitted.
.8 Sprinkler pipe and fittings: Metal.
.9 Provide schedule 40 galvanized pipe and fittings for dry sprinkler systems.

.3 Valves:

.1 ULC listed for fire protection service.
.2 Gate valves: Open by counterclockwise rotation.
.3 Provide OS & Y valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.
.4 Check valves: Flanged clear opening swing or spring actuated check type with flanged
inspection and access cover plate for sizes 100 mm and larger.
.5 Provide gate valve in piping protecting elevator hoistways, machine rooms and machinery
spaces

.4 Pipe hangers: ULC listed for fire protection services in accordance with NFPA.

2.04 SPRINKLER HEADS

.1 General: to NFPA 13 and ULC listed for fire services.

.2 Sprinkler Heads: As symbolized on the drawings rated to suit application, FM and ULC listed and labelled. Sprinkler heads to be as follows complete with Bellville seals. “0” ring seals are not acceptable.

.1 Chrome plated pendant complete with CP escutcheon; Gem Type F980 (Bulb Type).
.2 Brass upright and pendant; Gem Type F950.
.3 Recessed chrome plated head and off-white painted cup; Gem Type F972 (Bulb Type).
.4 Concealed white painted Gem Designer No. F976.
.5 Chrome plated horizontal sidewall with CP escutcheon; Gem Type F950/Q46.
.6 Brass pendant "Dry" Type: GEM issue 'C'.
.7 Sidewall; chrome plated Gem F950/Q-48.
.8 Dry type sidewall; chrome plated Gem F960/Q46.
.9 Dry type sidewall extended coverage; chrome plated Gem F960/Q48.
.10 Dry type pendant: chrome plated with white painted escutcheon Gem F960.
.11 Provide wire guards for all sprinkler heads located in storage rooms, mechanical rooms, janitors closets, stairwells, loading dock, garbage rooms and parking garage.
.12 FM and ULC listed and labelled sprinkler heads manufactured by Viking, Reliable and Star will also be accepted.
.13 Extended sprinkler heads are not allowed.

2.05 ALARM CHECK VALVE

.1 Alarm check valve to NFPA 13 and ULC listed for fire service.

.2 Alarm check valve: ULC labelled alarm check valves with double sets of contacts, sized for the area they are to cover, and equipped with all necessary trim. Wiring of valves to the fire alarm system is specified in Division 26.

.3 Provide valve complete with internal components that are replaceable without removing the valve from the installed position.

2.06 DRY PIPE VALVE

.1 Alarm Dry-pipe Valves: ULC labelled alarm dry-pipe valves with double sets of contacts, sized for the area they are to cover, and equipped with all necessary trim. Wiring of valves to the fire alarm system is specified in Division 26.

.2 Cast or ductile iron, flanged or grooved end type, sized to suit water main.

.3 Components:

.1 Accelerator.
.2 Air maintenance device with low pressure alarm.
.3 Alarm pressure switch with supervisory capability.
.4 Pressure gauges.
.5 Drain valve.
.6 Test valve with associated piping.
.7 Shut off valve - OS & Y with tamper-proof device wired back to fire alarm panel.
.8 Required air pressure 90 kPa (13 psi).

.4 Provide valve complete with internal components that are replaceable without removing valve from installed position.

2.07 COMPRESSED AIR SUPPLY

.1 Automatic Air Compressor.

.1 Provide an air compressor of a size capable of satisfying the demand for the dry-pipe systems, complete with ULC labelled control components and starter. Power wiring to the compressor motor starter is specified in Division 26.

.2 Capacity:

.1 To restore normal air pressure in system within 30 minutes or 60 minutes for low differential systems.
.2 To provide air pressure of 140 kPa in excess of calculated trip pressure of dry pipe.

.3 Piping: ferrous, NPS ¾ screwed joints and fittings, to NFPA 13.

2.08 WATER MOTOR ALARMS

.1 Provide alarms approved weatherproof and guarded type to sound locally on flow of water in each corresponding sprinkler system.

.2 Mount alarms on outside of outer walls of each building at location as directed.

.3 Provide separate drain piping directly to exterior of building.

2.09 SUPERVISORY SWITCHES

.1 General: to NFPA 13 and ULC listed for fire service.

.2 Valves: Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.

.3 Pressure Switches and Flow Switches:

.1 Provide ULC approved Potter Electric pressure and flow switches with double sets of contacts in the mains were indicated on the drawings.
.2 Wiring for pressure and flow switches to be provided by Division 26
.3 Other acceptable manufacturer: McDonnell & Miller.

.4 Pressure or flow switch type:

.1 With normally open and normally closed contacts and supervisory capability.
.2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.
.3 Connect into building fire alarm system.
.4 Connection of switch: Division 28 fire alarm
.5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.

.5 Pressure alarm switch: With normally open and normally closed contacts and supervisory capability.

2.10 PRESSURE REDUCING VALVES:

.1 Provide, where required, ULC and FM labelled pressure reducing valves (PRV) with adjustable spring range, sized to suit required flow and pressure differential, capable of maintaining differential pressure at 138 kPa (20 psi) during both flow and static conditions.

.2 Provide all necessary trim: Downstream and upstream pressure gauges, isolation valves, by-pass valves, pressure relief valve on low pressure side to compensate for leakage across the PRV.

2.11 PRESSURE CONTROL VALVES

.1 Automatic balanced piston, adjustable spring loaded type, ULC labelled and listed National Fire Equipment Ltd. models A201 and A203 or acceptable alternative.

2.12 WATER GONG

.1 To NFPA 13 and ULC listed for fire service. Location as indicated Provide a labelled water motor gong piped on the interior of the building with the drain line piped to nearest open drain to work in conjunction with the appropriate fire alarm check valves.

2.13 EXCESS PRESSURE PUMP

.1 Provide pumps on each sprinkler piping riser or as indicated in Schematic drawing.

.2 Pumps:

.1 Albany Model CEP-67, or acceptable alternative, bronze close coupled rotary gear type complete with ⅓ HP motor, flex. hose connections, discharge check valve, suction strainer, mounting bracket, PRV set at 1085 kPa (125 psig) and pressure switch rated for pump operation with range 70 to 860 kPa (10 to 125 psi).

.3 Provide electrical power supply connections for pump and pilot light panel at supply side of building service panel.

.4 Provide separate fused safety-type switch with locked lever for each connection.

.5 Provide pressure pump sensing piping in supply piping.

.6 Pump operation switch: to operate excess pressure pump with pressure differential as indicated on drawings.

.7 Shut-off valve and strainer on pump inlet. Relief valve, check valve and shut-off valve on discharge connections.

2.14 PRESSURE GAUGES

.1 ULC listed and to Section 20 05 10.

.2 Maximum limit of not less than twice normal working pressure at point where installed.

2.15 PIPE SLEEVES

.1 Provide pipe sleeves where piping passes through walls, floors and roofs.

.2 Secure sleeves in position and location during construction.

.3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors and

roofs.

.4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.

.1 Firmly pack space with mineral wool insulation.
.2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass, or provide mechanically adjustable segmented elastomeric seal.
.3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.

.5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:

.1 Provide hot-dip galvanized steel, ductile-iron or cast-iron sleeves to suit application.
.2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

.6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs: Provide 0.61 mm thick galvanized steel sheet.

2.16 ESCUTCHEON PLATES

.1 Provide one piece type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.

.2 Provide polished stainless steel plates in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

2.17 INSPECTOR'S TEST CONNECTION

.1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.

.2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.

.3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.18 SIGNS

.1 Attach properly lettered [Bilingual] and approved metal signs to each valve and alarm device to NFPA 13.

.2 Permanently fix hydraulic design data nameplates to riser of each system.

2.19 ANTI-FREEZE

.1 Anti-freeze loops to NFPA 13, locations as indicated.

2.20 RELIEF VALVE

.1 ULC listed.

2.21 SPARE PARTS CABINET

.1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13

(min 6 of each type).

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and data sheet.

3.02 SPRINKLER ZONING

.1 Generally provide sprinkler zoning as defined on the drawings and described herein:

.2 Ground floor to penthouse: Provide one zone per floor, including mechanical and electrical rooms on the floor.

.3 Loading dock, garbage room: Single zone dry pipe system.

.4 Parking garage levels: Provide one dry pipe zone for each level including storage rooms.

3.03 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

.2 Pressure gauges:

.1 Location:
.1 On water side and air side of dry pipe valve.
.2 At air receiver.
.3 In each independent pipe from air supply to dry pipe valve.
.4 At exhausters and accelerators.
.2 Install to permit removal.
.3 Locate so as not subjected to freezing.

.3 Valve identification: Identify drain valve, bypass valves and main shut-off valve and all auxiliary valves.

.4 Install and co-ordinate sprinkler head locations with the reflected ceiling plans and Architectural wall elevations and to ensure adequate coverage. Heads indicated on drawings are schematic, for purposes of indicating type of heads only.

.5 Provide additional heads for retail tenant areas to accommodate future partitioning. Maximum head coverage: 175 ft^2 in the perimeter zone, and 200 ft^2 in the interior zone.

.6 Provide additional heads for mechanical rooms to accommodate ductworks.

.7 Install chrome plated escutcheons for heads flush with wall and ceiling surface.

.8 Install all piping to provide maximum headroom.

.9 FM Approved equipment is to be used and details of the installation to conform to FM Global recommended good practices and FM Global Data Sheet 2-8N.

.10 Drains And Test Risers

.1 System drains and test connections: run to the nearest open drain in the building or to outdoors through wall away from paved areas. Seal and caulk around piping

through wall and provide escutcheon and prime paint all metal surfaces exposed to outdoors. Run to the nearest janitors sink or drain. Secure exposed piping with ring stays. Use copper piping only where exposed in the vicinity of the janitors sink.

.2 Route PRV drain line on pressure reducing station into the inspectors test and drain line.

.3 Run the base of the inspectors test and drain line and fire pump by-pass line into storm drain

.4 Provide drum drips on dry sprinkler system piping at low points and at any point where piping is trapped.

.11 Excess Pressure Pumps

.1 Install pumps in locations where they are readily accessible for maintenance and servicing. Refer to manufacturer's instructions and applicable codes for proper arrangement and connections. Mount the booster pump control panel as close as possible to the pump, but in a location providing at least 1m (3 ft.) clear space in front of the panel.

.2 Provide the services of the pump manufacturer for field testing of the pumps, motors, and controllers.

.12 Drum Drips

.1 Provide drum drips on dry sprinkler system piping at low points and at any point where piping is trapped. Refer to detail Drawings

3.04 PIPE INSTALLATION

.1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.4 Inspect piping before placing into position.

3.05 ELECTRICAL CONNECTION

.1 Provide electrical work associated with this section under Division 26.

.2 Provide fire alarm system under Division 28.

.3 Provide control and fire alarm wiring including connections to fire alarm systems, in accordance with Ontario Electrical Safety Code.

.4 Provide wiring in rigid metal conduit or intermediate metal conduit.

3.06 DISINFECTION

.1 Disinfect new piping.

.2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.

.3 Flush solution from systems with clean water until maximum residual chlorine content is

not greater than 0.2 part per million or residual chlorine content of domestic water supply.

.4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.07 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

.1 Notify Contracting Officer in writing at least 15 days prior to connection date.

.2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.

.3 Bolt sleeves around main piping.

.4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.

.5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

3.08 BURIED PIPING SYSTEM

.1 Bury tape with printed side up at depth of 30 cm below the top surface of earth or top surface of subgrade under pavements.

3.09 FIELD PAINTING

.1 Clean, pre-treat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.

.2 Apply coatings to clean, dry surfaces, using clean brushes.

.3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.

.4 Immediately after cleaning, provide metal surfaces with one coat of pre-treatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.

.5 Shield sprinkler heads with protective covering while painting is in progress.

.6 Upon completion of painting, remove protective covering from sprinkler heads.

.7 Remove sprinkler heads which have been painted and replace with new sprinkler

.8 Provide primed surfaces with the following:

.1 Piping in Finished Areas:
.1 Provide primed surfaces with two coats of paint to match adjacent surfaces.
.2 Provide valves and operating accessories with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
.3 Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.

.2 Piping in Unfinished Areas:
.1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
.2 Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 m intervals.

3.10 FIELD QUALITY CONTROL

.1 Site Test, Inspection:

.1 Perform test to determine compliance with specified requirements in presence of Consultant.
.2 Test, inspect, and approve piping before covering or concealing.
.3 Preliminary Tests:
.1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
.2 Flush piping with potable water in accordance with NFPA 13.
.3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
.4 Test alarms and other devices.
.5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.
.4 Formal Tests and Inspections:
.1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
.2 Submit written request for formal inspection at least 15 days prior to inspection date.
.3 Repeat required tests as directed.
.4 Correct defects and make additional tests until systems comply with contract requirements.
.5 Furnish appliances, equipment, instruments, connecting devices and personnel for tests.
.6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.3 Site Tests:

.1 Field test each fire pump, driver and controllers in accordance with NFPA 20. Testing shall include:

.1 Verification of proper installation, system initiation, adjustment and fine tuning.

.2 Verification of the sequence of operations and alarm systems.

.2 Testing to be witnessed by authority having jurisdiction.

.3 Develop detailed instructions for O & M of this installation.

.4 Verification requirements in accordance with Division 01, include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource re-use.

.5 Recycled content.

.6 Local/regional materials.

.7 Low-emitting materials.

3.11 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 21 13 00

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Requirements Section 20 05 05 and Mechanical Basic Materials and Methods, Section 20 05 10.

.3 Comply with requirements of Common Work Results For Fire Suppression Section 21 05 05.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide Fire Extinguishers, Fire Blankets and Cabinets as indicated on the mechanical drawings and to suit the requirements of NFPA 10.

1.03 REFERENCES

.1 Ontario Building Code

.2 Ontario Fire Code

.3 NFPA 10 Standard for Portable Fire Extinguishers

.4 CAN/ULC –S508

.5 Underwriters' Laboratories of Canada (ULC): Various listings.

1.04 QUALITY ASSURANCE

.1 Acceptable manufacturers: National Fire Equipment Ltd. CFH, Wilson & Cousings.

1.05 SUBMITTALS

.1 Submit shop drawings in accordance with Sections 20 05 01 – Shop Drawings, Product Data & Samples.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 – Mechanical Work General Instructions.

1.07 WARRANTY

.1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS, AND CABINETS:

.1 Provide portable filled and tested fire extinguishers as manufactured by National Fire Equipment Ltd., in sizes and classifications as shown on drawings. All extinguishers to be multi-purpose, ammonium phosphate type unless otherwise specified on the drawings.

.2 Provide wall brackets and cabinets as indicated on drawings. Cabinets: Model CE-950-2 surface mounted or recessed as indicated. All fronts: 5mm (3⁄16") Clear Float Glass. 6mm (□") Lexan in parking garage areas.

.3 Other acceptable manufacturers: CFH, Stelpro, Wilson and Cousins.

PART 3 - EXECUTION

3.01 FIRE EXTINGUISHERS

.1 Provide fire extinguishers for mechanical rooms, electrical rooms, storage rooms and garbage rooms. Unless noted otherwise, use 4.5 kg (10 lbs) extinguishers for all these areas. Unless noted otherwise, minimum size of extinguishers for parking garages shall be use 4.5 kg (10 lbs).

.2 Refer to drawings for location and types of extinguishers. Install brackets on firm backing to manufacturer's instruction. Install cabinets securely with flanges flush with finished wall surfaces.

.3 Spacing of extinguishers shall conform to the Ontario Fire code and the authority having jurisdiction. In no case shall there be less than one extinguisher in each electrical room, kitchen or mechanical room.

.4 Provide portable fire extinguishers in kitchen areas in accordance with the Ontario Fire Code and NFPA 10.

3.02 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 21 23 00

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Requirements Section 20 05 05 and Mechanical Basic Materials and Methods, Section 20 05 10.

.3 Comply with requirements of Common Work Results For Fire Suppression Section 21 05 05.

1.02 REFERENCES

.1 National Fire Protection Association (ANSI/NFPA)

.1 NFPA 20, Standard for the Installation of Stationary Fire Protection.

1.03 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Division 01

.2 Test reports:

.1 Submit certified test reports for packaged fire pumps from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Test each pump/driver package at factory to provide detailed performance data and to demonstrate compliance with NFPA and specification. Submit certified test curves for approval of the Consultant.

.3 Test hydrostatically to meet requirements of fire protection system to which it will be connected.

.3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: Submit manufacturer's installation instructions.

.5 Manufacturer's Field Reports: Manufacturer's field reports specified.

.6 Qualifications: Installer - company or person specializing in packaged fire pump installations with documented experience and approved by manufacturer.

.7 Acceptable manufacturers: Aurora, Peerless, S.A. Armstrong, Bell & Gossett, Xylem, Taco

1.04 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and datasheet for fire pump control and include product characteristics, performance criteria, physical size, finish and limitations in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

.2 Provide drawings for fire pump controller stamped and signed by professional engineer registered or licensed in Ontario and include:

.1 Method of anchorage

.2 Number of anchors.

.3 Supports.
.4 Reinforcement.
.5 Assembly details.
.6 Accessories.
.7 Indicate hydraulic and electrical characteristics including Net Positive Suction Head (NPSH) required, make and model number.
.8 Provide power and control diagrams.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WARRANTY

.1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION
.1 Design Requirements:
.1 Select fire pump to satisfy fire protection system requirements and NFPA 20.
.2 Water Supply
.1 Refer to 21 05 05 for water supply requirements.
.2 Base design on NFPA 20, the water supply data, the hydraulic calculations and the performance requirements noted in the equipment schedules.

2.02 COMBINED SPRINKLER/STANDPIPE BOOSTER PUMP

.1 Provide, in location and as detailed on the drawings, a complete packaged pump manufacturer factory assembled and tested booster pumping system consisting of horizontal split case pumps, electric motor drives, coupling guards, controllers, accessories, as manufactured by Aurora; listed and labelled by ULC, CSA; meeting requirements of NFPA 20.
.2 Selection: To satisfy hydraulic load calculation for sprinkler and standpipe systems to provide a residual pressure of 450 kPa (65 psi) at the most remote hose station while providing the required flow for both sprinkler and standpipe systems.
.3 Performance: Capable of delivering not less than 150% of rated capacity at a pressure of not less than 65% of rated head; Shut-off pressure not to exceed 120% of rated head at rated capacity; maximum permissible motor size; 40 HP.
.4 Accessories: Venturi type flow metering device, discharge tee, air release valve and fittings (UL/FM listed for fire pump service), discharge and suction pressure gauges, gauge cocks and nipples, casing relief valve, as per NFPA 20 section 3-3, by-pass relief valve or pressure relief as required by system design.
.5 Controllers: Combined manual and automatic reduced voltage starting (star delta closed transition) with externally openable quick-break disconnect switch, time delay type circuit breaker with trips in all phases set at 300% of full load current and interrupting capacity of 50,000 asymmetrical amperes; factory installed and wired pressure switch and automatic stop.
.1 The fire pump controller shall meet the requirements per NFPA20.

.6 Control Functions: Drop in system pressure starts pump which runs for 1 minute per 10 HP minimum.

.7 Automatic Transfer Switch: The automatic transfer switch and the main pump controller are to be mounted in separate enclosures mechanically attached to form one unit and to provide protection for the interlock wiring. The automatic transfer switch is to be mechanically held and electrically operable. It will provide automatic power transfer from normal to alternate power in case of a voltage drop below 90% of normal, phase failure, or phase reversal and automatic retransfer of power after restoration of normal power conditions.

.1 The automatic transfer switch will furnish the following manual controls:

.1 An externally operable main isolating switch ahead of the alternate power terminals of the transfer switch.

.2 An operating handle to allow for the manual operation of the transfer switch.

.3 A test switch to momentarily simulate normal source failure.

.2 The automatic transfer switch will furnish the following audio-visual alarms:

.1 Signal light (green) to indicate the transfer switch is connected to the normal source.

.2 Signal light (red) to indicate the transfer switch is connected to the alternate source.

.3 Signal light (red) and audible alarm to indicate alternate power isolating switch

.3 The automatic transfer switch will furnish the following remote contacts:

.1 One normally closed contact for transfer switch connected to the normal source.

.2 One normally closed contact for transfer switch connected to the alternate source.

.3 One normally open and one normally closed contact for transfer switch isolating switch in the ‘OFF’ position.

.4 One normally closed contact to start alternate source generator in case of normal power failure. Signal to be interrupted if the isolation switch is in the ‘OFF’ position.

.4 The automatic transfer switch will furnish the following time delays:

.1 One delay factory set to 3 seconds to delay power transfer and generator start signals.

.2 One unloaded generator delay factory set to 5 minutes to allow generator to cool down.

.3 One retransfer to normal power, delay factory set to 5 minutes with automatic bypass should the emergency power source fail.

.4 One electric motor start delay factory set to 2 seconds after power transfer to prevent current surges due to power source transfer.

.5 The automatic transfer switch is to have a memory circuit to provide automatic starting of the electric motor if the motor was manually started or started by any means requiring manual shutdown.

.8 Monitoring: Pilot lamp to indicate power available. Provide three (3) sets of normally open dry contacts for remote monitoring to indicate:

.1 Pump running;

.2 Loss of power;

.3 Phase reversal.

.9 Provide a listed pressure recording device to sense and record the pressure in each fire pump sensing line at the input to the controller. The recorder is to be capable of operating for at least 7 days without being reset or rewound.

.10 Mounting: Install pump and driver on common base.

.11 Materials and construction: To NFPA 20.

.12 Accessories to NFPA 20 requirements and in addition:

.1 Fire pump bypass fitted with shut off valves and check valves.
.2 Audible and visual suction side alarm.
.3 OS&Y valves on suction and shut off valves on discharge, electrically supervised.

.13 Anchor bolts and templates:
.1 Supply for installation by others.

2.03 PRESSURE MAINTENANCE (JOCKEY) PUMP

.1 Albany Model CEP-67, or acceptable alternative, bronze close coupled rotary gear type complete with 1/3 HP motor, flex. hose connections, discharge check valve, suction strainer, mounting bracket, PRV set at 1085 kPa (125 psig) and pressure switch rated for pump operation with range 70 to 860 kPa (10 to 125 psi).
.2 Accessories: to NFPA 20.

2.04 BOOSTER PUMP TEST CONNECTIONS

.1 Provide in quantities and in locations as shown on the drawings National Fire Equipment Model 230 flush mounted chrome plated wall hydrants with escutcheons and stainless steel screws.
.2 Other acceptable manufacturers: CFH, Stelpro, Wilson and Cousins.

PART 3 - EXECUTION

3.01 APPLICATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions and data sheets.

3.02 INSTALLATION

.1 Install in accordance with ULC listing, NFPA 20, manufacturer's instructions and reviewed shop drawings.
.2 Install pumps in locations where they are readily accessible for maintenance and servicing. Refer to manufacturer's instructions and applicable codes for proper arrangement and connections. Mount the booster pump control panel as close as possible to the pump, but in a location providing at least 1m (3 ft.) clear space in front of the panel.
.3 Provide the services of the pump manufacturer for field testing of the pumps, motors, and controllers.
.4 Provide a full flow test and plot the actual pump performance curve. Comply with all other testing procedures as required by Authorities.
.5 Perform all testing in the presence of the Authorities and the Consultant. Submit all test results to the Consultant.
.6 Align pump and motor shafts to within manufacturer's recommended clearances prior to start-up.
.7 Install wiring in accordance with manufacturer's instructions and applicable codes.

3.03 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.2 Site Tests:

.1 Field test each fire pump, driver and controllers in accordance with NFPA 20. Testing to include:

.1 Verification of proper installation, system initiation, adjustment and fine tuning.

.2 Verification of the sequence of operations and alarm systems.

.2 Testing to be witnessed by the authority having jurisdiction.

.3 Develop detailed instructions for O & M installation.

3.04 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 21 30 00

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05, Mechanical General Works Instructions and 20 05 10 Mechanical Basic Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide a complete plumbing system including domestic hot and cold water, non-potable water, natural gas piping, sanitary and storm drainage, and vent piping and all fixtures, trim and hot water heaters / tanks as shown on the drawings complete in every detail.

.2 Provide Municipal and Utility street services connections (Domestic and fire protection water, sewers, natural gas) as indicated on the site plan. Terminate fire protection supply within building with shut-off valve - continuation of fire protection work is specified in Division 21.

.3 Provide make-up water connections to heating and cooling systems and trapped condensate drains from cooling coil drip trays.

1.03 QUALITY ASSURANCE AND REGULATORY COMPLIANCE

.1 Qualifications: Execute work of this section only by licensed tradesmen regularly employed in the installation of natural gas, plumbing and drainage piping systems and site water supply and drainage services.

.2 Other acceptable manufacturers to specified items:

Plumbing Fixtures: as shown in the Interior Designer cut sheets, unless otherwise indicated in the mechanical specifications.

Plumbing Brass: as shown in the Interior Designer cut sheets, unless otherwise indicated in the mechanical specifications.

Water Closet Seats: as shown in the Interior Designer cut sheets

Drains and Specialities: Zurn, Watts

Shower Valves: as shown in the Interior Designer cut sheets

Precast Shower Bases and Mop Sinks: as shown in the Interior Designer cut

sheets Oil/Grease Interceptors: Zurn.

.3 Provide all Barrier Free Fixtures and Fittings to CAN/CSA-B651.

.4 Provide water closets and urinals with maximum flush for 6.0 and 3.8 litres respectively and provide flush valves that match the fixture capacities that are installed.

.5 Provide domestic hot water generation systems in compliance with ASHRAE 90.1, 2010.

.6 Where stops or shut-off valves are specified for fixtures, provide ball type valves - rough brass where concealed and chrome plated where exposed. Provide a complete plumbing system including domestic hot and cold water, natural gas piping, sanitary and storm drainage and vent piping and all fixtures, trim and hot water heaters as shown on the drawings complete in every detail.

1.04 SUBMITTALS

.1 Submittals: In accordance with Section 01 33 00 – Submittal Procedures and Section 20 05 05.
.2 Shop drawings to show:
  .1 Mounting arrangements.
  .2 Operating and maintenance clearances.
.3 Closeout Submittals:
  .1 Provide operation and maintenance data for incorporation into manual specified in Division 01 closeout submittals and as outlined in Section 20 05 05.
  .2 Site records and Record Drawings: Refer to Section 20 05 05:
  .3 Provide co-ordination/interference drawings, as required per Section 20 05 05, Co- ordination Drawings.

1.05 MAINTENANCE

.1 Furnish spare parts in accordance with Division 01 as follows:
  .1 One set of packing for each pump.
  .2 One casing joint gasket for each size pump.
  .3 One glass for each gauge glass.
.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01.
.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.06 COMMISSIONING

.1 Potable water supply systems:
  .1 Thoroughly flush and disinfect (chlorinate) water supply systems in accordance with municipal requirements.
  .2 Flush domestic water piping with a sufficient flow to produce a velocity of 1 metre per second for ten minutes, or until all foreign materials have been removed and the flushed water is clear. Provide connections and pumps as required. Open and close valves, hydrants, and service connections to ensure thorough flushing.
  .3 When flushing has been completed, introduce a strong chlorine solution into the piping and ensure that it is distributed throughout the entire domestic water system. Disinfect the piping in accordance with AWWA C601-68. The rate of chlorine application to be proportional to the rate of water entering the pipe.
  .4 The point of chlorine application to be close as possible to the point of filling the piping and to occur simultaneously. Operate valves, hydrants and similar appurtenances while chlorine solution is in the piping. Flush piping of chlorine solution after 24 hours.

.5 Arrange and pay for water quality tests to be performed by an independent testing laboratory acceptable to the Consultant as follows:

.1 Test for chlorine residuals at extreme ends of all piping systems. After a chlorine residual of not less than 50 ppm has been achieved in all parts of the system, let the system stand for 24 hours. After this period, take further samples to ensure that there is still not less than 10 ppm of chlorine residual throughout the system.

.2 When chlorine residuals of 10 ppm have been maintained for a minimum of 24 hours, flush the system and refill to put the system into service.

.3 Submit copy of report as prepared by the testing laboratory as well as a certificate attesting to level of safety of water supply being in conformance with standards of Authority having jurisdiction.

.2 Equipment: Make tests to demonstrate capabilities and general operating characteristics in the presence of the Consultant.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 22 05 00

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Materials and installation for plumbing pumps.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Division 01

.1 Construction Progress Schedule

.2 Submittal Procedures

.3 Health and Safety Requirements

.4 Quality Control

.5 Sustainable Requirements

.6 Construction/Demolition Waste Management and Disposal

.7 Closeout Submittals

.8 General Commissioning (Cx) Requirements

.2 Division 23

.1 Section 23 21 23 – Hydronic Pumps

1.02 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS): Material Safety Data Sheets (MSDS).

.2 Domestic water recirculation, pressure booster and sump pumps: Refer to pump schedule.

1.03 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

PART 2 - PRODUCTS

2.01 MATERIALS

.1 Materials and products in accordance with Division 02

2.02 DOMESTIC HOT WATER CIRCULATING PUMPS

.1 Capacity: Refer to Equipment Schedules

.2 Construction: closed-coupled, in-line centrifugal, all bronze construction, shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 860 kPa and 105 ºC continuous service.

.3 Motor: Refer to equipment schedules for motor HP, drip-proof, with thermal overload protection.

.4 Supports: provide as recommended by manufacturer.

2.03 DOMESTIC WATER BOOSTER SYSTEM

.1 Packaged duplex system, factory assembled, tested and adjusted, ready for site piping and electrical connections.
.2 Total Capacity: Refer to Equipment Schedules
.3 Flow rate: Refer to Equipment Schedules.
.4 System pressure: Refer to Equipment Schedules
.5 Available pressure at meter outlet: 215 kPa.
.6 Duplex system with 50% on lead pump and 50% on lag pump.
.7 Construction: vertical, in-line, closed coupled centrifugal, cast-iron casing, bronze impeller, stainless steel shaft sleeve, mechanical shaft seal, designed for 345 kPa suction pressure.
.8 Valves: To Section 22 11 16 - Domestic Water Piping. Suction and discharge gate **or** butterfly valves and pressure reducing and check valve for each pump connected to common suction and discharge headers.
.9 Motor: Refer to Equipment Schedules.
.10 Supports: Install complete package on factory fabricated structural steelwork.
.11 Anchor Bolts and Templates:

.1 Supply for installation by other Divisions.

.12 Control Panel: CSA 1 enclosure complete with:
.1 Externally operated disconnect switch.
.2 Magnetic across-the-line fused starters.
.3 Overload protection for each phase.
.4 Adjustable pressure switches.
.5 Low pressure safety cut-out.
.6 Control circuit transformer with fused secondary.
.7 Adjustable time delay relay.
.8 Hand-off-automatic selector switch for pumps.
.9 Pressure and suction gauges, 90 mm nominal dia., range 0 to 3100 kPa.
.10 Pilot lights, power on, low suction pressure.
.11 Lead/lag selector switch.
.12 Alarm: Visual and audible with silencing switch for abnormal conditions.
.13 Operation:
.1 Lead pump to operate continuously during demand.
.2 Should operating pump fail, next pump in sequence to start automatically.
.3 Should system demand exceed capacity of operating pump or pumps, next pump in sequence automatically starts.
.4 Adjustable 90 time delay to maintain starting pump operation and avoid "on-off" cycling.
.5 Constant pressure control, pressure switch to cycle pump.
.6 Low suction pressure switch to stop pumps.
.7 Temperature control for low or no system demand to bleed to drain.
.8 Constant pressure control valves on pumps to control pressure within 345 kPa from design maximum to zero flow.

2.04 SUMP PUMP VERTICAL SHAFT

.1 General:- Pedestal type as indicated complete with (4 float) level switches and mechanical alternators, control panels complete with electric alternators, motor starters, pilot lights, relays, numbered terminal boards.
.2 Capacity: Refer to M&E schedules.
.3 Construction: Duplex
.1 Vertical shaft centrifugal, cast-iron case, bronze impeller, stainless steel shaft.
.2 Column and cast-iron parts protected with baked epoxy paint.
.3 Non-corrosive cone type strainer cleanable without pump removal from sump.
.4 Vertical outlet case tapped for NPS1-1/2.
.5 Graphite bronze self-lubricated lower bearing.
.4 Motor: Refer to M&E schedules for horse power ratings and voltage requirements, rated for continuous duty, built-in overload protection, drip-proof, complete with sufficient length of three-wire rubber covered cord to complete power wiring as necessary.
.5 Control: Heavy duty snap-action switch complete with two adjustable plastic or rubber coated weights on corrosion resistant chain or cable.
.6 Sump pumps to be c/w sump frames and a minimum 10mm (3/8") thick reinforced checker plate steel cover/s unless specified otherwise. Refer to detail drawings for cover splitting arrangement for submersible pumps. All covers and frames are to be traffic compliant class C load bearing capable unless noted otherwise.

2.05 SUMP PUMP SUBMERSIBLE

.1 General:- Units up to 372 watts (2 HP) to be c/w self-contained float controls. Larger pumps to be complete with separate (4) float switches, mechanical alternators. Control panels c/w electric alternator, pilot lights, motor starters, relays and numbered terminal boards. Provide quick connect arrangement complete with rail guides and lifting cables where indicated in equipment schedules.
.2 Capacity: Refer to M&E schedules.
.3 Construction: Duplex CSA approved, housing epoxy coated cast iron, bronze fitted stainless steel shaft, non-clog bronze impeller, mechanical shaft seal.
.4 Motor: Refer to M&E schedules for horse power ratings and voltage requirements hermetically sealed, with automatic overload protection.
.5 Control: integral diaphragm type level control consisting of four level float switches..
.6 Sump pumps to be c/w sump frames and a minimum 10mm (3/8") thick reinforced checker plate steel cover/s unless specified otherwise. Refer to detail drawings for cover splitting arrangement for submersible pumps. All covers and frames are to be traffic compliant class C load bearing capable unless noted otherwise.

2.06 BILGE AND SEWAGE PUMP

.1 General:- Pedestal type as indicated complete with (4 float) level switches and mechanical alternators, control panels complete with electric alternators, motor starters, pilot lights, relays, numbered terminal boards.
.2 Capacity: Refer to M&E schedules.

.3 Construction: Duplex, vertical extended shaft, single stage centrifugal, designed to handle 50 mm solids and for sump depth as indicated bronze fitted construction, open dynamically balanced bronze impeller, automatic lubricated bronze bearings, copper or nylon lubrication lines to steel square baseplate with manhole.

.4 Motor: Refer to M&E schedules for horse power ratings and voltage requirements, drip-proof, with overload and under voltage protection.

.5 Control: copper ball float operated heavy duty switch. Starter switch on [cover plate] [as indicated]. [Automatic electric alternator with selector relays to alternate or activate both pumps. Adjustable float stops on stainless steel rod.

.6 Alarm: low voltage powered audible and visual alarm located as indicated controlled by float or pressure operated switch.

.7 Sump: concrete one piece, to manufacturers' standard, with heavy bituminous coating inside and out.

.8 Sump pumps to be c/w sump frames and a minimum 10mm (3/8") thick reinforced checker plate steel cover/s unless specified otherwise. Refer to detail drawings for cover splitting arrangement for submersible pumps. All covers and frames are to be traffic compliant class C load bearing capable unless noted otherwise.

2.07 NON-POTABLE WATER BOOSTER SYSTEM

.1 Packaged duplex system, factory assembled, tested and adjusted, ready for site piping and electrical connections.

.2 Total Capacity: Refer to Equipment Schedules.

.3 Available pressure at meter outlet: 15 kPa. Non-potable water booster system will be connected to a storage tank located at same elevation.

.4 Duplex system with 50% on lead pump and 50% on lag pump.

.5 Construction: vertical, in-line, closed coupled centrifugal, cast-iron casing, bronze impeller, stainless steel shaft sleeve, mechanical shaft seal, designed for 2,760 kPa suction pressure.

.6 Valves: To Section 20 05 10 Basic Mechanical Materials and Methods. Suction and discharge gate or butterfly valves and pressure reducing and check valve for each pump connected to common suction and discharge headers.

.7 Supports: Install complete package on factory fabricated structural steelwork.

.8 Provide diaphragm type expansion tank sized to suit requirements of system. It is the intent to locate tank in the mechanical room where domestic booster pumps will be located (Basement Level Mechanical Room).

.9 Anchor Bolts and Templates:

.1 Supply for installation by other Divisions.

.10 Control Panel: CSA 1 enclosure complete with:

.1 Externally operated disconnect switch.

.2 Magnetic across-the-line fused starters.

.3 Overload protection for each phase.

.4 Adjustable pressure switches.
.5 Low pressure safety cut-out.
.6 Control circuit transformer with fused secondary.
.7 Adjustable time delay relay.
.8 Hand-off-automatic selector switch for pumps.
.9 Pressure and suction gauges, 90 mm nominal dia., range 0 to 3100 kPa.
.10 Pilot lights, power on, low suction pressure.
.11 Lead/lag selector switch.
.12 Alarm: Visual and audible with silencing switch for abnormal conditions.

.11 Operation:
.1 Lead pump to operate continuously during demand.
.2 Should operating pump fail, next pump in sequence to start automatically.
.3 Should system demand exceed capacity of operating pump or pumps, next pump in sequence automatically starts.
.4 Adjustable 90 time delay to maintain starting pump operation and avoid "on-off" cycling.
.5 Constant pressure control, pressure switch to cycle pump.
.6 Low suction pressure switch to stop pumps.
.7 Temperature control for low or no system demand to bleed to drain.
.8 Constant pressure control valves on pumps to control pressure within 345 kPa from design maximum to zero flow.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and data sheet.

3.02 INSTALLATION

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
.2 Ensure pump and motor assembly do not support piping.
.3 Align vertical pit mounted pump assembly after mounting and securing cover plate.
.4 Place 150 mm sand under sump pit tank.

3.03 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
.1 Check power supply.
.2 Check starter protective devices.
.2 Start-up, check for proper and safe operation.
.3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
.4 Adjust flow from water-cooled bearings.
.5 Adjust impeller shaft stuffing boxes, packing glands.
.6 Verification requirements in accordance with Division 01, include:

.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource re-use.
.5 Recycled content.
.6 Local/regional materials.
.7 Certified wood.
.8 Low-emitting materials.

3.04 START-UP

.1 General:
.1 In accordance with Division 01, to suit General Commissioning (Cx) Requirements and General Requirements, supplemented as specified herein.
.2 Procedures:
.3 Check power supply.
.4 Check starter O/L heater sizes.
.5 Start pumps, check impeller rotation.
.6 Check for safe and proper operation.
.7 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
.8 Test operation of hands-on-auto switch.
.9 Test operation of alternator.
.10 Adjust leakage through water-cooled bearings.
.11 Adjust shaft stuffing boxes.
.12 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
.13 Check base for free-floating, no obstructions under base.
.14 Run-in pumps for 12 continuous hours.
.15 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
.16 Adjust alignment of piping and conduit to ensure full flexibility.
.17 Eliminate causes of cavitation, flashing, air entrainment.
.18 Measure pressure drop across strainer when clean and with flow rates as finally set.
.19 Replace seals if pump used to degrease system or if pump used for temporary heat.
.20 Verify lubricating oil levels

3.05 DOMESTIC HW CIRCULATING PUMPS

.1 Equipped with mechanical seals, non-overloading (not including motor service factor) over entire performance curve and bronze fitted except where noted. Provide split coupling for pumps having a motor equal to or higher than 5.6 kw (7½ HP).
.2 All pumps to be complete with equally sized suction and discharge flanged connections, tapping for gauge, drain and flush line connections. All bronze body or stainless steel.
.3 Pumps with mechanical seals to be equipped with factory installed Micro-Wynd II Cuno filters and Arkon flow indicators. Provide an additional set of filters to replace original filters after system is cleaned and treated.

3.06 PERFORMANCE VERIFICATION (PV) PRESSURE BOOSTER PUMPS

.1 General: In accordance with Division 01 to suit General Commissioning (Cx) Requirements and General Requirements, supplemented as specified.
.2 Obtain manufacturer's approval before performing PV to ensure warranties remain intact.

.3 Application tolerances:

.1 Flow: +/- 10%.
.2 Pressure: Plus 15%, minus 5%.

.4 PV procedures:
.1 Open pump balancing valve fully.
.2 Measure differential pressure (DP) across pump.
.3 Measure amperage and voltage and compare with manufacturer's data sheets and motor nameplate data.
.4 If suction is different size than discharge connection, add velocity head correction factor to DP.
.5 Mark this DP on manufacturer's pump curve.
.6 If flow rate is higher than specified, slow close balancing valve until specified DP is reached.
.7 Repeat measurements of amps and volts. Compare with manufacturer's data sheets.
.8 Calculate BHP and compare with nameplate data.

3.07 PV – SANITARY AND STORM WATER PUMPS

.1 Application tolerances:
.1 Flow: Plus 10 %; minus 0%.
.2 Pressure: Plus 10%; minus 5%.
.2 Timing:
.3 PV Procedures:
.1 Fill sump at rate slower than capacity of pump #1.
.2 Record levels at which pump #1 starts and stops. Determine flow rate by observing time taken to down water level.
.3 Fill sump at rate faster than capacity of pump #1 but slower than capacities of pumps #1 and #2 operating in parallel.
.4 Record levels at which pumps start and stop - water level rising and water level falling.
.5 Verify operation of alternator.
.6 Adjust water level controls as necessary.
.7 Fill sump at rate faster than capacities of pumps #1 and #2 operating in parallel.
.8 Record levels at pump starts and stops - water level rising and falling.
.9 Check operation of alternator.
.10 Adjust level controls as necessary.
.11 Check level at which high water level alarm starts and stops. Adjust as necessary.
.4 Check removability of pumps for servicing without interfering with installation or operation of other equipment.
.5 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

3.08 REPORTS

.1 In accordance with Division 01 to suit General Commissioning (Cx) Requirements: reports, supplemented as specified.
.2 Include:
.1 PV results on approved PV Report Forms.

.2 Product Information report forms.
.3 Pump performance curves (family of curves) with final point of actual performance.

3.09 TRAINING

.1 In accordance with Division 01 to suit General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

3.10 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 22 10 10

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

.1 Refer to Division 1.

1.02 REFERENCES

.1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)
- .1 ANSI Z21.10.1/CSA 4.1, Gas Water Heaters - Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per hour or less.
- .2 ANSI Z21.10.1A/CSA 4.1A, Addenda 1 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per hour or less.
- .3 ANSI Z21.10.1b/CSA 4.1b, Addenda 2 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per hour or less.
- .4 ANSI Z21.10.3A/CSA 4.3, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.

.2 Canadian Standards Association (CSA International)
- .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .2 CGSB51.65 – Insulating Blankets For Domestic Hot Water Heaters.
- .3 CAN/CSA-B139, Installation Code for Oil Burning Equipment.
- .4 CAN/CSA-B140.0, Oil Burning Equipment: General Requirements.
- .5 CAN/CSA-B149.1, Natural Gas and Propane Installation Code.
- .6 CAN/CSA-B149.2, Propane Storage and Handling Code.
- .7 CSA B140.12, Oil-Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools.
- .8 CAN/CSA C22.2 No.110, Construction and Test of Electric Storage Tank Water Heaters.
- .9 CAN/CSA-C191, Performance of Electric Storage Tank Water Heaters for Household Service.
- .10 CAN/CSA-C309-M90, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

.3 ASHRAE 90.1 – 2013 – Energy Standard For Buildings Except Low Rise Residential Buildings.

.4 Ontario Building Code 2012.

.5 Local Authority Having Jurisdiction.

1.03 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

1.04 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Front End Documents and Section 22 05 01.

1.05 1.4 MAINTENANCE AND ENGINEERING DATA

.1 Provide maintenance data for incorporation into maintenance manual specified in Section 22 05 02.

PART 2 - PRODUCTS

2.01 COMPONENTS

Provide as shown on the Drawings, electric element domestic hot water storage tanks, in size and capacity as described in the Equipment Schedules.

2.01 ELECTRIC DOMESTIC HOT WATER STORAGE TANKS

.1 Storage tanks are required for Central Domestic Hot Water Heater.
.2 Capacity shall be in accordance with the schedule.
.3 Water heaters shall meet CSA C191 and ASHRAE 90.1 requirements.
.4 The storage section of the water heater shall be ASME HLW stamped and National Board Registered for a maximum allowable working pressure of 150 psi and pressure tested at 1-1/2 times working pressure.
.5 All tank connections/ fittings shall be nonferrous. Tank shall be equipped with a ball-type drain valve. Tank design will include a manway sized access to the tank interior.
.6 The storage tank shall be an unlined pressure vessel constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2and ASTM G123 - 00(2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.”
.7 Waterside surfaces shall be welded internally utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
.8 All internal and external tank surfaces shall undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not accepted. Immersion passivation and pickling certification documents are required and shall be provided with each product.
.9 Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% postconsumer recycled materials and be 100% recyclable.
.10 Water contacting tank surfaces will be non-porous and exhibit 0% water absorption.
.11 Lined or plated storage tanks will not be acceptable.
.12 Heating elements will be rated at 9 kW and 40 watts per square inch heat density
.13 Heating elements will be sheathed in Incoloy. Each element will individually mount to the tank by means of a four-bolt bronze flange over stainless steel studs with an o-ring seal. A fused magnetic contactor will be supplied for each power circuit. Maximum current per circuit will be 50 amps on three-phase units.
.14 Heating Element
  .1 Unit shall be provided with a unit mounted electrical junction box
  .2 Water heater shall be completely factory assembled, including an ASME rated, temperature/pressure relief valve.
  .3 Fully adjustable from 37.8 C (100 F) to 82.2 C (180 F) operating thermostat.
.15 High temperature limiting device which shall shut off the element if the preset temperature is exceeded.
.16 The tanks shall be constructed in accordance with (Standard) (ASME Boiler and Pressure Vessel Code) requirements, and shall have a valid CRN #. The tanks shall be furnished with the following minimum connections:
  .1 NPT dielectric circulating connections
  .2 NPT dielectric hot water outlet,

.3 NPT relief valve
.4 NPT aquastat opening and
.5 NPT drain connection
.6 NPT drain connection on tanks
.7 Additional connections shall be provided as per piping connections shown in schematic drawings and layout drawings.

.17 The tanks shall be completely encased in a minimum of 75mm (3") thick, high density polyurethane foam insulation to meet the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard.

.18 he tanks shall be provided with a man way access for ease of inspection, cleanout and service. The man way access shall be of a minimum diameter of 24” (600mm).

.19 Tanks shall be of a vertical configuration and provided with integral saddles.

.20 Provide electronic low water cutoff, tank temperature and pressure Gauge, ASME Temperature and Pressure Relief Valve.

.21 Warranty
.1 Storage Tank: 25-year (15 years full, 10 years prorated) coverage for manufacturing or material defects, leaks, production of rusty water and/or chloride stress corrosion cracking.
.2 The heater shall have a first year service policy, which shall cover labor and freight costs for warranty covered services.

.22 Standard of Acceptance: PVI, AO Smith, Lochinvar

2.02 DHW STORAGE TANKS

.1 Storage tank:
.1 Sizes, capacity: Refer to equipment schedules.
.2 Shell: vertical, steel to CSA B51, ANSI/ASME Unfired Pressure Vessel Code and Province of Ontario standards, WWP/WSP 1034 kPa. Provide certificates.
.3 Lining: cement, 20 mm thick.
.4 Service Hole: 300 x 400 mm ASME, with gasketed cover.
.5 Cathodic protection: Magnesium anodes, number and size to provide for 20 years protection of tank material.
.6 Cradles: Steel, minimum of 2.
.7 Thermal insulation: See Section 20 05 25 – Mechanical Insulation.
.8 Extended warranty: 10 years. Provide certificate.

2.03 TRIM AND INSTRUMENTATION

.1 Drain valve: NPS 25mm with hose end.
.2 Thermometer 100 mm dial type with red pointer and thermowell filled with conductive paste
.3 Pressure gauge: 75 mm dial type with red pointer, and shut-off cock.
.4 Thermowell filled with conductive paste for control valve temperature sensor.
.5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
.6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

PART 3 - EXECUTION

3.01 APPLICATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.02 INSTALLATION

4 Connect domestic water heater to cold water supply and domestic hot water supply connections as indicated.

5 .2 Install in accordance with applicable codes and manufacturer's recommendations.

6 .3 Install water heaters level and plumb in accordance with manufacturer’s written instructions and referenced standards.

7 .4 Pipe pressure and temperature relief valve to drain.

8 .5 Where two (2) or more water heaters are shown manifolded together, provide prefabricated manifolds to ensure water flow through heaters is equal.

9 .6 Provide structural steel for support as required. 3.2.7 Provide a thermometer in the hot water supply downstream of the hot water heater. For the requirements for thermometers refer to Section 23 05 19 of the specification.

.1 Provide insulation between tank and supports.

9.02 FIELD QUALITY CONTROL

.1 Start up and commission DHW storage tanks.

9.03 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 22 30 05

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05, Mechanical General Works Instructions and 20 05 10 Mechanical Basic Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide a complete plumbing system including domestic hot and cold water, non-potable water, natural gas piping, sanitary and storm drainage, and vent piping and all fixtures, trim and hot water heaters / tanks as shown on the drawings complete in every detail.

.2 Provide Municipal and Utility street services connections (Domestic and fire protection water, sewers, natural gas) as indicated on the site plan. Terminate fire protection supply within building with shut-off valve - continuation of fire protection work is specified in Division 21.

.3 Provide make-up water connections to heating and cooling systems and trapped condensate drains from cooling coil drip trays.

1.03 QUALITY ASSURANCE AND REGULATORY COMPLIANCE

.1 Qualifications: Execute work of this section only by licensed tradesmen regularly employed in the installation of natural gas, plumbing and drainage piping systems and site water supply and drainage services.

.2 Other acceptable manufacturers to specified items:

Plumbing Fixtures: as shown in the Interior Designer cut sheets, unless otherwise indicated in the mechanical specifications.

Plumbing Brass: as shown in the Interior Designer cut sheets, unless otherwise indicated in the mechanical specifications.

Water Closet Seats: as shown in the Interior Designer cut sheets

Drains and Specialities: Zurn, Watts

Shower Valves: as shown in the Interior Designer cut sheets

Precast Shower Bases and Mop Sinks: as shown in the Interior Designer cut

sheets Oil/Grease Interceptors: Zurn.

.3 Provide all Barrier Free Fixtures and Fittings to CAN/CSA-B651.

.4 Provide water closets and urinals with maximum flush for 6.0 and 3.8 litres respectively and provide flush valves that match the fixture capacities that are installed.

.5 Provide domestic hot water generation systems in compliance with ASHRAE 90.1, 2010.

.6 Where stops or shut-off valves are specified for fixtures, provide ball type valves - rough brass where concealed and chrome plated where exposed. Provide a complete plumbing system including domestic hot and cold water, natural gas piping, sanitary and storm drainage and vent piping and all fixtures, trim and hot water heaters as shown on the drawings complete in every detail.

1.04 SUBMITTALS

.1 Submittals: In accordance with Section 01 33 00 – Submittal Procedures and Section 20 05 05.
.2 Shop drawings to show:
  .1 Mounting arrangements.
  .2 Operating and maintenance clearances.
.3 Closeout Submittals:
  .1 Provide operation and maintenance data for incorporation into manual specified in Division 01 closeout submittals and as outlined in Section 20 05 05.
  .2 Site records and Record Drawings: Refer to Section 20 05 05:
  .3 Provide co-ordination/interference drawings, as required per Section 20 05 05, Co- ordination Drawings.

1.05 MAINTENANCE

.1 Furnish spare parts in accordance with Division 01 as follows:
  .1 One set of packing for each pump.
  .2 One casing joint gasket for each size pump.
  .3 One glass for each gauge glass.
.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01.
.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.06 COMMISSIONING

.1 Potable water supply systems:
  .1 Thoroughly flush and disinfect (chlorinate) water supply systems in accordance with municipal requirements.
  .2 Flush domestic water piping with a sufficient flow to produce a velocity of 1 metre per second for ten minutes, or until all foreign materials have been removed and the flushed water is clear. Provide connections and pumps as required. Open and close valves, hydrants, and service connections to ensure thorough flushing.
  .3 When flushing has been completed, introduce a strong chlorine solution into the piping and ensure that it is distributed throughout the entire domestic water system. Disinfect the piping in accordance with AWWA C601-68. The rate of chlorine application to be proportional to the rate of water entering the pipe.
  .4 The point of chlorine application to be close as possible to the point of filling the piping and to occur simultaneously. Operate valves, hydrants and similar appurtenances while chlorine solution is in the piping. Flush piping of chlorine solution after 24 hours.

.5 Arrange and pay for water quality tests to be performed by an independent testing laboratory acceptable to the Consultant as follows:

.1 Test for chlorine residuals at extreme ends of all piping systems. After a chlorine residual of not less than 50 ppm has been achieved in all parts of the system, let the system stand for 24 hours. After this period, take further samples to ensure that there is still not less than 10 ppm of chlorine residual throughout the system.

.2 When chlorine residuals of 10 ppm have been maintained for a minimum of 24 hours, flush the system and refill to put the system into service.

.3 Submit copy of report as prepared by the testing laboratory as well as a certificate attesting to level of safety of water supply being in conformance with standards of Authority having jurisdiction.

.2 Equipment: Make tests to demonstrate capabilities and general operating characteristics in the presence of the Consultant.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 22 05 00

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Materials and installation for plumbing pumps.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Division 01

.1 Construction Progress Schedule

.2 Submittal Procedures

.3 Health and Safety Requirements

.4 Quality Control

.5 Sustainable Requirements

.6 Construction/Demolition Waste Management and Disposal

.7 Closeout Submittals

.8 General Commissioning (Cx) Requirements

.2 Division 23

.1 Section 23 21 23 – Hydronic Pumps

1.02 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS): Material Safety Data Sheets (MSDS).

.2 Domestic water recirculation, pressure booster and sump pumps: Refer to pump schedule.

1.03 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

PART 2 - PRODUCTS

2.01 MATERIALS

.1 Materials and products in accordance with Division 02

2.02 DOMESTIC HOT WATER CIRCULATING PUMPS

.1 Capacity: Refer to Equipment Schedules

.2 Construction: closed-coupled, in-line centrifugal, all bronze construction, shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for 860 kPa and 105 ºC continuous service.

.3 Motor: Refer to equipment schedules for motor HP, drip-proof, with thermal overload protection.

.4 Supports: provide as recommended by manufacturer.

2.03 DOMESTIC WATER BOOSTER SYSTEM

.1 Packaged duplex system, factory assembled, tested and adjusted, ready for site piping and electrical connections.
.2 Total Capacity: Refer to Equipment Schedules
.3 Flow rate: Refer to Equipment Schedules.
.4 System pressure: Refer to Equipment Schedules
.5 Available pressure at meter outlet: 215 kPa.
.6 Duplex system with 50% on lead pump and 50% on lag pump.
.7 Construction: vertical, in-line, closed coupled centrifugal, cast-iron casing, bronze impeller, stainless steel shaft sleeve, mechanical shaft seal, designed for 345 kPa suction pressure.
.8 Valves: To Section 22 11 16 - Domestic Water Piping. Suction and discharge gate **or** butterfly valves and pressure reducing and check valve for each pump connected to common suction and discharge headers.
.9 Motor: Refer to Equipment Schedules.
.10 Supports: Install complete package on factory fabricated structural steelwork.
.11 Anchor Bolts and Templates:

.1 Supply for installation by other Divisions.

.12 Control Panel: CSA 1 enclosure complete with:
.1 Externally operated disconnect switch.
.2 Magnetic across-the-line fused starters.
.3 Overload protection for each phase.
.4 Adjustable pressure switches.
.5 Low pressure safety cut-out.
.6 Control circuit transformer with fused secondary.
.7 Adjustable time delay relay.
.8 Hand-off-automatic selector switch for pumps.
.9 Pressure and suction gauges, 90 mm nominal dia., range 0 to 3100 kPa.
.10 Pilot lights, power on, low suction pressure.
.11 Lead/lag selector switch.
.12 Alarm: Visual and audible with silencing switch for abnormal conditions.
.13 Operation:
.1 Lead pump to operate continuously during demand.
.2 Should operating pump fail, next pump in sequence to start automatically.
.3 Should system demand exceed capacity of operating pump or pumps, next pump in sequence automatically starts.
.4 Adjustable 90 time delay to maintain starting pump operation and avoid "on-off" cycling.
.5 Constant pressure control, pressure switch to cycle pump.
.6 Low suction pressure switch to stop pumps.
.7 Temperature control for low or no system demand to bleed to drain.
.8 Constant pressure control valves on pumps to control pressure within 345 kPa from design maximum to zero flow.

2.04 SUMP PUMP VERTICAL SHAFT

.1 General:- Pedestal type as indicated complete with (4 float) level switches and mechanical alternators, control panels complete with electric alternators, motor starters, pilot lights, relays, numbered terminal boards.
.2 Capacity: Refer to M&E schedules.
.3 Construction: Duplex
.1 Vertical shaft centrifugal, cast-iron case, bronze impeller, stainless steel shaft.
.2 Column and cast-iron parts protected with baked epoxy paint.
.3 Non-corrosive cone type strainer cleanable without pump removal from sump.
.4 Vertical outlet case tapped for NPS1-1/2.
.5 Graphite bronze self-lubricated lower bearing.
.4 Motor: Refer to M&E schedules for horse power ratings and voltage requirements, rated for continuous duty, built-in overload protection, drip-proof, complete with sufficient length of three-wire rubber covered cord to complete power wiring as necessary.
.5 Control: Heavy duty snap-action switch complete with two adjustable plastic or rubber coated weights on corrosion resistant chain or cable.
.6 Sump pumps to be c/w sump frames and a minimum 10mm (3/8") thick reinforced checker plate steel cover/s unless specified otherwise. Refer to detail drawings for cover splitting arrangement for submersible pumps. All covers and frames are to be traffic compliant class C load bearing capable unless noted otherwise.

2.05 SUMP PUMP SUBMERSIBLE

.1 General:- Units up to 372 watts (2 HP) to be c/w self-contained float controls. Larger pumps to be complete with separate (4) float switches, mechanical alternators. Control panels c/w electric alternator, pilot lights, motor starters, relays and numbered terminal boards. Provide quick connect arrangement complete with rail guides and lifting cables where indicated in equipment schedules.
.2 Capacity: Refer to M&E schedules.
.3 Construction: Duplex CSA approved, housing epoxy coated cast iron, bronze fitted stainless steel shaft, non-clog bronze impeller, mechanical shaft seal.
.4 Motor: Refer to M&E schedules for horse power ratings and voltage requirements hermetically sealed, with automatic overload protection.
.5 Control: integral diaphragm type level control consisting of four level float switches..
.6 Sump pumps to be c/w sump frames and a minimum 10mm (3/8") thick reinforced checker plate steel cover/s unless specified otherwise. Refer to detail drawings for cover splitting arrangement for submersible pumps. All covers and frames are to be traffic compliant class C load bearing capable unless noted otherwise.

2.06 BILGE AND SEWAGE PUMP

.1 General:- Pedestal type as indicated complete with (4 float) level switches and mechanical alternators, control panels complete with electric alternators, motor starters, pilot lights, relays, numbered terminal boards.
.2 Capacity: Refer to M&E schedules.

.3 Construction: Duplex, vertical extended shaft, single stage centrifugal, designed to handle 50 mm solids and for sump depth as indicated bronze fitted construction, open dynamically balanced bronze impeller, automatic lubricated bronze bearings, copper or nylon lubrication lines to steel square baseplate with manhole.

.4 Motor: Refer to M&E schedules for horse power ratings and voltage requirements, drip-proof, with overload and under voltage protection.

.5 Control: copper ball float operated heavy duty switch. Starter switch on [cover plate] [as indicated]. [Automatic electric alternator with selector relays to alternate or activate both pumps. Adjustable float stops on stainless steel rod.

.6 Alarm: low voltage powered audible and visual alarm located as indicated controlled by float or pressure operated switch.

.7 Sump: concrete one piece, to manufacturers' standard, with heavy bituminous coating inside and out.

.8 Sump pumps to be c/w sump frames and a minimum 10mm (3/8") thick reinforced checker plate steel cover/s unless specified otherwise. Refer to detail drawings for cover splitting arrangement for submersible pumps. All covers and frames are to be traffic compliant class C load bearing capable unless noted otherwise.

2.07 NON-POTABLE WATER BOOSTER SYSTEM

.1 Packaged duplex system, factory assembled, tested and adjusted, ready for site piping and electrical connections.

.2 Total Capacity: Refer to Equipment Schedules.

.3 Available pressure at meter outlet: 15 kPa. Non-potable water booster system will be connected to a storage tank located at same elevation.

.4 Duplex system with 50% on lead pump and 50% on lag pump.

.5 Construction: vertical, in-line, closed coupled centrifugal, cast-iron casing, bronze impeller, stainless steel shaft sleeve, mechanical shaft seal, designed for 2,760 kPa suction pressure.

.6 Valves: To Section 20 05 10 Basic Mechanical Materials and Methods. Suction and discharge gate or butterfly valves and pressure reducing and check valve for each pump connected to common suction and discharge headers.

.7 Supports: Install complete package on factory fabricated structural steelwork.

.8 Provide diaphragm type expansion tank sized to suit requirements of system. It is the intent to locate tank in the mechanical room where domestic booster pumps will be located (Basement Level Mechanical Room).

.9 Anchor Bolts and Templates:

.1 Supply for installation by other Divisions.

.10 Control Panel: CSA 1 enclosure complete with:

.1 Externally operated disconnect switch.

.2 Magnetic across-the-line fused starters.

.3 Overload protection for each phase.

.4 Adjustable pressure switches.
.5 Low pressure safety cut-out.
.6 Control circuit transformer with fused secondary.
.7 Adjustable time delay relay.
.8 Hand-off-automatic selector switch for pumps.
.9 Pressure and suction gauges, 90 mm nominal dia., range 0 to 3100 kPa.
.10 Pilot lights, power on, low suction pressure.
.11 Lead/lag selector switch.
.12 Alarm: Visual and audible with silencing switch for abnormal conditions.

.11 Operation:
.1 Lead pump to operate continuously during demand.
.2 Should operating pump fail, next pump in sequence to start automatically.
.3 Should system demand exceed capacity of operating pump or pumps, next pump in sequence automatically starts.
.4 Adjustable 90 time delay to maintain starting pump operation and avoid "on-off" cycling.
.5 Constant pressure control, pressure switch to cycle pump.
.6 Low suction pressure switch to stop pumps.
.7 Temperature control for low or no system demand to bleed to drain.
.8 Constant pressure control valves on pumps to control pressure within 345 kPa from design maximum to zero flow.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and data sheet.

3.02 INSTALLATION

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
.2 Ensure pump and motor assembly do not support piping.
.3 Align vertical pit mounted pump assembly after mounting and securing cover plate.
.4 Place 150 mm sand under sump pit tank.

3.03 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
.1 Check power supply.
.2 Check starter protective devices.
.2 Start-up, check for proper and safe operation.
.3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
.4 Adjust flow from water-cooled bearings.
.5 Adjust impeller shaft stuffing boxes, packing glands.
.6 Verification requirements in accordance with Division 01, include:

.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource re-use.
.5 Recycled content.
.6 Local/regional materials.
.7 Certified wood.
.8 Low-emitting materials.

3.04 START-UP

.1 General:
.1 In accordance with Division 01, to suit General Commissioning (Cx) Requirements and General Requirements, supplemented as specified herein.
.2 Procedures:
.3 Check power supply.
.4 Check starter O/L heater sizes.
.5 Start pumps, check impeller rotation.
.6 Check for safe and proper operation.
.7 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
.8 Test operation of hands-on-auto switch.
.9 Test operation of alternator.
.10 Adjust leakage through water-cooled bearings.
.11 Adjust shaft stuffing boxes.
.12 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
.13 Check base for free-floating, no obstructions under base.
.14 Run-in pumps for 12 continuous hours.
.15 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
.16 Adjust alignment of piping and conduit to ensure full flexibility.
.17 Eliminate causes of cavitation, flashing, air entrainment.
.18 Measure pressure drop across strainer when clean and with flow rates as finally set.
.19 Replace seals if pump used to degrease system or if pump used for temporary heat.
.20 Verify lubricating oil levels

3.05 DOMESTIC HW CIRCULATING PUMPS

.1 Equipped with mechanical seals, non-overloading (not including motor service factor) over entire performance curve and bronze fitted except where noted. Provide split coupling for pumps having a motor equal to or higher than 5.6 kw (7½ HP).
.2 All pumps to be complete with equally sized suction and discharge flanged connections, tapping for gauge, drain and flush line connections. All bronze body or stainless steel.
.3 Pumps with mechanical seals to be equipped with factory installed Micro-Wynd II Cuno filters and Arkon flow indicators. Provide an additional set of filters to replace original filters after system is cleaned and treated.

3.06 PERFORMANCE VERIFICATION (PV) PRESSURE BOOSTER PUMPS

.1 General: In accordance with Division 01 to suit General Commissioning (Cx) Requirements and General Requirements, supplemented as specified.
.2 Obtain manufacturer's approval before performing PV to ensure warranties remain intact.

.3 Application tolerances:

.1 Flow: +/- 10%.
.2 Pressure: Plus 15%, minus 5%.

.4 PV procedures:
.1 Open pump balancing valve fully.
.2 Measure differential pressure (DP) across pump.
.3 Measure amperage and voltage and compare with manufacturer's data sheets and motor nameplate data.
.4 If suction is different size than discharge connection, add velocity head correction factor to DP.
.5 Mark this DP on manufacturer's pump curve.
.6 If flow rate is higher than specified, slow close balancing valve until specified DP is reached.
.7 Repeat measurements of amps and volts. Compare with manufacturer's data sheets.
.8 Calculate BHP and compare with nameplate data.

3.07 PV – SANITARY AND STORM WATER PUMPS

.1 Application tolerances:
.1 Flow: Plus 10 %; minus 0%.
.2 Pressure: Plus 10%; minus 5%.
.2 Timing:
.3 PV Procedures:
.1 Fill sump at rate slower than capacity of pump #1.
.2 Record levels at which pump #1 starts and stops. Determine flow rate by observing time taken to down water level.
.3 Fill sump at rate faster than capacity of pump #1 but slower than capacities of pumps #1 and #2 operating in parallel.
.4 Record levels at which pumps start and stop - water level rising and water level falling.
.5 Verify operation of alternator.
.6 Adjust water level controls as necessary.
.7 Fill sump at rate faster than capacities of pumps #1 and #2 operating in parallel.
.8 Record levels at pump starts and stops - water level rising and falling.
.9 Check operation of alternator.
.10 Adjust level controls as necessary.
.11 Check level at which high water level alarm starts and stops. Adjust as necessary.
.4 Check removability of pumps for servicing without interfering with installation or operation of other equipment.
.5 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

3.08 REPORTS

.1 In accordance with Division 01 to suit General Commissioning (Cx) Requirements: reports, supplemented as specified.
.2 Include:
.1 PV results on approved PV Report Forms.

.2 Product Information report forms.
.3 Pump performance curves (family of curves) with final point of actual performance.

3.09 TRAINING

.1 In accordance with Division 01 to suit General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

3.10 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 22 10 10

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

.1 Refer to Division 1.

1.02 REFERENCES

.1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)
- .1 ANSI Z21.10.1/CSA 4.1, Gas Water Heaters - Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per hour or less.
- .2 ANSI Z21.10.1A/CSA 4.1A, Addenda 1 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per hour or less.
- .3 ANSI Z21.10.1b/CSA 4.1b, Addenda 2 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu per hour or less.
- .4 ANSI Z21.10.3A/CSA 4.3, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.

.2 Canadian Standards Association (CSA International)
- .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.
- .2 CGSB51.65 – Insulating Blankets For Domestic Hot Water Heaters.
- .3 CAN/CSA-B139, Installation Code for Oil Burning Equipment.
- .4 CAN/CSA-B140.0, Oil Burning Equipment: General Requirements.
- .5 CAN/CSA-B149.1, Natural Gas and Propane Installation Code.
- .6 CAN/CSA-B149.2, Propane Storage and Handling Code.
- .7 CSA B140.12, Oil-Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools.
- .8 CAN/CSA C22.2 No.110, Construction and Test of Electric Storage Tank Water Heaters.
- .9 CAN/CSA-C191, Performance of Electric Storage Tank Water Heaters for Household Service.
- .10 CAN/CSA-C309-M90, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

.3 ASHRAE 90.1 – 2013 – Energy Standard For Buildings Except Low Rise Residential Buildings.

.4 Ontario Building Code 2012.

.5 Local Authority Having Jurisdiction.

1.03 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

1.04 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Front End Documents and Section 22 05 01.

1.05 1.4 MAINTENANCE AND ENGINEERING DATA

.1 Provide maintenance data for incorporation into maintenance manual specified in Section 22 05 02.

PART 2 - PRODUCTS

2.01 COMPONENTS

Provide as shown on the Drawings, electric element domestic hot water storage tanks, in size and capacity as described in the Equipment Schedules.

2.01 ELECTRIC DOMESTIC HOT WATER STORAGE TANKS

.1 Storage tanks are required for Central Domestic Hot Water Heater.
.2 Capacity shall be in accordance with the schedule.
.3 Water heaters shall meet CSA C191 and ASHRAE 90.1 requirements.
.4 The storage section of the water heater shall be ASME HLW stamped and National Board Registered for a maximum allowable working pressure of 150 psi and pressure tested at 1-1/2 times working pressure.
.5 All tank connections/ fittings shall be nonferrous. Tank shall be equipped with a ball-type drain valve. Tank design will include a manway sized access to the tank interior.
.6 The storage tank shall be an unlined pressure vessel constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2and ASTM G123 - 00(2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.”
.7 Waterside surfaces shall be welded internally utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
.8 All internal and external tank surfaces shall undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not accepted. Immersion passivation and pickling certification documents are required and shall be provided with each product.
.9 Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% postconsumer recycled materials and be 100% recyclable.
.10 Water contacting tank surfaces will be non-porous and exhibit 0% water absorption.
.11 Lined or plated storage tanks will not be acceptable.
.12 Heating elements will be rated at 9 kW and 40 watts per square inch heat density
.13 Heating elements will be sheathed in Incoloy. Each element will individually mount to the tank by means of a four-bolt bronze flange over stainless steel studs with an o-ring seal. A fused magnetic contactor will be supplied for each power circuit. Maximum current per circuit will be 50 amps on three-phase units.
.14 Heating Element
  .1 Unit shall be provided with a unit mounted electrical junction box
  .2 Water heater shall be completely factory assembled, including an ASME rated, temperature/pressure relief valve.
  .3 Fully adjustable from 37.8 C (100 F) to 82.2 C (180 F) operating thermostat.
.15 High temperature limiting device which shall shut off the element if the preset temperature is exceeded.
.16 The tanks shall be constructed in accordance with (Standard) (ASME Boiler and Pressure Vessel Code) requirements, and shall have a valid CRN #. The tanks shall be furnished with the following minimum connections:
  .1 NPT dielectric circulating connections
  .2 NPT dielectric hot water outlet,

.3 NPT relief valve
.4 NPT aquastat opening and
.5 NPT drain connection
.6 NPT drain connection on tanks
.7 Additional connections shall be provided as per piping connections shown in schematic drawings and layout drawings.

.17 The tanks shall be completely encased in a minimum of 75mm (3") thick, high density polyurethane foam insulation to meet the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard.

.18 he tanks shall be provided with a man way access for ease of inspection, cleanout and service. The man way access shall be of a minimum diameter of 24” (600mm).

.19 Tanks shall be of a vertical configuration and provided with integral saddles.

.20 Provide electronic low water cutoff, tank temperature and pressure Gauge, ASME Temperature and Pressure Relief Valve.

.21 Warranty
.1 Storage Tank: 25-year (15 years full, 10 years prorated) coverage for manufacturing or material defects, leaks, production of rusty water and/or chloride stress corrosion cracking.
.2 The heater shall have a first year service policy, which shall cover labor and freight costs for warranty covered services.

.22 Standard of Acceptance: PVI, AO Smith, Lochinvar

2.02 DHW STORAGE TANKS

.1 Storage tank:
.1 Sizes, capacity: Refer to equipment schedules.
.2 Shell: vertical, steel to CSA B51, ANSI/ASME Unfired Pressure Vessel Code and Province of Ontario standards, WWP/WSP 1034 kPa. Provide certificates.
.3 Lining: cement, 20 mm thick.
.4 Service Hole: 300 x 400 mm ASME, with gasketed cover.
.5 Cathodic protection: Magnesium anodes, number and size to provide for 20 years protection of tank material.
.6 Cradles: Steel, minimum of 2.
.7 Thermal insulation: See Section 20 05 25 – Mechanical Insulation.
.8 Extended warranty: 10 years. Provide certificate.

2.03 TRIM AND INSTRUMENTATION

.1 Drain valve: NPS 25mm with hose end.
.2 Thermometer 100 mm dial type with red pointer and thermowell filled with conductive paste
.3 Pressure gauge: 75 mm dial type with red pointer, and shut-off cock.
.4 Thermowell filled with conductive paste for control valve temperature sensor.
.5 ASME rated temperature and pressure relief valve sized for full capacity of heater, having discharge terminating over floor drain and visible to operators.
.6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

PART 3 - EXECUTION

3.01 APPLICATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.02 INSTALLATION

4 Connect domestic water heater to cold water supply and domestic hot water supply connections as indicated.

5 .2 Install in accordance with applicable codes and manufacturer's recommendations.

6 .3 Install water heaters level and plumb in accordance with manufacturer’s written instructions and referenced standards.

7 .4 Pipe pressure and temperature relief valve to drain.

8 .5 Where two (2) or more water heaters are shown manifolded together, provide prefabricated manifolds to ensure water flow through heaters is equal.

9 .6 Provide structural steel for support as required. 3.2.7 Provide a thermometer in the hot water supply downstream of the hot water heater. For the requirements for thermometers refer to Section 23 05 19 of the specification.

.1 Provide insulation between tank and supports.

9.02 FIELD QUALITY CONTROL

.1 Start up and commission DHW storage tanks.

9.03 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 22 30 05

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

.1 Refer to General Requirements of Division 01.

1.02 REFERENCES

.1 Canadian Standards Association (CSA International)

CAN/CSA-B45 Series, Plumbing Fixtures.

CAN/CSA-B125.3, Plumbing Fittings.

CAN/CSA-B651, Accessible Design for the Built Environment.

.2 Green Seal Environmental Standards (GSES) Standard GS-36, Commercial Adhesives.

.3 South Coast Air Quality Management District (SCAQMD), California State SCAQMD Rule 1168, Adhesive and Sealant Applications.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Product Data: Provide manufacturer's printed product literature and datasheets for washroom fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Indicate fixtures and trim:

Dimensions, construction details, roughing-in dimensions.Factory-set water consumption per flush at recommended pressure. (For water closets, urinals): Minimum pressure required for flushing.

.4 Shop Drawings: Provide drawings stamped and signed by Professional Engineer registered or licensed in Province of Ontario, Canada.

1.04 QUALITY ASSURANCE AND REGULATORY COMPLIANCE

.1 Qualifications: Execute work of this section only by licensed tradesmen regularly employed in the installation of natural gas, plumbing and drainage piping systems and site water supply and drainage services.

.2 Other acceptable manufacturers to specified items:

Plumbing Fixtures: As detailed below and as per appendix cutsheets at end of this section.

Plumbing Brass: As detailed below and as per appendix cutsheets at end of this section.

Water Closet Seats: As detailed below and as per appendix cutsheets at end of this section.

Drains and Specialities: Zurn, Watts
Shower Valves: As detailed below and as per appendix cutsheets at end of this section.
Precast Shower Bases and Mop Sinks: As detailed below and as per appendix cutsheets at end of this section.

.3 Provide all Barrier Free Fixtures and Fittings to CAN/CSA-B651.

.4 Provide water closets and urinals with maximum flush for 6.0 and 3.8 litres respectively and provide flush valves that match the fixture capacities that are installed.

.5 Provide domestic hot water generation systems in compliance with ASHRAE 90.1 (latest version).

.6 Where stops or shut-off valves are specified for fixtures, provide ball type valves - rough brass where concealed and chrome plated where exposed.

1.05 CLOSE-OUT SUBMITTALS

.1 Provide operation and maintenance data for washroom fixtures, for incorporation into manual specified in Division 01 Close-out Submittals.

.2 Include:

Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
Details of operation, servicing, maintenance.
List of recommended spare parts.

PART 2 - PRODUCTS

2.01 SUSTAINABLE MATERIALS

.1 Sustainable Requirements: Materials and resources in accordance with Division 01.

.2 Adhesives and sealants: Maximum VOC limit in accordance with Division 01.

2.02 MANUFACTURED UNITS

.1 Fixtures: Manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: Manufacture in accordance with CAN/CSA-B125.3.

.3 Exposed plumbing brass to be chrome-plated.

.4 Number, locations: as indicated.

.5 Fixtures in any one location to be product of one manufacturer and of same type.

Trim in any one location to be product of one manufacturer and of same type.

2.03 PLUMBING FIXTURES AND BRASS

.1 AMENITY Component of Building

Refer to appendix cutsheets for make and model. Provide shut off valves, traps, drains, strainers, vacuum breakers and all other associated fittings to provide fully functioning fixtures. The following is suggested trim, contractor to confirm to suit fixtures:

.1 TOILET - FLOOR MOUNTED - VITREOUS CHINA – ELECTRONIC

FLUSH VALVE: Refer to appendix cutsheets for make and model.
Provide Toilet Supply, C.P. with metal angle stop, escutcheon and metal flexible riser. Provide Floor Flange, flange bolts and gasket. Ensure water closets are a complete unit with all necessary fixture and fittings such as but not limited to wall carriers, floor mounts, floor outlet, bolt caps, seats, lids, stainless steel check hinges, metal flat washers stainless steel posts and nuts, floor Flange with all brass bolts and with rubber gasket. Refer to schedules for make and model.

.2 BASIN - BARRIER-FREE DESIGN & GENERAL USE:
Refer to appendix cutsheets for make and model.
Provide tee adaptors and flex. copper tubing to suit installation. McGuire #155CRS-WC Basin Drain, C.P., cast brass 1 pc. top, offset strainer with plug and chain, 17ga. (1.5mm), 1-1/4" (32mm) tailpiece. Provide Supplies, C.P. with metal angle stops, adaptors, escutcheons and metal flexible risers. McGuire #8872C-20T 'p' Trap, C.P. brass adjustable body, 20 gauge (0.9mm), 1-1/4" (32mm) and escutcheon. McGuire #PW2000WC 'PROWRAP' Sanitary Covering, of PVC, vandal-resistant flexible seamless construction, anti-microbial, to exposed piping (to protect against heat/contusions) as per local codes. Refer to schedules for make and model.

.3 JANITOR MOP SINK: Stern Williams SB-902-T-35-T-40-BP Sink –
Hose and wall hook, Mop hanger, Splash Catcher, Installed on finished floor, Terrazzo, Pearl grey marble chips and white Portland cement, Mop Service Basin, Single compartment, without faucet ledge

Chicago Faucets 897-RCF Faucet - Manual operation, Wall mounted, 8" (203 mm) faucet centerset, Cast brass, 2 holes, Mop Sink Faucets, Rough Chrome plated, 3/4" male hose thread outlet, Vacuum breaker spout with pail hook and wall brace, 3/4" (19 mm) Ø male hose thread outlet, 5-3/4" (146 mm) spout projection, Less Supply, 8" (203 mm) body size, Ceramic quater-turn operating cartridge, Less Drain, ADA, 2-3/8"(60 mm) lever type handle with indexed buttons, Dual Handles, With Top Brace

.2 RESIDENTIAL Component of Building

Refer to the manufacturer cut sheets (at the end of this section). Provide shut off valves, traps, drains, strainers, vacuum breakers and all other associated fittings to provide fully functioning fixtures. Suggested trim as follows:

.1 TOILET - FLOOR MOUNTED - VITREOUS CHINA - GRAVITY TANK TYPE:

Refer to appendix cutsheets for make and model.
Provide Toilet Supply, C.P. with metal angle stop, escutcheon and metal flexible riser. Provide Floor Flange, flange bolts and gasket. Refer to schedules for make and model.

.2 BASIN:
Refer to appendix cutsheets for make and model.
Provide tee, adaptors and flex. copper tubing to suit installation. Provide Supplies, C.P. with metal angle stops, adaptors, escutcheons and metal flexible risers. McGuire #8872C-20T 'p' Trap, C.P. brass adjustable body, 20 gauge (0.9mm), 1-1/4" (32mm) and escutcheon. Refer to schedules for make and model.

.3 SHOWER – BUILT ON-SITE:
Refer to appendix cutsheets for make and model.
Jay R. Smith #2005A Drain, all duco-coated cast- iron body, reversible flashing clamp with seepage openings and adjustable 5" (127mm) diameter nickel bronze 1/4" (6.35mm) thick strainer, secured with S.S. screws, 4" (102mm) throat on strainer. Provide 'p' trap. Refer to schedules for make and model.

.4 SHOWER KIT –
Refer to appendix cutsheets for make and model.
C.P. pressure balancing valve, solid brass body, adjustable temperature limit stop, integral check stops, C.P. escutcheon plate and single metal level handle. Refer to schedules for make and model.

.5 KITCHEN SINK - STANDARD USE:
Refer to appendix cutsheets for make and model.
Provide tee, adaptors and flex. copper tubing to suit installation. Provide Supplies, C.P. with metal angle stops, adaptors, escutcheons and metal flexible risers. Provide 'p' Trap, cast brass 1-1/2" (38mm) with cleanout, union and escutcheon. Refer to schedules for make and model.

.6 BATH TUB –:
Refer to appendix cutsheets for make and model.
Provide all necessary piping, couplings and adaptors to connect tub spout, shower valve, controls and shower head. Provide adequate backing in wall for mounting head and valves. Provide tub spout, C.P., cast brass body with diverter, universal bath drain, C.P., 'P' Trap, cast brass 1-1/2" (38mm) with cleanout, and rotary pop-up assembly. Refer to schedules for make and model.

.3 Washing machine hot/cold supply (WM):

Refer to appendix cutsheets for make and model.

Symmons 'Eliminator' #W-600-X single lever operated valve, hose end outlets, copper liner, service stops, ½" (12.7mm) H & CW connection, 1 ½" (38mm) drain outlet, provide 'P' Trap cast brass, 1
½" (38mm) (concealed in wall).

.4 Mixing valve (MV 1):

Refer to appendix cutsheets for make and model.

Provide tempered water mixing valve –Symmons Model 7-102-PRV or HI-LO-7-102-PRV, capacity 3 gpm (11LPM)] at 10 psi pressure drop, suitable for 29ºC to 71ºC water temperature, thermostatic temperature control valve with liquid filled motor, check stops, safety shut off, volume control valve, rough bronze, ball valves, dial thermometer, in a stainless steel cabinet, top supplies, top outlet. Valve to provided 3 way protection against hot or cold supply line and thermostat failure. Temperature differential between hot supply and outlet of 20ºF, temperature range 90ºF (32ºC) to 120ºF (49ºC) with set point at 110ºF (43ºC).

.5 Emergency / Eye Wash – Wall Hung (EW)

Refer to appendix cutsheets for make and model.

Haws #7260B-7270B wall mounted eye/face wash shall include a green ABS plastic 11" bowl, an anti-microbially treated AXION MSR eye/face wash head to help protect against the growth of mold and mildew on the treated components, and shall feature inverted directional laminar flow which achieves zero vertical velocity supplied by an integral 3.7 gpm flow control, chrome-plated brass stay-open ball valve equipped with stainless steel ball and stem, and chrome-plated brass in-line

50 x 50 mesh water strainer. Unit shall also include cast-aluminum chromate protected wall bracket, yellow plastic pop-off dust cover for eyewash head, universal sign, ½" IPS inlet, and 1-1/4" IPS waste

2.04 GAS COCKS:

.1 Gas Cocks – Single:

.1 CGA listed Chicago Faucets 986-909C single ball valve gas cock of one piece chrome plated brass stem and handle with check valve and universal hose nozzle, escutcheon and tailpiece. Turret valve Series #980WS-909C as above.

.2 Gas Cocks - Double

.1 CGA listed Chicago Faucets 987-909C double ball valve gas cock of one piece chrome plated brass stem and handle with check valve and universal hose nozzle, escutcheon and tailpiece. Turret valve series #982-WS-909C as above.

PART 3 - EXECUTION

3.01 APPLICATION

.1 Manufacturer's Instructions: Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.02 INSTALLATION

.1 Mounting heights:

Standard: to manufacturer's recommendations and as indicated on Architectural and Interior design drawings.
Wall-hung fixtures: as indicated on Architectural and Interior Design drawings Barrier free: To most stringent NBCC, CAN/CSA B651.

3.03 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

Adjust water flow rate to design flow rates.
Adjust pressure to fixtures to ensure no splashing at maximum pressures.
Adjust flush valves to suit actual site conditions.
Adjust urinal flush timing mechanisms.
Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.

.3 Checks:

Water closets, urinals: Flushing action.
Aerators: Operation, cleanliness.
Vacuum breakers, backflow preventers: Operation under all conditions.

.4 Thermostatic controls: Verify temperature settings, operation of control, limit and safety controls.

3.04 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 22 42 03

APPENDIX A

PLUMBING FIXTURES

CUT SHEETS

COUNTY OF HASTINGS
AFFORDABLE HOUSING

PLUMBING FIXTURES

Prepared on August 12, 2023

Revision: R*0*

Prepared By:

Galang Consulting Services

GCS Project #23006

FOR

SUPPORTING PEOPLE Hastings™ AND OUR COMMUNITIES

Table of contents

Roca

A3480R7000

GEORGIA

Vitreous china close-coupled toilet S-Trap 12", elongated, concealed trap-way

DIMENSIONS

Length	740 mm
Width	380 mm
Height	431 mm

COLOURS AND FINISHES

00 White

FEATURES
Vitreous china close-coupled toilet, elongated, concealed trap-way. The seat and tank shown in the image are not included. Please check below for details on compatible products.
Comfort height
Elbow included
Fixing kit: Included
Flushing jet
Flushing system: Siphonic
Installation type: Floorstanding
Outlet type: Dual (vario), Vertical
Publication Status
Roca Rimless®
S-Trap min setout (mm): 305
Shape: Elongated
Water Inlet System: Bottom Inlet

Z5957SS-STS

White, open front toilet seat, with cover and, stainless steel check hinge.
-AM ZurnSHIELDTM protection, Self-sustaining stainless steel check hinge

DEBBA A32799M00A

Vitreous china countertop lavatory, 500 x 410 mm, square shaped, self-rimming, twin front overflow, drilled single hole.

Z82200-XL-27M

Single lever faucet, low lead, with an integral 127 mm (5 in) cast spout, cast brass body, quarter-turn ceramic disc cartridge, lever handle, single hole installation, polished chrome finish, adjustable high temperature limit stop,with 1.9 L/min. (0.5 usgpm) vandal-resistant pressure compensating male laminar flow, stainless steel braided hoses.

Z8743-PC

Strainer drain assembly, cast brass body, 32 mm (1 1/4 in), polished chrome finish.

Z8700-8-PC-BD

32 mm (1 1/4")
Cast brass adjustable P-trap, 32 mm (1 1/4 in) with deep wall flange and cleanout, chrome plate finish.

ZH8824XL-LRLKQ-PC (2)

10 x 300 mm
Extra heavy duty quarter turn stops, low lead, DN 1/2 po compression, loose key, vertical flexible hoses of 10 x 300 mm (3/8 x 12 po), flanges chrome plated finish.

Z5321

581 x 514 mm (22 7/8 x 20 1/4")
Vitreous china wall hung lavatory for barrier-free application, 581 x 514 mm (22 7/8 x 20 1/4 in), backsplash, front overflow, pre-drilled for concealed arms, drilled single hole.

Z82200-XL-27M

Single lever faucet, low lead, with an integral 127 mm (5 in) cast spout, cast brass body, quarter-turn ceramic disc cartridge, lever handle, single hole installation, polished chrome finish, adjustable high temperature limit stop,with 1.9 L/min. (0.5 usgpm) vandal-resistant pressure compensating male laminar flow, stainless steel braided hoses.

ZH8824XL-LKQ-PC/Z8952-58 (2)

Lavatory extra heavy duty quarter turn stops, low lead, DN 1/2 in compression x 3/8 in compression, loose key, flanges chrome plated finish.

OS&B

37D

32 mm (1 1/4")
"Daisy" type strainer drain assembly, cast brass body, 32 mm (1 1/4 in), polished chrome finish.

ZURN

Z8700-8-PC-BD

32 mm (1 1/4")
Cast brass adjustable P-trap, 32 mm (1 1/4 in) with deep wall flange and cleanout, chrome plate finish.

Z1231

Back to back concealed wall hung carrier, steel uprights with welded feet, cast iron adjustable headers, concealed arms, alignment truss and mounting fasteners.

Z8946-1-NT

Antimicrobial protectors, resists thermal transfers for P-trap, stop and supply.

Z5321

581 x 514 mm (22 7/8 x 20 1/4")
Vitreous china wall hung lavatory for barrier-free application, 581 x 514 mm (22 7/8 x 20 1/4 in), backsplash, front overflow, pre-drilled for concealed arms, drilled single hole.

Z82200-XL-27M

Single lever faucet, low lead, with an integral 127 mm (5 in) cast spout, cast brass body, quarter-turn ceramic disc cartridge, lever handle, single hole installation, polished chrome finish, adjustable high temperature limit stop,with 1.9 L/min. (0.5 usgpm) vandal-resistant pressure compensating male laminar flow, stainless steel braided hoses.

ZH8824XL-LKQ-PC/Z8952-58 (2)

Lavatory extra heavy duty quarter turn stops, low lead, DN 1/2 in compression x 3/8 in compression, loose key, flanges chrome plated finish.

37DWC

32 mm "Daisy" type strainer offset drain assembly, cast brass body, 32 mm (1 1/4 in), polished chrome finish.

Z8700-8-PC-BD

32 mm (1 1/4") Cast brass adjustable P-trap, 32 mm (1 1/4 in) with deep wall flange and cleanout, chrome plate finish.

Z1231

Back to back concealed wall hung carrier, steel uprights with welded feet, cast iron adjustable headers, concealed arms, alignment truss and mounting fasteners.

Z8946-3-NT

Antimicrobial protectors, resists thermal transfers for P-trap, offset drain assembly, stop and supply.

ELKAY

ILR3322L1-LK99

838 x 559 x 194 mm (33 x 22 x 7 5/8")
Drop-in stainless steel single bowl sink with right drainboard and ledge, 838 x 559 x 194 mm (33 x 22 x 7 5/8 in), type 304, 18 gauge, satin finish, sound deadening pads, rim seal pre-installed, installation kit, 89 mm (3 1/2 in) centered right basket strainer assembly. Includes 3 1/2 inch drain fitting deep strainer with basket. Includes stainless steel bottom grid protection for sink, pre-drilled 1 center hole.

ELKAY

LK1500CR

Single-lever faucet, cast brass body, ceramic disc cartridges, polished chrome finish, with lever handle, 203 mm (8 in) swivel 360° gooseneck spout with aerator limiting flow to 5.7 lpm (1.5 gpm), single hole. Maximum countertop thickness 51 mm (2 1/2 in).

ZH8824XL-LRLKQ-8860-12-PC (2)

10 x 300 mm (3/8 x 12")
Extra heavy duty quarter turn stops, low lead, DN 1/2 in compression, loose key, vertical flexible stainless braided hoses of 10 x 300 mm (3/8 x 12 in), flange, chrome plated finish.

Z8702-9BD

38 mm (1 1/2")
Cast brass adjustable P-Trap, 38 mm (1 1/2 in) with cleanout, deep seal flange, polished chrome finish.

ELKAY

DLRQ2522121-LK99

635 x 559 x 308 mm (25 x 22 x 12 1/8")
Stainless steel single bowl sink with ledge, 635 x 559 x 308 mm (25 x 22 x 12 1/ in), lustrous satin finish, type 304, 18 gauge, sound deadening pads, rim seal pre-installed, installtion kit, 89 mm (3 1/2 in) basket strainer assembly, pre-drilled single center hole.

ELKAY

LK1500CR

Single-lever faucet, cast brass body, ceramic disc cartridges, polished chrome finish, with lever handle, 203 mm (8 in) swivel 360° gooseneck spout with aerator limiting flow to 5.7 lpm (1.5 gpm), single hole. Maximum countertop thickness 51 mm (2 1/2 in).

ZH8824XL-LRLKQ-8860-12-PC (2)

10 x 300 mm (3/8 x 12")
Extra heavy duty quarter turn stops, low lead, DN 1/2 in compression, loose key, vertical flexible stainless braided hoses of 10 x 300 mm (3/8 x 12 in), flange, chrome plated finish.

Z8702-9BD

38 mm (1 1/2")
Cast brass adjustable P-Trap, 38 mm (1 1/2 in) with cleanout, deep seal flange, polished chrome finish.

Z1996-24

610 x 610 x 254 mm (24 x 24 x 10")
Molded high density composite mop basin, 610 x 610 x 254 mm (24 x 24 x 10 po), 44 x 16 mm (1 3/4 x 5/8 in) rim, 76 mm (3 in) PVC drain body with stainless steel dome strainer/lint basket, NPS 76 mm (3 in) gasketed outlet.

Z1996-MH

610 x 76 mm (24 x 3")
Stainless steel mop hanger, with 3 wall hooks.

Z1996-WG24

Stainless steel 2 panels wall guard, 610 mm (24") for corner installation, 20 gauge, satin finish, 305 mm (1/2") high, corner molding.

Z843M4-XL

Wallmount polished chrome-plated cast brass 203mm (8 in) sink faucet, low lead, short swivel inlets, 184 to 222 mm (7 1/4 to 8 3/4 in) adjustable centers, integral service stops, ceramic disc cartridges, polished chrome finish, 102 mm (4 in) vandal-resistant color-coded metal wrist blade handles, rigid spout with atmospheric vacuum breaker, wall brace, pail hook and hose threaded outlet, outlet at 232 mm (9 1/8 in) from finished wall.

Z1996-BS24

Stainless steel bumper guard. Quantity to be determined. 610 mm (24 in) in length. Note: The item is sold by default as a pair.

Z1996-HH

16 X 762 mm (5/8 x 30 po)
Reinforced hose for intensive use 16 x 762 mm (5/8 x 30 in) in length with brass coupling with hose bracket with rubber grip.

7600

Thermostatic (T type) mixing valve for concealed piping, copper encapsulated thermostat assembly with brass shuttle, compensates for temperature and minor pressure fluctuation, rotation from cold to hot, high temperature limit stop factory preset at 43 ºC (110 ºF), brass body, internal brass, copper and stainless steel componants, metal trim and handle, color-coded indicator, combined service stops/check stops, DN 13 mm (1/2") sweat inlet and outlet, DN 13 mm (1/2") threaded bottom outlet, 15 L/min (4 usgpm) flow.

Standards: ASME A112. 18. 1/CSA B125.1

LEONARD

H-15

Adjustable water saver institutional shower head, chromed thermo-plastic ABS body, ball joint, 5.7 L/min (1.50 usgpm), chromed brass mounting plate with optional chromed brass anchor plate.

D (BR)

Brass diverter tub spout, 1/2" or 3/4".

MAXX Rubix Access 6030 Acrylic Alcove Bathtub 106348
Alcove bathtub with integrated flat skirt and tiling flange, Low deck height of 16 in. (AFR) or 14 in, Stabili-T anti-slip bottom meeting ADA, ANSI or CSA requirements

7600-H-15

Thermostatic (T type) mixing valve for concealed piping, copper encapsulated thermostat assembly with brass shuttle, compensates for temperature and minor pressure fluctuation, rotation from cold to hot, high temperature limit stop factory preset at 43 ºC (110 ºF), brass body, internal brass, copper and stainless steel componants, metal trim and handle, color-coded indicator, combined service stops/check stops, DN 13 mm (1/2") sweat inlet and outlet, DN 13 mm (1/2") threaded bottom outlet, 15 L/min (4 usgpm) flow. Institutional adjustable water saver shower head, chromed thermoplastic ABS body, ball joint,5.7L/min (1.50 usgpm), chromed brass mounting plate with optional chromed brass anchor plate.

Product's notes : Note : Pressure regulators will be required if pressure differential between hot and cold water is greater than 10%.

Standards: ASME A112. 18. 1/CSA B125.1

7600

Thermostatic (T type) mixing valve for concealed piping, copper encapsulated thermostat assembly with brass shuttle, compensates for temperature and minor pressure fluctuation, rotation from cold to hot, high temperature limit stop factory preset at 43 ºC (110 ºF), brass body, internal brass, copper and stainless steel componants, metal trim and handle, color-coded indicator, combined service stops/check stops, DN 13 mm (1/2") sweat inlet and outlet, DN 13 mm (1/2") threaded bottom outlet, 15 L/min (4 usgpm) flow.

Product's notes : Pressure regulators will be required if pressure differential between hot and cold water is greater than 10%.

Standards: ASME A112. 18. 1/CSA B125.1

LEONARD

H-15

Adjustable water saver institutional shower head, chromed thermo-plastic ABS body, ball joint, 5.7 L/min (1.50 usgpm), chromed brass mounting plate with optional chromed brass anchor plate.

62003-1.5-72

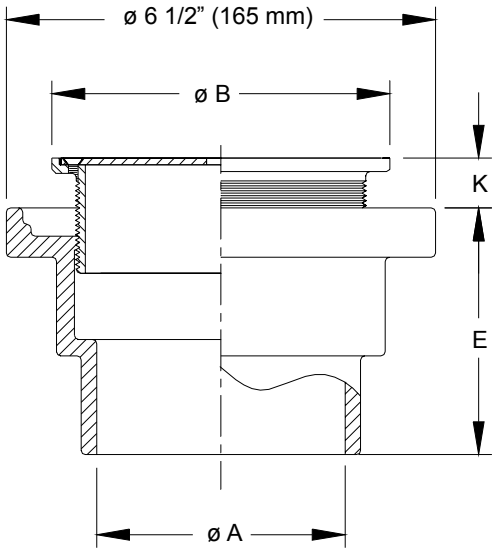
Hand shower kit including: 38 mm (1 1/2") in diam. x 914 mm (36") grab bar, sliding and pivoting handshower hanger manageable by hand or with closed fist requires no more than 2.27 kg (5 lbs) pressure to operate, institutional handshower with instant shut-off button, 5.7 l/min (1.5 usgpm) flow with integral checkstops, Braided stainless steel double spiral metalic hose flexible and extended out from 60” to 84” Conforms to ADA, DN 1/2" wall mount supply elbow with flange.

D-2L

Recessed diverter, chrome plated lever handle with flange, DN 1/2 in sweat.

ZN211-B5-P-Y

Cast iron floor drain with a 165 mm (6 1/2") in diam. body with a 100 mm (4") in diam. threaded throat to receive adjustable 127 mm (5") in diam. adjustable round strainer combined with 3 mm (1/8") round polished nickel bronze regular traffic grate. Trap primer protection. Sediment bucket

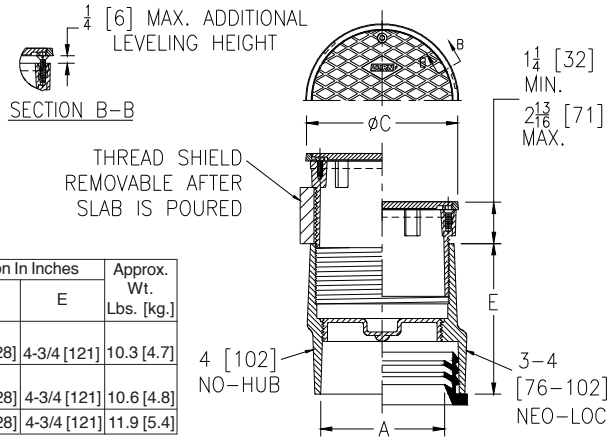


Z556-FO-Y-P

Cast iron floor drain with a 213 mm (8 3/8") in diam., 171 mm (6 3/4") in diam. grate and funnel with 203 mm (8") in diam. frame for heavy duty traffic, clamp collar with secondary drainage, adjustable frame and sediment bucket; all cast iron. Trap primer connection.

ZN1400-BZ1

Cast iron floor ajustable cleanout with a 128 mm (5 1/32") body and strainer combined with a slip proof light duty traffic cover. ABS threaded seal plug inside body.



Dimension In Inches			Approx. Wt. Lbs. [kg.]
A Pipe Size	C	E	
No-Hub			
4 [102]	5-1/32 [128]	4-3/4 [121]	10.3 [4.7]
Neo-Loc			
3 [76]	5-1/32 [128]	4-3/4 [121]	10.6 [4.8]
4 [102]	5-1/32 [128]	4-3/4 [121]	11.9 [5.4]

PNV-200-LF-2PS

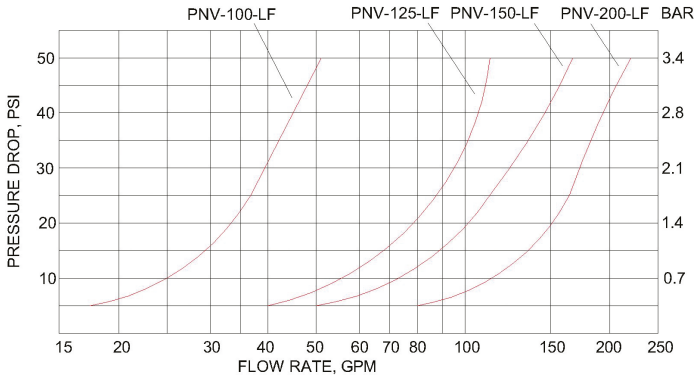
Warning! Minimum pressure required for proper operation of the mixer is 35 psi. This does not take into account the minimum pressure required from the device supplied and the loss through the mixer.

Digital thermostatic mixing valve, inlet DN 3 in, outlet DN 4 in, minimum flow of 0.95 to 625 l/min (0.25 to 173 guspm) at 30 psi pressure drop (flows are for one mixing vlave, multply by 2), digital thermostat, +/- 2?F water temperature control, 2?F minimum inlet to outlet water temperature differential, automatic shutoff of hot water upon cold water inlet supply failure, automatic shutoff of cold water upon hot water inlet supply failure, maintain last control position in the event of power failure or be equipped with UPS standby power for approximately 2 hour run time, programmable set point range of 65-180?F (18-82?C), self-balancing - No need to manually adjust or balance recirculation, self-cleaning - Daily shuttle sweep keeps shuttle free of debris Connectivity capabilites 120V plug in power supply with 6' cord
2 line, 16 character LED display
BMS connectivity available as option with Protocast (IOT) Shall be compliant with ASSE standard 1017 and CSA B125/cUPC and so certified and identified, Shall be cULus listed and identified

MODEL	IN	OUT	MINIMUM FLOW GPM	PRESSURE DROP 5	10	15	20	25	30	35	40	45	50	PSI
			L/MIN	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.8	3.1	3.4	BAR
PNV-100-LF	3/4"	1"	0.25*	17	25	28	32	36	39	43	45	48	51	GPM
	(19.1mm)	(25.4mm)	0.95*	64	95	106	121	136	148	163	170	182	193	L/MIN
PNV-125-LF	1"	1 1/4"	0.25*	40	56	66	77	86	95	104	109	114	120	GPM
	(25.4mm)	(31.6mm)	0.95*	151	212	250	291	326	360	394	413	432	454	L/MIN
PNV-150-LF	1 1/4"	1 1/2"	0.25*	50	72	86	100	115	122	136	140	158	165	GPM
	(31.6mm)	(38.1mm)	0.95*	189	273	326	379	435	462	515	530	598	625	L/MIN
PNV-200-LF	2"	2"	0.25*	80	115	130	147	165	173	189	198	215	226	GPM
	(50.8mm)	(50.8mm)	0.95*	303	435	492	556	625	655	715	750	814	856	L/MIN

VALVE ASSEMBLY(S) ARE ASSE STANDARD 1017 LISTED
ALL VALVE ASSEMBLY(S) ARE 3RD PARTY CERTIFIED TO BE LEAD FREE
*WHEN INSTALLED NEAR HOT WATER SOURCE AND WITH A PROPERLY SIZED, CONTINUOUSLY OPERATING RECIRCULATION PUMP

MAXIMUM FLOW CAPACITY



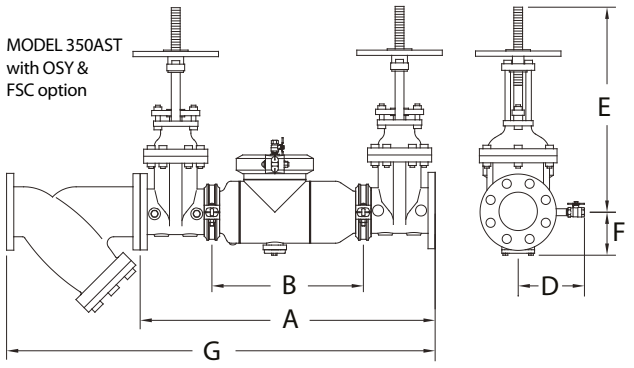
350AST 2 1/2

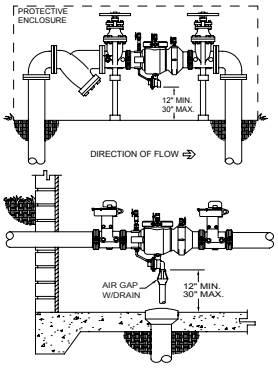
Moderate hazard backflow preventer (DCVA), low lead, to be installed on potable water lines to protect against both backsiphonage and backpressure of polluted water into the water supply, stainless steel body, stainless steel fasteners and springs, Noryl™ seat ring and check valve, stainless steel stem, seat disc EPDM elastomer, flanged end gate valves, maximum working pressure 175 psi, maximum working water temperature 140 °F (60 °C), hydraulic test pressure 350 psi, horizontal or vertical installation, 63 mm (2 1/2 in) flanged connection.

FSC 2 1/2

Cast iron Y strainer, low lead, 200 psi at 66 °C (150 °F) WOG or 125 psi at 232 °C (450 °F) steam, body and cover cast iron (ASTM A 126 Class B), with FDA approved epoxy coating inside and out, integral strainer screen accessible without removing device from line. Complying to MIL-S-16293F type 2. 2 ½" diameter.

MODEL 350AST SIZE		DIMENSION (approximate)																					
		A		A WITH BUTTERFLY		B LESS GATE VALVES		C		D		E NRS GATE		E OS&Y OPEN		E OS&Y CLOSED		E WITH BUTTERFLY VALVES		F		G	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
2 1/2	65	31 7/8	810	28 3/4	730	16 5/8	422	4 1/2	114	7 1/4	184	11 1/2	292	17 3/4	451	15 3/8	391	8 1/4	210	5	127	42	1067
3	80	32 7/8	835	29 3/8	746	16 5/8	422	4 1/2	114	7 1/4	184	12 3/4	324	20 1/4	514	17	432	8 1/4	210	5	127	43 1/2	1105
4	100	34 7/8	886	30 1/4	768	16 5/8	422	4 1/2	114	8	203	14 1/2	368	22 1/2	572	18 1/4	464	9	229	5	127	50	1270
6	150	43 1/2	1105	36 1/2	927	22 1/4	565	5 1/2	140	10	254	18	457	30 1/2	775	24 1/4	616	10 1/4	260	6	152	61 5/8	1565
8	200	52 3/4	1340	45 3/4	1162	29 1/2	749	9 1/4	235	11	279	21 1/8	537	37	940	28 1/2	724	18 1/2	470	8 3/8	213	77 1/8	1959
10	250	55 3/4	1416	49 3/4	1264	29 1/2	749	9 1/4	235	12	305	24 3/4	629	45 5/8	1159	34 3/4	883	18 1/2	470	8 3/8	213	85 3/8	2169





696RG2313MF

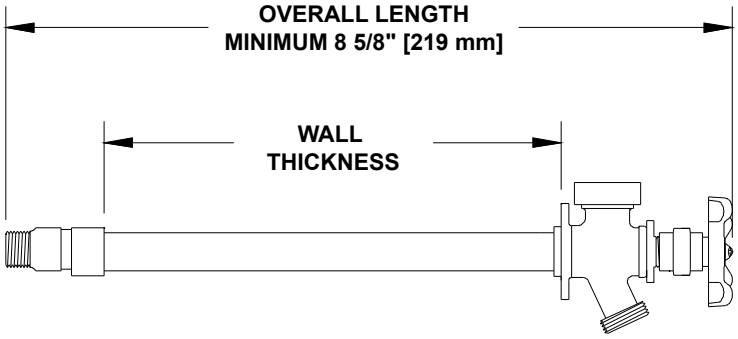
Fire-rated washing machine outlet boxes with water hammer arresters; heavy duty fire retardant plastic resin box with intumescent pads; separate supply and drain boxes allowing a reversed position and plumbed into separate stud bays(1); recessed installations; finishing frame; c. p. no lead brass ball valves; outlet to fit on copper.

696CF

Secondary funnel to be inserted on the drain side in a washing machine box for condensate.

Z1345-8

Freeze resistant wall hydrant, exposed type, removable wheel handle, brass body, copper casing, all bronze interior componants, self-draining vacuum breaker, DN 1/2 in male IP or female sweat. Wall thickness 8" (203 mm). To avoid damage or freezing, the hose must be completely removed for drainage.



Wall Thickness In. [mm]	A Overall Length	Approx. Wt. Lbs. [kg]
4[102]	8-5/8[219]	2 [1]
6 [152]	10-5/8 [270]	2 [1]
8 [203]	12-5/8 [321]	3 [1]
10 [254]	14-5/8 [371]	3 [1]
12 [305]	16-5/8 [422]	4 [2]
14 [356]	18-8/8 [473]	4 [2]

ZN1448-4

Dura-Coated cast iron cleanout tee, 102 mm (4 in) for gas and watertight ABS tapered thread plug and round, scoriated secured nickel bronze floor access cover and frame.

Z1445-BP 4"

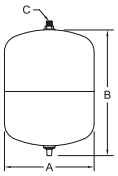
Column cleanout with 102 mm (4") cast iron body with gaz and water proof bronze cap.

ZURN WIL

XT-8

Potable water expansion tank designed for pressure control due to thermal expansion. 16 gauge cold rolled steel with epoxy coating, top chamber is 100% butyl rubber, lower chamber is copolymer polypropylene, pre-charge 40 psi, maximum working pressure of 150 psi. Maximum working temperature of 200 ºF (93,3 ºC). NSF 61 (cold) standard. Tank volume 8, 18 and 32 litres (2.1, 4.8 and 9.0 usg).

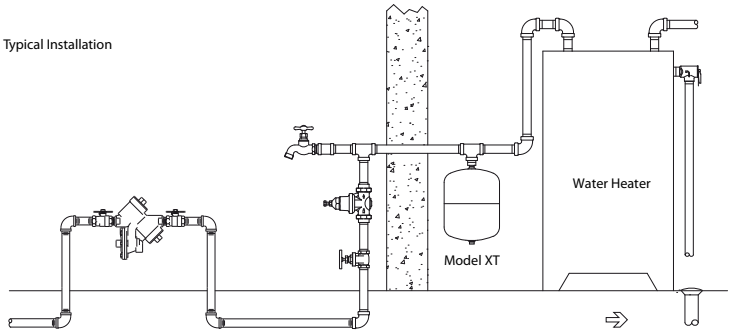
MODEL NUMBER	MAXIMUM WORKING PRESSURE psi	TANK VOLUME (gallons)	MAXIMUM ACCEPTANCE VOLUME (gallons)	FACTORY PRE-CHARGE psi	DIMENSIONS			WEIGHT lbs.
					DIAMETER A	HEIGHT B	SYSTEM CONNECTION C	
XT-8	150	2.1	1.0	40	8	10 1/2	3/4NPT	5.5
XT-18	150	4.8	2.4	40	11	13 1/2	3/4 NPT	10
XT-35	150	9.0	4.25	40	12 1/2	17 1/4	3/4 NPT	15.5



Sizing Chart

Supply Pressure (psig)	WATER HEATER CAPACITY (U.S. gal)										
	20	30	40	50	60	80	100	120	150	175	200
40	8	8	8	8	8	18	18	18	35	35	35
50	8	8	8	8	8	18	18	18	35	35	35
55	8	8	8	8	8	18	18	18	35	35	35
60	8	8	8	8	18	18	18	18	35	35	35
70	8	8	8	18	18	18	18	35	35	35	35
80	8	8	18	18	18	18	35	35	35	35	35
90	8	18	18	18	18	35	35	35	35		
100	18	18	18	18	35	35	35				
110	18	18	35	35	35						
120	35	35	35								

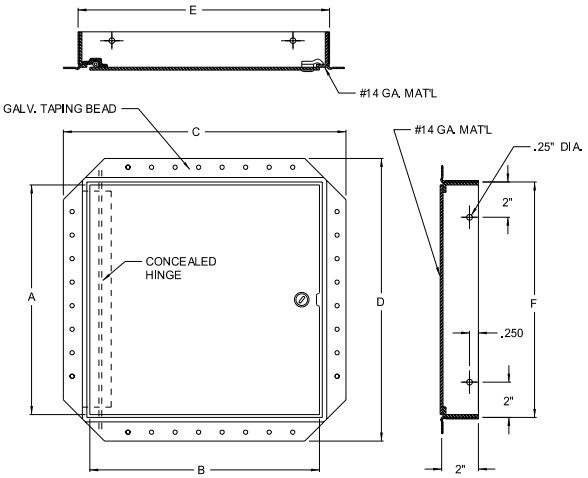
Typical Installation



DW5040 30 x 30

Access door designed for flush installation in drywall or plaster surfaces. 762 x 762 mm (30 x 30 in), satin coat steel-primed white finish. 14 ga. door flush to 16 ga. frame. Concealed continuous piano hinge.

NOMINAL SIZE	A	B	C	D	E	F	LOCK
6 x 6 (152 x 152)	5.81 (148)	5.81 (148)	8.5 (216)	8.5 (216)	6 (152)	6 (152)	1
8 x 8 (202 x 203)	7.81 (198)	7.81 (198)	10.5 (267)	10.5 (267)	8 (203)	8 (203)	1
10 x 10 (254 x 254)	9.81 (249)	9.81 (249)	12.5 (318)	12.5 (318)	10 (254)	10 (254)	1
12 x 12 (305 x 305)	11.81 (300)	11.81 (300)	14.5 (368)	14.5 (368)	12 (305)	12 (305)	1
14 x 14 (355 x 355)	13.81 (351)	13.81 (351)	16.5 (419)	16.5 (419)	14 (356)	14 (356)	1
16 x 16 (406 x 406)	15.81 (401)	15.81 (401)	18.5 (470)	18.5 (470)	16 (406)	16 (406)	2
18 x 18 (457 x 457)	17.81 (452)	17.81 (452)	20.5 (521)	20.5 (521)	18 (457)	18 (457)	2
22 x 22 (560 x 560)	21.81 (554)	21.81 (554)	24.5 (622)	24.5 (622)	22 (559)	22 (559)	2
24 x 24 (610 x 610)	23.81 (605)	23.81 (605)	26.5 (673)	26.5 (673)	24 (610)	24 (610)	2
24 X 36 (610 X 914)							2
30 X 30 (762 X 762)							2
36 X 36 (914 X 914)							2



PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

.1 Heating and Cooling

.1 Heating, cooling, refrigeration piping systems.

.2 Supply and installation of boilers, pumps, convectors, fluid coolers, tanks, coils, unit heaters, air handling units, heat exchangers and other heating/cooling systems piped components.

.2 Air Distribution

.1 Provide a complete installation of ventilation systems as shown on the Drawings and Detail Drawings including ductwork, grilles, and diffusers, fans, dampers, hoods and provision of personnel and materials to assist in air balancing.

.2 Install all automatic dampers supplied by Division 25 Building Automation System.

1.03 QUALITY ASSURANCE

.1 Qualifications: execute work of this section only by skilled tradesmen regularly employed in the installation of pressure piping systems and heating and cooling equipment.

.2 All filters to be ULC labelled and listed for flame spread rating of less than 25 and smoke classification of less than 50.

.3 Other HVAC equipment to meet the performance standards of the Model National Energy Code of Canada for Buildings (latest edition) or ASHRAE 90.1-2010 whichever is more stringent. Comply with the requirements of Ontario Building Code Supplementary Standard SB-10.

.4 Large air conditioners, heat pumps and condensing units to meet the Energy Efficiency Performance Standard of CAN/CSA-C746 (current version).

.5 Submittals: Submit shop drawings on boilers, fluid coolers, heat exchangers, pumps, terminal heating equipment, coils, air handling units, refrigeration system. Provide fan curves for all air handling units.

1.04 SUBMITTAL

.1 Submit shop drawings on registers, grilles, diffusers, fans, filters, fire dampers, fire/smoke dampers, filter gauges, prefabricated plenums and generator exhaust system. Provide fan curves for all fans 200 l/s (400 CFM) and greater capacity.

.2 Provide co-ordination/interference drawings, as required per Section 20 05 05, Co-ordination Drawings.

1.05 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 78 00 – Close-out Submittal**s** as follows:
- .1 One set of packing for each pump.
- .2 One casing joint gasket for each size pump.
- .3 One head gasket set for each heat exchanger.
- .4 One glass for each gauge glass.
- .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01 to suit Close-out Submittals.

.3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 EQUIPMENT AND TERMINALS

.1 Deliver equipment to the Site of the Work and store in area as designated by the Contractor. Set equipment on temporary bases to avoid contact with the ground. Protect equipment from damage.

.2 Comply with manufacturer's requirements for the installation of all specified equipment.

.3 Locate equipment as shown on the drawings to provide best possible connection arrangement and accessibility for servicing. Provide clearances on all sides of equipment as required by Authorities having jurisdiction or manufacturer, whichever is greater.

.4 Install items of equipment such as convectors with due regard to Architectural treatment, and ensure all items are level and finished in keeping with good workmanship. Grade all convector elements upward in direction of flow. Refer to detail drawings.

.5 Provide drains to nearest floor drain on all back flow preventors.

.6 Provide chemical treatment connections on heating and condenser water circuits as directed by chemical treatment supplier.

.7 Pitch coils for air handling systems 18mm/m (3"/ft) toward access end of unit.

.8 Provide branch take-offs from mains of heating and cooling pipes with shut off valves.

.9 Install and connect remote components such as thermostats, humidistats, control panels, level controllers, etc., that are supplied with the equipment. Install in locations as shown on the drawings.

.10 Install rooftop HVAC and H&V equipment on bases per Manufacturer's instructions and in locations as shown on the Drawings. Provide PVC condensate drains to roof for HVAC units. Provide condensate drains with deep traps equivalent to 25 mm (1") deeper than air pressure in the unit with the top of the trap 50 mm (2") minimum below the unit condensate outlet. Condensate must be effectively trapped to avoid condensate hang-up in the unit and to prevent air flowing into the unit through the trap.

.11 Install Infra-red heaters in locations and elevations as shown on the Drawings. Take care to ensure a neat installation to provide the best possible appearance. Install exposed items such as piping, vent tubing or wiring parallel with wall and ceiling surfaces.

3.02 EQUIPMENT STARTUP

.1 Follow manufacturer's instructions and have manufacturer's representative present to certify the installation.

.2 Check each item of equipment to ensure proper electrical connections, etc., and to verify proper operation.

END OF SECTION 23 05 00

PART 1 - GENERAL

1.01 SUMMARY

.1 Description

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05 Mechanical Work General Instructions and Section 20 05 10 Basic Mechanical Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide a complete ULC-listed system of heating cables, components and controls to prevent pipelines from freezing.

.2 Determine the extent of the scope of work from the drawings.

1.03 WORK PERFORMED BY DIVISION 26

.1 Division 26 will provide a power panel with a number of breakers in designated locations as shown on the plan, to allow Divisions 20, 21, 22, 23 and 25 to connect to the necessary pipe tracing circuits.

1.04 QUALITY ASSURANCE

.1 Qualifications: Execute work of this section only by licensed tradesmen regularly employed in the installation of electrical heat tracing. Retain the services of an electrical contractor, as a sub- contractor.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01.

.3 The specifications are based on Raychem XL-Trace System.

1.05 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01.

.2 Quality assurance submittals: Submit following in accordance with Division 01.

.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Instructions: Submit manufacturer's installation instructions.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

PART 2 - PRODUCTS

2.01 ELECTRIC HEATING CABLE

.1 Provide self-regulating heating cable consisting of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field.

.2 The heating cable shall be covered by a radiation-crosslinked, modified polyolefin dielectric jacket with a braid of tinned-copper and an outer jacket of modified polyolefin (CR) as required by the electrical code.

.3 Provide heating cable with self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heating cable output going from 40°F pipe temperature operation to 150°F pipe temperature operation.

.4 The heating cable shall operate on line voltages of 120 and/or 208 volts without the use of transformers.

.5 The heating cable shall be sized according to the table below. The required heating cable output rating is in watts per foot at 50°F. Heating cable selection is based on 1" fiberglass insulation on metal piping.

Pipe Size	Minimum Ambient - 10°F
3 in or less	5 watts
4 in	5 watts
6 in	8 watts
8 in	2 strips – 5 watts
12 in to 14 in	2 strips – 8 watts

.1 Provide power connection, end seal, splice and feed kit components to be applied in the field.

.2 Heating cable circuit shall be protected by a ground fault device for equipment protection.
Coordinate breaker requirements with Division 26.

2.02 SYSTEM CONTROL

.1 The system shall be controlled by an ambient sensing thermostat AMC-1A set at 40°F either directly or through an appropriate contactor.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

.1 Apply the heating cable linearly on the pipe after piping has been successfully pressure-tested.
Secure the heating cable to piping with cable ties or fiberglass tape.

.2 Apply “Electric Traced” signs to the outside of the thermal insulation.

.3 For heat tracing for fire protection piping, all products need to be ULC listed and FM labelled meeting the requirements of NFPA 13 and 14. Refer to Section 15500 for other specific requirements.

3.03 TESTS

.1 After installation and before and after installing the thermal insulation, subject heating cable testing using a 2500 Vdc Megger. Minimum insulation resistance shall be 20 to 1000 megohms regardless of length.

3.04 PIPING SYSTEMS WHICH REQUIRE HEAT TRACING AND INSULATION

.1 Unless noted otherwise, provide electric heat tracing for piping subject to freezing. Piping located in an unheated or partially heated parking garage is considered as area subject to freezing.

.2 Refer to the following table for piping systems which require heat tracing.

Piping System	Heat Trace	Insulation
Potable Water System		
Domestic Cold Water	Yes	Yes
Domestic Hot Water	Yes	Yes
Domestic Hot Water Recirculation	Yes	Yes
Fire Protection – Sprinkler and Standpipe Systems		
Wet System Pipe	Yes*	Yes
Dry System Pipe	No	No
Drum Drips	Yes*	Yes
HVAC Piping System		
Chilled Water Pipes (4 – Pipe System)	Yes	Yes
Heating Water Pipe (4 – Pipe System)	Yes	Yes
Heating & Cooling Water Pipes (2 – Pipe Changeover)	Yes	Yes
Heating and cooling piping without glycol protection	Yes	Yes
Drainage Systems		
Storm	No	Yes

Sanitary	No**	Yes
Pumped pressure lines	Yes	Yes

Notes:

***** Heat tracing used for fire protection system to be UL and ULC listed meeting the requirements of NFPA 13 and 14. Refer to Division 21
****** Sanitary p-traps are required to be heat traced and insulated in unheated

spaces. eat trace and insulate 3 meters of sanitary pipe downstream of

trap.

Heat trace and insulate any wet piping & drainage piping at the loading dock and within 5 meters radius from a parking fresh air intake shaft and parking ramp overhead door. Co-ordinate with Section 20 05 25 contractor for piping which requires heat tracing and insulation.

3.05 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 05 33

PART 1 - GENERAL

1.01 SUMMARY

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME Bd.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
- .2 ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings - Class 150, 300, 400, 600, 900, 1500 and 2500.
- .3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
- .4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)

.1 CSA B52, Mechanical Refrigeration Code.

.4 Environment Canada (EC)

.1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.03 SUBMITTALS

.1 Submittals in accordance with Division 01 and Section 20 05 00.

.2 Co-ordinate submittal requirements and provide submittals required by Division 01.

.3 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
- .2 Submit WHMIS MSDS in accordance with Division and Division 02. Indicate VOC's for adhesive and solvents during application and curing.

.4 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.6 Instructions: Submit manufacturer's installation instructions.
.7 Close-out submittals: Submit maintenance and engineering data for incorporation into manual specified in Division 01 to suit Close-out Submittals and Section 20 05 00.

1.04 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Division 01 to suit Health and Safety Requirements.
.2 Construction requirements: In accordance with Division 01.
.3 Verification: Contractor's verification in accordance with Division 01.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 REFRIGERATION PIPING AND SYSTEMS
.1 Provide for all systems indicated on the drawings a complete refrigeration piping system by a recognized contractor regularly employed in commercial and industrial refrigeration.
.2 Prepare and submit layout drawings and control arrangements for review by the Consultant prior to starting work. Size piping equivalent to a maximum of 1.1°C temperature drop. Size all suction and hot gas piping, using double risers where necessary, to ensure oil entertainment under minimum load.
.3 Refrigeration circuits: refer to schematics and provide strainer/driers, sight glasses, moisture indicators, shut off valves, thermal expansion valves, solenoid valves, receiver, refrigerant, oil, safety accessories, etc. as required for a complete and working installation.
.4 Provide all control wiring and motor control interlocks as described on the drawings and as required by the refrigeration equipment manufacturer's installation instructions and control schematics to achieve required operating sequences and maximum equipment protection.
.5 Provide a 100% parts and labour, and loss of refrigerant and oil (by leakage or contamination) warranty during the normal guarantee period.

2.02 PIPING

.1 Piping: Type L hard temper copper tubing with bronze alloy (Silfos) joints. For sizes 12mm (½") and under, type K soft temper copper tubing with silfos or flared joints may be used.

2.03 VALVES AND SPECIALTIES

.1 Valves and Specialities: seal cap type, brass with teflon seats; acceptable manufacturers: Superior, Mueller, Henry, Frick. Check valves: type CK 1 as manufactured by Refrigeration Specialities or Frick. Thermal expansion valves, filter/driers, solenoid valves, moisture indicators: Sporlan. All thermal expansion valves to be provided with external equalisers.

2.04 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.05 VALVES

.1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 GENERAL

.1 Install in accordance with Section 20 05 10, CSA B52, EPS1/RA/1 and ASME B31.5.

3.03 REFRIGERATION SYSTEM

.1 Submit application to TSSA or the Authority Having Jurisdiction and pay for all required fees. Obtain approval from TSSA or the Authority Having Jurisdiction prior to installation of the refrigeration system.

.2 Install piping, components, equipment, etc., in accordance with schematics, code and standard industry practice.

.3 During brazing procedures, charge piping with inert gas to prevent scale formation.

.4 Pressure tests: Prior to application of insulation and dehydration, test all systems under pressure with nitrogen for 24 hours minimum until no pressure drop occurs. If leaks are detected, repeat test procedure after repairs. Test pressure according to manufacturer's requirement. As a minimum, test high side at 2100 kPa (300 psi) and low side at 1050 kPa (150 psi).

.5 Dehydration: Evacuate system, and hold for 24 hours minimum a vacuum of 99.9 KPa (29" HG). Break vacuum with refrigerant operating charge, monitor moisture indicators and change or replace filter/driers, or filter drier cores until moisture is eliminated.

.6 Start-up system, monitor operation and perform all tests to ensure system operates to manufacturer's requirements. Issue certificate attesting thereto.

.7 Instruct Owner in proper operating and maintenance procedures.

3.04 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.
.2 Remove valve internal parts, solenoid valve coils, sight glass.
.3 Do not apply heat near expansion valve and bulb.

3.05 PIPING INSTALLATION

.1 General:
  .1 Hard drawn copper tubing: do not bend. Minimize use of fittings.
.2 Hot gas lines:
  .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
  .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
  .3 Provide inverted deep trap at top of risers.
  .4 Provide double risers for compressors having capacity modulation.
    .1 Large riser: Install traps as specified.
    .2 Small riser: Size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.06 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.
.2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.
.3 Test Procedure: Build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.07 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
  .1 Close service valves on factory charged equipment.
.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
.3 Use copper lines of largest practical size to reduce evacuation time.
.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
  .1 Twice to 14 Pa absolute and hold for 4 h.
  .2 Break vacuum with refrigerant to 14 kPa.
  .3 Final to 5 Pa absolute and hold for at least 12 h.

.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
.5 Submit test results to Consultant.

.7 Charging:
.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:
.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
.2 Record and report measurements to Consultant.

.9 Manufacturer's Field Services:
.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Schedule site visits, to review Work, at stages listed:
.1 After delivery and storage of products and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of the Work, after cleaning is carried out.
.4 Obtain reports, within 3 days of review and submit, immediately, to Consultant.

.10 Verification requirements in accordance with Division 01, include:
.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource re-use.
.5 Recycled content.
.6 Local/regional materials.
.7 Certified Wood.
.8 Low-emitting materials.

3.08 DEMONSTRATION

.1 Instructions:
.1 Post instructions in frame with glass cover in accordance with Division 01 to suit Close-out Submittals and CSA B52.

3.09 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 23 00

PART 1 - GENERAL

1.01 GENERAL

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 For flexible ductwork please refer to section 23 33 46.

1.02 SUMMARY

.1 Section includes:
- .1 Materials and installation for ductwork and accessories including plenums and casings.
- .2 Sustainable requirements for construction and verification.

.2 Related Sections:
- .1 Division 01
  - .1 Construction Progress Schedules
  - .2 Submittal Procedures
  - .3 Health and Safety Requirements
  - .4 Quality Control
  - .5 Sustainable Requirements
  - .6 Construction/Demolition Waste Management and Disposal
  - .7 Close-out Submittal**s**

1.03 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
- .1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
- .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.04 SUBMITTALS

.1 Submittals in accordance with Division 01.

.2 Co-ordinate submittal requirements and provide submittals required by Division 01.

.3 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
  - .1 Flexible connections.
  - .2 Duct access doors.
  - .3 Turning vanes.
  - .4 Instrument test ports.
- .2 Submit WHMIS MSDS in accordance with Division 01. Indicate VOC's for adhesive and solvents during application and curing.

.4 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  .1 Certification of ratings: Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
.5 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.6 Instructions: Submit manufacturer's installation instructions.
.7 Manufacturer's Field Reports: Manufacturer's field reports specified.
.8 Close-out submittals: Submit maintenance and engineering data for incorporation into manual specified in Division 01.

1.05 QUALITY ASSURANCE

.1 Pre-Installation Meetings:
  .1 Convene pre-installation meeting **one** week prior to beginning work of this Section and on- site installations in accordance with Division 01.
    .1 Verify project requirements.
    .2 Review installation conditions.
    .3 Co-ordination with other building subtrades.
    .4 Review manufacturer's installation instructions and warranty requirements.
.2 Health and Safety:
  .1 Do construction occupational health and safety in accordance with Division 01.
.3 Construction requirements: In accordance with Division 01 Verification: Contractor's verification in accordance with Division 01.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

.1 Materials and resources in accordance with Division 01.

2.02 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.03 DUCTWORK

.1 Provide rectangular and round ductwork constructed of ASTM A525 hot dip galvanized steel sheets in arrangements as shown on the Drawings complete with reinforcement, hanging methods, joints, seams and fittings as specified in Sections I through 5 as well as appendices A-1 through A-32 in the SMACNA HVAC Duct Construction Standards - Metal and Flexible latest version.

.1 For exhaust, return and air supply systems where system static pressure does not exceed
0.124 kPa (½" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-3.

.2 For exhaust, return and air supply systems where system static pressure does not exceed
0.248 kPa (1" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-4.

.3 For exhaust, return and air supply systems where system static pressure does not exceed
0.496 kPa (2" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-5.

.4 For exhaust, return and air supply systems where system static pressure does not exceed 0.744 kPa (3" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-6.

.5 For exhaust, return and air supply systems where system static pressure does not exceed 1.0 kPa (4" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-7.

.6 For exhaust, return and air supply systems where system static pressure does not exceed
1.5 kPa (6" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-8.

.7 Cross break all ductwork greater than 300mm (12") in width.

.2 Factory fabricated rectangular and round sheetmetal ductwork, factory fabricated "Spirosafe" ductwork and gasketed self sealing fittings as manufactured by Lindab Inc. to Lindab published specifications (manufacture and installation) and performing to specified system static pressure requirements is also acceptable.

.3 Button lock longitudinal seam may be used on systems up to 0.125 kPa (½" w.g.) positive or negative static pressure.

.4 Shower room exhaust ductwork: constructed of 316 stainless steel. Provide stainless steel hangers and stainless steel screws.

.5 Provide balancing dampers at all connections to ceiling diffusers.

.6 In place of duct joints previously specified, "Nexus" or "Ductmate" gasketed flanges, installed to Manufacturer's instructions, may be used provided gasketing meets approval of ULC and installation is to SMACNA Standards.

2.04 PLENUMS AND CASINGS

.1 All apparatus sheet metal connections, plenum chambers and casings above 400mm (16") in any dimension, or air handling unit casings: 20 gauge galvanized steel sheet as shown on the Detail Drawings, reinforced with 40mm x 40mm x 5mm (12" x 12" x 3/16") galvanized steel angles.

.2 Refer to detail drawings regarding air handling unit plenum access doors, drip trays and coil

mounting, construction details.

.3 Special prefabricated enclosures: Provide, in the configurations and dimensions shown on the drawings, built-up system enclosures constructed of prefabricated acoustic panels complete with access doors.

.1 Side and top Panels: 100mm (4") nominal thickness consisting of 72 kg/m; (4.5 lbs/ft;) density insulation packed between 18 ga. galvanized steel outer shell and 22 ga. galvanized perforated steel inner shell, reinforced by 10 ga. galvanized steel channels spot welded or riveted in place. Panel joints: Interlocking tongue and groove design. Trim angles: 16 ga. galvanized steel.

.2 Doors: 600mm x 1500mm (24" x 60") located as shown on the drawings constructed in the same manner as the panels except with solid sheets both sides, and complete with two butt hinges, two camlocking latches operable from inside and outside with single air seal gasket. Door action: To swing open against plenum pressure.

.3 Acceptable Manufacturers: Vibron, Vibro Acoustics.

.4 Submit shop drawings for all field or shop fabricated plenums, casings and enclosures.

2.05 SEALANTS

.1 Duct Sealants

.1 Provide water based duct sealant, Unimastic 181 as manufactured by United McGill Corporation, conforming to NFPA 90A, 90B and ASTM E 84 requirements and with UL classification of 0 flame spread and smoke development based on a .0028 mm (0.011 inch) thick application and UL test methods.

.2 Sealant to comply with ASHRAE 90.1-2010 and SMACNA leakage requirements and be unyielding up to 10 times operating stress and permanently flexible when cured.

.3 Sealant odour to be mild and non-irritating when wet and be odourless when dry.

.2 Internal Insulation Sealants

.1 Provide Superseal joint and edge sealants on internal duct insulation as manufactured by Shuller.

.2 Sealant to be acrylic polymer conforming to ASHRAE 62-89 as well as ASTM G-21 and G- 22 for prevention of fungus and bacterial growth.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 DUCT INSTALLATION

.1 Install all ductwork and fittings using crossbreaking, joining, attachment and hanging methods as specified in the SMACNA HVAC Duct Construction Standards - Metal and Flexible 1995.

.2 Provide hangers for rectangular and round ductwork as specified in tables 4-1 and 4-2 as specified in the SMACNA HVAC Duct Construction Standards - Metal and Flexible 1985.

.3 Refer to Section 20 05 10, Air and Water Balancing and Testing for testing requirements and procedures.

.4 Ground across flexible connectors with No. 2/0 braided copper strap.

.5 Install balancing dampers at branch ducts and where indicated on the Drawings.
.6 Sealing of ductwork and plenums:
.1 Apply sealant on all seams and joints on all air supply, return and exhaust ducts and all plenums in accordance with ASHRAE 90.1-2010 and as described in the SMACNA HVAC Duct Construction Standards (latest version). In case of conflicts between the standards or codes, the stringent requirement takes precedence. Apply sealants on all seams and joints on built-up air handling unit casings.
.2 Refer to article 6.4.4.2 of ASHRAE 90.1-2010. Ductwork and all plenums are to be constructed to seal class A. Openings for rotating shafts to be sealed with bushings or other devices that seal off air leakage. Pressure sensitive tape is not to be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent laboratory and the tape is used in accordance with that certification. All connections such as spin-ins, taps, branch connections, access doors, access panels and duct connection to equipment are to be sealed.
.3 Refer to SMACNA HVAC Duct Construction Standards Table 1-1 for Pressure Classification For Ductwork.
.7 Where interior of duct is visible through grilles, registers or diffusers, paint interior of duct with flat black Tremco paint formulated for galvanized surfaces.
.8 Apply full coverage of adhesive (all internal surfaces) for internal insulation.
.9 Apply internal insulation edge, joint and pin sealant to manufacturer's instructions. Thoroughly seal all exposed edges, perforations and joints on internal duct lining.
.10 Ductwork installed outdoors (not externally insulated): Seal all joints with paintable Silicon caulking compound.
.11 Provide spin on connections c/w dampers at each boot or plenum supplying integrated ceiling air supply outlets.
.12 During installation of ductwork, protect open ends of ducts to prevent entry of debris and dust.
.13 Place ductwork as close as possible to partitions where shown on the Drawings in such locations.
.14 All outdoor air intake and exhaust systems are to be equipped with motorized dampers. Unless noted otherwise, back draft gravity dampers are acceptable with a design capacity of 141 l/s (300 cfm) or less

3.03 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product[s] and submit written reports, in acceptable format, to verify compliance of Work with Contract.
.2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Schedule site visits, to review work, at stages listed:
.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of the Work, after cleaning is carried out.
.4 Obtain reports, within **3** days of review, and submit, immediately, to Consultant.

.2 Verification requirements in accordance with Division 01, include:
- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource re-use.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Certified Wood.
- .8 Low-emitting materials.

.3 Refer to detail drawings in the Specifications and layouts and arrangements as shown on the Drawings. Install hinged doors to swing outward on the suction side of the fan and inward where a positive pressure may exist in the plenum. Provide gasketing around all doors and seal all seams and joints with high velocity duct sealer. Construct coil mounting racks to ensure convenient filter removal and replacement. Provide two coats of mastic compound on inner surface of drip trays. Seal all joints in filler pieces to prevent bypass and install filter banks for easy servicing.

Provide independently gasketed removable panels for access to coils and coil headers. Provide split escutcheon plates with gasketing, securely screwed in place, at all points where panels are penetrated by piping and conduit.
Where fabricated panels are placed near walls, provide 50mm (2") spacing to prevent vibration transmission.

3.04 DUCTWORK PRESSURE CLASSIFICATION

.1 Unless noted in paragraph .2 below, all ducts downstream of the supply fans are not designed to operate in excess of 750 kpa (3”0) and shall be leak tested according to SMACNA 1985.

.2 Ductwork pressure classification downstream of the following fan systems are higher than 750 kPa (3”):

Fan System Ref	Location/ Service	Fan Design SP kPa (in)	Fan Discharge Design SP kPa (in)	Remark
N/A				

3.05 AIR BALANCING

.1 Air balancing is specified in Section 20 05 10 Basic Materials and Methods.

.2 Provide personnel, tools and materials to assist and work under the direction of the air balancing firm to perform the following:
- .1 Removal and replacement of ceiling tiles.
- .2 Installation of pitot tube test opening enclosures.
- .3 Installation of dampers and baffles as required for specified air balance and elimination of stratification.
- .4 Provision of access openings and covers.
- .5 Provision of ladders and scaffolds
- .6 Removal and replacement of belt guards.
- .7 Removal and replacement and provision of required sheaves and belts as directed, and other items as necessary for complete and acceptable air balancing procedures.

3.06 VIBRATION AND OBJECTIONABLE NOISE

.1 Install ductwork free from pulsation, chatter, vibration or objectionable noises. Should any of these defects appear after the system is in operation, correct same by either removing and replacing or reinforcing the work as directed by the Consultant.

3.07 FLASHING

.1 Provide flashings to suit installation.
.2 Follow detail Drawings for vents and pipes penetrating roofs.

3.08 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 31 13

PART 1 - GENERAL

1.01 SUMMARY

.1 Section includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars, balancing dampers, fire and smoke dampers.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Division 01

.1 Construction Progress Schedules

.2 Submittal Procedures

.3 Health and Safety Requirements

.4 Quality Control

.5 Sustainable Requirements

.6 Construction/Demolition Waste Management and Disposal

.7 Close-out Submittals

1.02 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.03 SUBMITTALS

.1 Submittals in accordance with Division 01.

.2 Co-ordinate submittal requirements and provide submittals required by Division 01.

.3 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

.5 Balancing dampers

.6 Fire dampers and smoke dampers

.1 Operators.

.2 Fusible links.

.3 Design details of breakaway joints.

.2 Submit WHMIS MSDS in accordance with Division 01. Indicate VOC's for adhesive and solvents during application and curing.

.4 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
.1 Certification of ratings: Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
.5 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.6 Instructions: Submit manufacturer's installation instructions.
.7 Manufacturer's Field Reports: Manufacturer's field reports specified.
.8 Close-out submittals: Submit maintenance and engineering data for incorporation into manual specified in Division 01.

1.04 QUALITY ASSURANCE

.1 Pre-Installation Meetings:
.1 Convene pre-installation meeting one week prior to beginning work of this Section and on- site installations in accordance Division 01.
.1 Verify project requirements.
.2 Review installation conditions.
.3 Co-ordination with other building subtrades.
.4 Review manufacturer's installation instructions and warranty requirements.
.2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Division 01.
.3 Construction requirements: In accordance with Division 01.
.4 Verification: Contractor's verification in accordance with Division 01

1.05 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

.1 Materials and resources in accordance with Division 01.

2.02 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.03 FLEXIBLE CONNECTIONS

.1 Frame: Galvanized sheet metal frame 3 mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire-resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m^2.

2.04 ACCESS DOORS IN DUCTS

.1 Ductwork: Provide latched access doors where required constructed of No. 22 gauge materials with flat iron or angle iron stiffening frame so constructed that the door can be operated without twisting or distortion. Doors in insulated ductwork: double panel construction with a 25mm (1") insulating filler.
.2 Access panels for kitchen exhaust duct shall be listed and shall have a gasket or sealant that is rated for 815.6 C (1,500 F) and shall be grease tight.
.3 Acceptable alternative: for non hinged type, provide cam-latched insulated access doors model 08 as manufactured by Nailor Industries Inc.
.4 Non-Insulated Ducts: Sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
.5 Insulated Ducts: Sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
.6 Gaskets: neoprene
.7 Hardware:
.1 Up to 300 x 300 mm: Two sash locks complete with safety chain.
.2 301 to 450 mm: Four sash locks complete with safety chain.
.3 451 to 1000 mm: Piano hinge and minimum two sash locks.
.4 Doors over 1000 mm: Piano hinge and two handles operable from both sides.
.5 Hold open devices.

2.05 TURNING VANES

.1 Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.06 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.
.2 Cam lock handles with neoprene expansion plug and handle chain.
.3 28 mm minimum inside diameter. Length to suit insulation thickness.
.4 Neoprene mounting gasket.

2.07 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
.2 Sheet metal thickness to co-responding round duct standards.

2.08 SPLITTER DAMPERS

.1 Provide splitter dampers as described in the detail drawings.

2.09 QUADRANT DAMPERS

.1 Construct quadrant dampers of not less than 22 gauge material. Where installed in ducts up to 300mm (12") deep, provide single blade, and in ducts greater than 300mm (12") provide multi-blade with linkages, each blade being not wider than 228mm (9").

2.10 MOTORIZED DAMPERS

.1 Refer to Section 23 33 10.
.2 Motorized dampers actuators are specified in Building Automation, Section 25 01 01.

2.11 FIRE DAMPERS AND CEILING DAMPERS

.1 Refer to Section 23 33 10.

2.12 COMBINATION FIRE AND SMOKE DAMPERS

.1 Refer to Section 23 33 10.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

.1 Flexible Connections:
  .1 Install in following locations:
    .1 Inlets and outlets to supply air units and fans.
    .2 Inlets and outlets of exhaust and return air fans.
    .3 As indicated.
  .2 Length of connection: **100** mm.
  .3 Minimum distance between metal parts when system in operation: **75** mm.
  .4 Install in accordance with recommendations of SMACNA.
  .5 When fan is running:
    .1 Ducting on sides of flexible connection to be in alignment.
    .2 Ensure slack material in flexible connection.
.2 Access Doors and Viewing Panels:
  .1 Size:
    .1 900 x 900 mm for person size entry.
    .2 600 x 600 mm for servicing entry.
    .3 300 x 600 mm for viewing.
    .1 As indicated.

  .2 Locations:
    .1 Fire and smoke dampers.
    .2 Control dampers.
    .3 Devices requiring maintenance.
    .4 Required by code.

.5 Reheat coils.
.6 Elsewhere as indicated.

.3 Instrument Test Ports:
.1 General:
.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
.2 Locate to permit easy manipulation of instruments.
.3 Install insulation port extensions as required.
.4 Locations:
.1 For traverse readings:
.1 Ducted inlets to roof and wall exhausters.
.2 Inlets and outlets of other fan systems.
.3 Main and sub-main ducts.
.4 and as indicated.
.2 For temperature readings:
.1 At outside air intakes.
.2 In mixed air applications in locations as approved by the Consultant.
.3 At inlet and outlet of coils.
.4 Downstream of junctions of two converging air streams of different temperatures.
.5 And as indicated.

.4 Turning vanes:
.1 Install in accordance with recommendations of SMACNA and as indicated.

.5 Fire Dampers and Ceiling Dampers
.1 Install to ULC requirements. Locate in fire walls, ceilings and partitions where indicated.
Coordinate with and provide ULC installation details to drywall installer.
.2 Seal around fire damper assembly.
.3 After completion, have installation approved prior to concealment.

3.03 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product**[s]** and submit written reports, in acceptable format, to verify compliance of Work with Contract.
.2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review work, at stages listed:
.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
.2 Twice during progress of Work at 25% and 60% complete.
.3 Upon completion of the Work, after cleaning is carried out.
.4 Obtain reports, within **3** days of review, and submit, immediately, to Consultant.

.2 Verification requirements in accordance with Division 01 to include:
.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource re-use.
.5 Recycled content.
.6 Local/regional materials.
.7 Certified Wood.
.8 Low-emitting materials.

3.04 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 33 00

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Fire and smoke dampers and fire stop flaps.

.2 Operating dampers and Balancing dampers for mechanical forced air ventilation and air conditioning systems.

.3 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Division 01

.1 Construction Progress Schedules

.2 Submittal Procedures

.3 Health and Safety Requirements

.4 Quality Control

.5 Sustainable Requirements

.6 Construction/Demolition Waste Management and Disposal

.7 Close-out Submittals

1.02 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A653/A653M-[04a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.3 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

.1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S112, Fire Test of Fire Damper Assemblies.

.2 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.

.3 ULC-S505, Fusible Links for Fire Protection Service.

1.03 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 and to suit Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 and to suit Submittal Procedures.
.2 Indicate the following as required:
.1 Performance data.
.2 Fire dampers.
.3 Smoke dampers.
.4 Combination fire/smoke dampers
.5 Fire stop flaps.
.6 Operators.
.7 Fusible links.
.8 Design details of break-away joints.

.2 Quality assurance submittals: Submit following in accordance with Division 01 and to suit Submittal Procedures.
.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.2 Instructions: Submit manufacturer's installation instructions.

.3 Closeout Submittals
.1 Provide maintenance data for incorporation into manual specified in Division 01 and to suit Closeout Submittals.

1.04 QUALITY ASSURANCE

.1 Health and Safety Requirements:
.1 Do construction occupational health and safety in accordance with Division 01 and to suit Health and Safety Requirements.

.2 Certificates:
.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

1.05 MAINTENANCE

.1 Extra Materials:
.1 Provide maintenance materials in accordance with Division 01 and to suit Close-out Submittals.
.2 Provide following:
.1 6 fusible links of each type.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01 and to suit Sustainable Requirements: Construction.

2.02 GENERAL

.1 Manufacture to SMACNA standards.

2.03 MULTI-LEAF DAMPERS

.1 Opposed and or parallel blade type as indicated.
.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
.3 Pressure fit self-lubricated bronze bearings.
.4 Linkage: Plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
.5 Performance:
  .1 Leakage: In closed position less than 2% of rated air flow at 250 Pa differential across damper.
  .2 Pressure drop: At full open position less than 36 Pa differential across damper at 5.08 m/s.
.6 Insulated aluminum dampers:
  .1 Frames: Insulated with extruded polystyrene foam with RSI 0.88.
  .2 Blades: Constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.04 DISC TYPE DAMPERS

.1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
.2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
.3 Gasket: Extruded neoprene, field replaceable, with 10 year warranty.
.4 Bearings: Roller self-lubricated and sealed.
.5 Operator: Compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.
.6 Performance:
  .1 Leakage: In closed position less than 0.001 % of rated airflow at 125 kPa pressure differential across damper.
  .2 Pressure drop: At full open position less than 36 kPa differential across damper at 5.08 m/s.

2.05 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi or single leaf, aluminum construction with nylon bearings, centre pivoted, spring assisted.

2.06 RELIEF DAMPERS

.1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at 36 Pa static pressure.

2.07 SPLITTER DAMPERS

.1 Provide splitter dampers as described in the detail drawings.
.2 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
.3 Single thickness construction.
.4 Control rod with locking device and position indicator.
.5 Rod configuration to prevent end from entering duct.
.6 Pivot: Piano hinge.
.7 Folded leading edge.

2.08 QUADRANT DAMPERS

.1 Construct quadrant dampers of not less than 22 gauge material. Where installed in ducts up to 300mm (12") deep, provide single blade, and in ducts greater than 300mm (12") provide multi-blade with linkages, each blade being not wider than 228mm (9").

2.09 MOTORIZED DAMPERS

.1 Standard Dampers for Return Air: TAMCO series 1000 supplied by the automatic control manufacturer. Provide parallel blade type for mixing applications. All bearings to be "oilite" bronze. Size all dampers as NET dimensions (damper blade area = duct cross sectional area) as shown on drawings.
.2 Low Leakage Dampers for Outdoor Intake and Exhaust Applications: Provide, in sizes and in locations as shown on the drawings, parallel blade (air flow directed upwards) extruded aluminium Tamco air foil dampers series 9000 as manufactured by T.A. Morrison with features as follows:
  .1 1% leakage at 1 kPa (4") static pressure differential.
  .2 12 ga. extruded aluminium air foil single unit internally reinforced blades with continuous extruded overlapping vinyl seals.
  .3 12 ga. extruded frame with extruded vinyl seals on all sides.
  .4 Out-of-airstream aluminium alloy linkages and crank arms with celcon bearings.
  .5 Celcon and polycarbonate bearings with no metal to metal contact.
.3 Sized for "flanged" installation (damper blade area to be equal to duct cross sectional area).
.4 Actuators are specified in Building Automation, Section 25 01 01

2.10 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
.3 Locking quadrant with shaft extension to accommodate insulation thickness.
.4 Inside and outside nylon end bearings.
.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.11 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.
.2 Opposed blade: Configuration, metal thickness and construction to recommendations of SMACNA.
.3 Maximum blade height: 100 mm.
.4 Bearings: self-lubricating nylon.
.5 Linkage: Shaft extension with locking quadrant.
.6 Channel frame of same material as adjacent duct, complete with angle stop.
.7 Maximum leakage: 1 % at 250 Pa.

2.12 FIRE DAMPERS AND CEILING DAMPERS

.1 Provide ULC labelled and listed units as manufactured by Controlled Air Manufacturing Ltd. type "B" or "C" gravity or spring type.
.2 Provide Fire Dampers in sizes and in arrangements to suit openings shown on the drawings to ULC requirements as they relate to maximum sizes permissible in the applicable fire separation construction. Where installed in metal studs walls, comply with ULC requirements and advise other affected Trades i.e. stud and drywall installers.
.3 Do not use asbestos in any form in the construction of fire dampers or ceiling dampers.
.4 On ceiling dampers, in place of using ceiling tile material for diffuser protection as detailed, the CK2000 thermal blanket along with required transitions may be used.
.5 Other acceptable manufacturers: Ruskin, Kerr-Hunt, Nailor Industries, Air Balance of Canada Ltd.
.6 Fire dampers: Arrangement Type B or C, meet requirements of provincial fire authority and ANSI/NFPA 90A and Authorities having jurisdiction. Fire damper assemblies fire tested in accordance with CAN4-S112.
.7 Mild steel, factory fabricated for fire-rating requirement to maintain integrity of fire wall and/or fire separation.
    .1 Fire dampers: 1-½ hour fire-rated unless otherwise indicated.
    .2 Fire dampers: Automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.8 Top hinged: Offset single damper, round or square; multi-blade hinged or guillotine type; sized to maintain full duct cross section.

.9 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.10 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.11 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.12 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.13 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.14 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.15 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.13 SMOKE DAMPERS

.1 Smoke Dampers: To be ULC or UL listed and labelled.

.2 Normally closed reverse action smoke vent (S/D-RASV): Folding blade type, opening by gravity upon detection of smoke, and from remote alarm signalling device actuated by an electro thermal link**.** Two flexible stainless steel blade edge seals to provide required constant sealing pressure.

.3 Normally open smoke/seal (S/D-SSSD): Folding blade type, closing when actuated by means of electro thermal link and from remote alarm signaling device. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts.

.4 Motorized (S/D-M): Folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.

.5 Electro thermal link (S/D-ETL): Dual responsive fusible link which melts when subjected to local heat of 74 degrees C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.

2.14 COMBINATION FIRE AND SMOKE DAMPERS

.1 Provide where shown on the Drawings combination fire/smoke dampers as manufactured by Controlled Air Manufacturing Limited model FSD-3V-S-57 ULC, listed and labelled. All damper units to be equipped with linkages for mounting of actuators for smoke control operation, fusible links for fire damper mode and micro switches for status signal (open and closed).

.2 Provide all required electric actuators, Belimo Model FSLF 120 or equivalent. Damper complete with actuators including linkages, power wiring and all required components for activation from smoke detector system. Also provide, as required, relays adjacent to the actuators for interface to fire alarm system by Division 26. Wire relays to actuators. Dampers shall be tested the manufacturer per applicable codes.

.3 Micro switches to be dust tight with flexible steel levers - malleable metal not acceptable.

.4 Other Acceptable manufacturers: EH Price, Ruskin, Kerr-Hunt, Nailor Industries.

.5 Damper: Similar to smoke dampers specified above.

.6 Combined actuator: Electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

2.15 FIRE STOP FLAPS

.1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN4-S112.2.

.2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.

.3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C, or as indicated.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.4 Run-outs to registers and diffusers: Install single blade damper located as close as possible to main ducts.

.5 Seal multiple damper modules with silicon sealant.

.6 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.7 Dampers: Vibration free.

.8 Ensure damper operators are observable and accessible.

.9 Corrections and adjustments conducted by Engineer.

.10 Fire Dampers, Smoke Dampers, Ceiling Dampers and Fire Stop Flaps

.1 Fire Dampers and Ceiling Dampers

.1 Install to ULC requirements. Locate in fire walls, ceilings and partitions where indicated. Coordinate with and provide ULC installation details to drywall installer.

.2 Seal around fire damper assembly.

.3 After completion, have installation approved prior to concealment.

.2 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.3 Maintain integrity of fire separation.

.4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.5 Co-ordinate with installer of firestopping.

.6 Ensure access doors/panels, fusible links damper operators are easily observed and accessible.

.7 Install break away joints of approved design on each side of fire separation.

3.03 FIELD QUALITY CONTROL

.1 Tests:

.1 Tests to cover period of not less than 30 days and demonstrate that system is functioning as specified.

.2 Verification requirements in accordance with Division 01 and to suit Sustainable Requirements, include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource re-use.

.5 Recycled content.

.6 Local/regional materials.

.7 Low-emitting materials.

3.04 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 33 10

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Materials and installation of flexible ductwork, joints and accessories.

.2 Sustainable requirements for construction and verification.

.3 Related Sections:

.1 Division 01

.1 Submittal Procedures

.2 Health and Safety Requirements

.3 Sustainable Requirements: Construction

.4 Sustainable Requirements: Contractor's Verification

.5 Construction/Demolition Waste Management and Disposal**]**

1.02 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.2 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.4 National Fire Protection Association (NFPA).

.1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.

.5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, (Addendum No.1, November 1997).

.2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition.

.6 Underwriters' Laboratories Inc. (UL).

.1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.

.7 Underwriters' Laboratories of Canada (ULC).

.1 CAN/ULC-S110, Fire Tests for Air Ducts.

1.03 SUBMITTALS

.1 Make submittals in accordance with Division 01.

.2 Co-ordinate submittal requirements and provide submittals required by Division 01

.3 Submit Indoor Air Quality (IAR) Management Plan in accordance with Division 01.
.4 Product Data: Submit WHMIS MSDS in accordance with Division 01 for the following:
  .1 Thermal properties.
  .2 Friction loss.
  .3 Acoustical loss.
  .4 Leakage.
  .5 Fire-rating.
.5 Samples: Submit samples with product data of different types of flexible duct being used in accordance with Division 01

1.04 QUALITY ASSURANCE

.1 Certification of Ratings:
  .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
.2 Health and Safety:
  .1 Do construction occupational health and safety in accordance with Division 01
.3 Sustainable Requirements:
  .1 Construction requirements: In accordance with Division 01
  .2 Verification: Contractor's verification in accordance with Division 01.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

.1 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01 for construction and preoccupancy phases of building.
.2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01

2.02 GENERAL

.1 Factory fabricated to CAN/ULC-S110.
.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.03 METALLIC – FLEXIBLE DUCTWORK

.1 Flexible ductwork: provide, where indicated on the Drawings, flexible ductwork bearing ULC Class 1 Label, insulated or acoustic, as manufactured by Flexmaster. Alpha Industries, or Thermaflex are acceptable alternative manufacturers.
.2 Refer to Section 23 33 53 for insulation requirement of flexible ducts.
.3 Use Flexmaster model T/L-VT and T/L-A for insulated and acoustic flexible ducts.
.4 Flexible duct to be manufactured of aluminum with a continuous seam capable of delivering air without leakage up to positive pressures of 3.0 kPa (12" w.g.) and negative pressure of 0.25 kPa (1" w.g).

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

.1 Install in accordance with: CAN/ULC-S110, UL-181, NFPA 90A, NFPA 90B and SMACNA.
.2 Install all ductwork and fittings using crossbreaking, joining, attachment and hanging methods as specified in the SMACNA HVAC Duct Construction Standards - Metal and Flexible 1995.
.3 Provide hangers for rectangular and round ductwork as specified in tables 4-1 and 4-2 as specified in the SMACNA HVAC Duct Construction Standards - Metal and Flexible 1985.
.4 Maximum installed length: One continuous length at 1600 mm (5' 0"). [Use standard sheetmetal elbows at drop points to outlets. Refer to detail drawings.] [do not bend flexible ductwork any greater than 1.5 X diameter].

3.02 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01, include:
.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource re-use.
.5 Recycled content.
.6 Local/regional materials.
.7 Low-emitting materials.

3.03 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 33 46

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Materials and installation for acoustic duct lining.

.2 Related Sections:

.1 Division 01

.1 Submittal Procedures

.2 Health and Safety Requirements

.3 Sustainable Requirements

.4 Construction/Demolition Waste Management and Disposal

1.02 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.2 ASTM C916, Standard Specification for Adhesives for Duct Thermal Insulation.

.3 ASTM C1071, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.4 ASTM C1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

.5 ASTM G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.4 National Fire Protection Association (NFPA).

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.5 North American Insulation Manufacturers Association (NAIMA).

.1 NAIMA AH116- 5th Edition, Fibrous Glass Duct Construction Standards.

.6 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).

.1 SMACNA, HVAC DCS, HVAC, Duct Construction Standards, Metal and Flexible.

.2 SMACNA IAQ Guideline for Occupied Buildings 95.

.7 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.8 Underwriter's Laboratories of Canada (ULC).

.1 CAN/ULC-S102, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.03 SUBMITTALS

.1 Submit product data in accordance with Division 01.
.2 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Division 01
.3 Submit Indoor Air Quality (IAQ) Management Plan in accordance with Division 01

1.04 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Division 01.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for re-use and recycling in accordance with Division 01.
.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
.4 Place materials defined as hazardous or toxic in designated containers.
.5 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.
.6 Ensure emptied containers are sealed and stored safely.
.7 Fold up metal banding, flatten and place in designated area for recycling.

1.07 SUSTAINABLE REQUIREMENTS

.1 Construction requirements detailed in Division 01 form integral part of this project including materials and products of this Section. Sustainable construction requirements include:
  .1 Specific construction requirements for project.
  .2 Specification text to ensure that project will comply with green design process and sustainability requirements.
  .3 Administrative, temporary and procedural requirements for the use of materials and methods of construction.
.2 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01 for construction and preoccupancy phases of building.
.3 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01.

2.02 DUCT LINER

.1 General:
- .1 One inch thick Flexible coated glass fibre blanket with noise absorbing properties to ASTM C 1071with NRC not less than .70, thermal performance of .70 m^2 C/W, in conformance to ASHRAE 62-89 and in compliance with CGSB 51-GP-11M, CAN/ULC S102-M88 and NFPA 90A and 90B.
- .2 Surface burning characteristics: flame spread not exceed 25 and smoke development not to exceed 50.
- .3 Maximum velocity: 20.3 m/sec (4000 fpm).
- .4 Non supportive of microbial growth when surfaces maintained in clean condition.
- .5 Acceptable Manufacturers: Schuller, Knauf, Microtex, Certainteed, Owens-Corning.
- .6 Duct liner sealants:
  - .1 Superseal joint and edge sealants on internal duct insulation as manufactured by Shuller.
  - .2 Sealant to be acrylic polymer conforming to ASHRAE 62-89 as well as ASTM G- 21 and G-22 for prevention of fungus and bacterial growth.

.2 General:
- .1 Mineral fibre duct liner: Air surface coated mat facing.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102 and NFPA 90A.
- .3 Recycled Content: EcoLogo certified with minimum 35 % by weight recycled content.
- .4 Fungi resistance: To ASTM C1338

.3 Rigid:
- .1 Use on flat surfaces.
- .2 25 mm thick, to ASTM C1071 Type 2, fibrous glass rigid board duct liner.
- .3 Density: 48 kg/m^3minimum.
- .4 Thermal resistance to be minimum 0.76 (m^2. degrees C)/W for 25 mm thickness; 1.15 (m^2.degrees C)/W for 38 mm thickness; 1.53 (m^2.degrees C)/W for 50 mm thickness - when tested in accordance with ASTM C177, at 24°C mean temperature.
- .5 Maximum velocity on faced air side: 20.3 m/sec.
- .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.
- .7 Recycled Content: EcoLogo certified, containing minimum 45 % by weight recycled content.

.4 Flexible:
- .1 Use on round or oval surfaces.
- .2 25 mm thick, to ASTM C1071 Type **1**, fibrous glass blanket duct liner.
- .3 Density: 24 kg/m^3 minimum.

.4 Thermal resistance to be minimum 0.37 (m^2.degrees C)/W for 12 mm thickness; 0.74 (m^2.degrees C)/W for 25 mm thickness, 1.11 (m^2.degrees C)/W for 38 mm thickness; 1.41 (m^2.degrees C)/W for 50 mm thickness - when tested in accordance with ASTM C177 at 24°C mean temperature.

.5 Maximum velocity on coated air side: 25.4 m/sec.

.6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C423.

2.03 ADHESIVE

.1 Adhesive: To NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50.
Temperature range minus 29°C to plus 93°C.

.3 Water-based fire retardant type.

2.04 FASTENERS

.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

2.05 JOINT TAPE

.1 Poly-vinyl treated open weave fibreglass membrane **50** mm wide.

2.06 SEALER

.1 Meet requirements of NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50.
Temperature range minus 68°C to plus 93°C.

PART 3 - EXECUTION

3.01 GENERAL

.1 Do work in accordance with SMACNA HVAC DCS except as specified otherwise.

.2 Line inside of ducts where indicated. This includes supply air discharge from heat pumps and ERVs were indicated or detailed on drawings. Refer to drawings for locations.

.3 Duct dimensions, as indicated, are clear inside duct lining.

3.02 LINER INSTALLATION

.1 Install, with facing on the air stream side, to SMACNA HVAC Duct Construction Standards 1985 pages 2-25, 2-26 and 2-27 as well as in accordance with Fig. 2-22, 2-23,2-24 and 2-25.

.2 Adhesive: water proof in accordance to ASTM C-916. Coat and seal all insulation edges and joints.

.3 In air handling unit casings, imbed glassfab tape in the sealant at all insulation joints and edges and pin washers. Provide pins and washers for duct and unit casings per SMACNA Fig. 2-22 and 2-23.

3.03 LINER SCHEDULE

.1 Except where noted otherwise, provide ductwork liner as indicated in the following table:

Application	Thickness
1. Low pressure supply/return in conditioned space	1”
2. Low pressure supply in return air plenum	1”
3. Low pressure supply/return in unconditioned space or in plenums not used for return air whether or not above conditioned space	2”
4. Exhaust within 10 feet of fan inlet	2”
5. Sound isolation boots	1”
6. Exhaust within 5 feet of inlet grille	1”
8. Interior of air handling unit plenums	1"

Conditioned space: any space or plenum (i.e., above plaster or lay-in ceilings or the interior of an air handling unit or spaces without ceilings) where ambient temperature range of 10°c to 30°c may occur.

3.04 DUCT LINER

.1 Install in accordance with manufacturer's recommendations, and as follows:
- .1 Fasten to interior sheet metal surface with **100** % coverage of adhesive to ASTM C916
  - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
- .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres to compress duct liner sufficiently to hold it firmly in place.
  - .1 Spacing of mechanical fasteners in accordance with SMACNA HVAC DCS

.2 In systems, where air velocities exceeds 20.3 m/sec, install galvanized sheet metal noising to leading edges of duct liner.

3.05 JOINTS

.1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations and as follows:
- .1 Bed tape in sealer.
- .2 Apply two coats of sealer over tape.

.2 Replace damaged areas of liner at discretion of the Consultant.

.3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

3.06 VERIFICATION

.1 Verification requirements in accordance with Division 01, include:
- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource re-use.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Low-emitting materials.

3.07 OPERATION REQUIREMENTS

.1 Operational requirements in accordance with Division 01, include:
- .1 Cleaning materials and schedules.
- .2 Repair and maintenance materials and instructions.

3.08 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 33 53

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Section 20 05 05 Mechanical Work General Instructions and Section 20 05 10 Basic Mechanical Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide all silencers, properly selected to provide sound and vibration for all motor driven equipment.

1.03 QUALITY ASSURANCE

.1 Execute work of this section in accordance with the manufacturer's instructions by workman only experienced in the installation of vibration isolation systems and equipment.

.2 Silencers licensed to bear AMCA Certified Ratings Seal. Ratings based on tests and procedures performed in accordance with and complying with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to acoustical and aerodynamic performance. Dynamic Insertion Loss and Pressure Drop: Silencer dynamic insertion loss and pressure drop based on tests and procedures performed in accordance with ASTM E477 testing procedures

.3 Provide all equipment to control noise such that the average noise criteria curves for the conditioned occupied space, do not exceed NC35.

.4 Provide the inspection and supervision services of the noise control equipment. Manufacturer to ensure that during construction all equipment is installed as required to achieve specified performance.

.5 Meet seismic requirements of the current National Building Code for the Place of the Work.

.6 Silencers and any finishes to be ULC labelled and listed for flame spread rating of less than 25 and smoke development classification of less than 50.

1.04 SUBMITTALS

.1 Submit shop drawings on all required silencers detailing geometry and construction, dynamic insertion losses, pressure drops and regenerated noise.

.2 Provide certified test data or calculations as prepared by a registered Professional Engineer attesting to conformance with the requirements of this section.

PART 2 - PRODUCTS

2.01 SILENCERS

.1 Provide silencers as listed in the equipment schedules. Only silencers with duct to reverberant room insertion ratings will be accepted.

.2 Construction:

.1 ROUND: A minimum of 22 ga. G90 galvanized steel outer shell with lock formed mastic filled seams pre-fabricated, with 40 kg/m^3 (2 ½ lb/ft^3) density acoustic media packed under 10% compression and protection from air erosion by 22 ga. perforated galvanized steel liner, stream lined inlets and tapered diffuser outlets for maximum insertion loss and minimum pressure drop.

.2 RECTANGULAR: as above with acoustic media on all four sides whereby HTL to be externally applied and sealed to the silencer to assure quality controlled transmission loss. Construction of the HTL walls to be as required to obtain the specified room noise criteria (NC) level and to ensure noise "Break-out" is prevented.

.3 Interior baffles and bullet for standard rectangular straight, rectangular elbow and circular silencers shall be made of not less than 22 gauge and properly stiffened to ensure structural integrity; lock form quality, perforated steel, galvanized steel, Type G90.

.4 Construction: Sound attenuators capable of withstanding a differential air pressure of 8”
w.g. Airtight construction shall be provided by use of a duct sealing compound. HTL Casing: Silencer can be equipped with STC 45 High Transmission Loss casing to prevent breakout noise through side walls of unit.

.5 Where internal air velocities exceed 23 m/s (75 ft/s) provide additional Fiberglas cloth over perforated steel liner.

.6 Fire and smoke performance data derived from testing in accordance with ASTM E84, NFPA 255, UL-723 and ULC S102 testing methods. Incombustible filler material exhibits the following fire hazard classification values:

.1 FLAMESPREAD - 20

.2 SMOKE DEVELOPED - 20

2.02 MANUFACTURERS

.1 Acceptable Silencer Manufacturer: VBA Systems, Vibron, E H Price Ltd., IAC, Kinetics or VAW Systems.

PART 3 - EXECUTION

3.01 INSTALLATION

.1 Obtain all relevant equipment information and provide shop and installation drawings for all vibration isolation elements and steel bases. Include details of attachment to both the equipment and the structure to meet the specified forces involved. Do not perform any work or order any materials or equipment prior to review of shop and installation drawings by the Consultant.

.2 Use the lowest RPM scheduled for 2-speed equipment.

.3 Use Type 4 spring hangers for a minimum static deflection of 25 mm (1") for all ceiling hung fans, air handling units and emergency generator exhaust silencers.

.4 Spec note: use item J. if there is a concern about transmitting vibration noise from the mechanical room to the floor below – e.g. for high-end residential or hotel projects or as suggested by Acoustic Consultant.

3.02 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 33 55

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Fans, motors, accessories and hardware for commercial use.

.2 Sustainable requirements for construction and verification.

1.02 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

.1 AMCA Publication 99, Standards Handbook.

.2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.03 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: Obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: Flow rate, total and static pressure, bhp, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: Statically and dynamically balanced, constructed in conformity with AMCA 99.

.4 Sound ratings: Comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.

.5 Performance ratings: Based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.04 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01.

.2 Shop Drawings:

- .1 Submit shop drawings and product data in accordance with Division 01.
  - .1 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.

.3 Provide:
- .1 Fan performance curves showing point of operation, BHP and kW and efficiency.
- .2 Sound rating data at point of operation.

.4 Indicate:
- .1 Motors, sheaves, bearings, shaft details.
- .2 Minimum performance achievable with variable speed controllers if appropriate.

.5 Quality assurance submittals: Submit following in accordance with Division 01.
- .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: Submit manufacturer's installation instructions.

.6 Close-out Submittals:
- .1 Provide operation and maintenance data for incorporation into manual specified in Division 01.

1.05 QUALITY ASSURANCE

.1 Health and Safety Requirements: Do construction occupational health and safety in accordance with Division 01.

1.06 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials in accordance with Division 01.
  - .1 Spare parts to include:
    - .1 Matched sets of belts.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
  - .1 Bearings and seals.
  - .2 Addresses of suppliers.
  - .3 List of specialized tools necessary for adjusting, repairing or replacing.

1.07 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.08 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01.

2.02 FANS GENERAL

.1 Motors:
  .1 For use with variable speed controllers.
  .2 Sizes as indicated.
.2 Accessories and hardware: matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated. Inlet or outlet dampers and vanes and as indicated.
.3 Factory primed before assembly in colour standard to manufacturer.
.4 Scroll casing drains: As indicated.
.5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
.6 Vibration isolation: To Section 20 05 15 Seismic Control and Restraint and 20 05 20 Mechanical Vibration Control.
.7 Flexible connections: To Section 23 33 00 - Air Duct Accessories.

2.03 CENTRIFUGAL FANS

.1 Provide fans as indicated on the Drawings and in the equipment schedules, statically and dynamically balanced, constructed in conformance with AMCA 2408 69 and carrying the AMCA seal for sound and air flow performance.
.2 Bearings: Belted ventilating sets and Class I and Class II fans: Heavy duty ball bearings, grease lubricated self aligning pillow block. On arrangement III single inlet fans with ducted inlets, provide extended lubrication fittings.
.3 Provide continuously welded scrolls on all fans.
.4 Provide electric motors, disconnect switches (on roof mounted units), vibration isolators (refer to Section 20 05 20), belts, belt guards, weatherhoods where mounted outdoors and back draft dampers on exhaust fans.
.5 Provide integral bases on floor mounted Class I and Class II fans. Refer to Section 20 05 20 for requirements for inertia bases.

.6 Sheaves and Belts:
- .1 Provide variable pitch sheaves on fans up to and including 3.7 KW (5 HP) and fixed pitch double belt sheaves on fans up to 7.47 KW (10 HP). For fans 11.2 KW (15 HP) and greater, provide a minimum of three groove fixed sheaves. Provide two sets of sheaves; one set to provide specified RPM and another set as specified by the air balance firm should field testing make this necessary.
- .2 Provide premium quality oil resistant B or C section V belts. For fans 11.2 (15 HP) and greater, provide multi groove power band belts.
- .3 Submit sheave and belt selection data with shop drawings.

.7 Belt Guards: Provide expanded metal type with 25mm (1") dia. tachometer openings at both fan and motor shaft locations. Provide one opening with adjustable plate to compensate for motor position adjustment.

.8 On fans for variable air volume duty, provide variable frequency drives - refer to Sections 20 05 30 and 20 05 10 for motor and drive requirements.

.9 Acceptable Manufacturers:
- .1 Greenheck, Chicago Blower, Sheldons, Barry Blower, Trane, Joy, Woods, SF, New York Blower, Twin City, Northern Blower and Acme for Belted Vent Sets, Class I, Class II, in line and propeller applications.
- .2 Cook, Jenn Fan, Delhi, Lau, Greenheck, Aerovent, Acme, Penn and Carnes for Light Duty Roof and Sidewall Mounted Exhaust propeller, belted vent sets and Air Transfer.

2.04 CABINET FANS - GENERAL PURPOSE

.1 Fan characteristics and construction: For centrifugal fans.

.2 Cabinet hung single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, variable speed V-belt drive and guard inside casing.

.3 Fabricate casing of zinc coated or phosphate treated steel of 2 mm thickness reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to CAN/CGSB 1.181. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet with 50 mm thick rigid acoustic insulation, pinned and cemented, 3.0 kg/m^3density.

2.05 UTILITY SETS

.1 Characteristics and construction: for centrifugal fans.

.2 Pre-assemble single width centrifugal fan with removable weatherproof protective hood with vents, and automatic spring loaded back draft dampers and 12 mm mesh birdscreens.

.3 Provide belt driven sets with adjustable motor bed plate and variable pitch driver sheave.

2.06 ROOF AND INSIDE WALL FANS

.1 Characteristics and construction: as for centrifugal fan wheels, with axial flow construction and direct or belt drive.

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

2.07 PROPELLER FANS

.1 Fabricate multi-bladed propellers of aluminum of airfoil shape within bell mouth entrance on integral mounts, with grease lubricated ball bearings, with extended lubrication fittings, suited for operating in any position, direct or belt driven, complete with motor as indicated.

.2 Provide blade guards, bird screen and automatic back draft dampers on discharge, with gasketted edges.

2.08 VANE AXIAL FANS

.1 Provide belt driven constant volume vane axial fans as indicated on the Drawings and described in the equipment schedules, statically and dynamically balanced to maximum tolerance of 1 mil double amplitude at design operating speed and rated per AMCA Standard 210 74.

.2 Housing: Hot rolled steel with integral flanges 4.76mm ($3/16$") thick for fans up to 965mm (38") ID;
6.4mm (3") for fans 1067mm (42") ID and larger; continuously welded, mechanically expanded concentric, sandblasted and painted all sides, minimum of eight 4.76mm ($3/16$") thick stationary guide vanes and 12.7mm (2") thick steel motor support plate welded to housing.

.3 Rotor hub and blades: Cast aluminium; 356 T6 alloy heat treated for hub and 356 alloy for air foil blades with tip clearance of 1.27mm (0.050") for rotors up to 900mm (36") and not exceeding
4.57mm (0.180") for larger sizes.

.4 Motors: With ball bearings (20,000 Hr. B 10 Target Life); Class B insulation for operation in 400C ambient; extended lubrication fittings, NEMA Standard TEFC suitable for vertical and angular position; conduit box with air tight conduit on direct drive units.

.5 Supports: For horizontal or angular mounting; steel angles located on centre line of fan housing.

.6 Capacity adjustments where specified as constant volume: Blades to be adjustable to factory stamped graduations.

Variable speed with motor suitable for use with variable frequency drive - refer to Sections 20 05 30 and 20 05 10 for motor and drive requirements.

.7 Provide inlet bells, outlet or inlet cones and companion flanges.

.8 Provide, to current AMCA Standards, performance curves and sound power level data (PWL) re 10 12 watts for each of the 8 octave bands.

.9 Acceptable Manufacturers: Cook, Joy, Woods, Flakt, (Sheldons Axico), Greenheck.

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PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section 20 05 15 Seismic Control and Restraint and 20 05 20 Mechanical Vibration Control, flexible electrical leads and flexible connections in accordance with Section 23 33 00 Air Duct Accessories.
.2 Provide sheaves and belts required for final air balance.
.3 Bearings and extension tubes to be easily accessible.
.4 Access doors and access panels to be easily accessible.

3.03 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

3.04 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01, include:
.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource re-use.
.5 Recycled content.
.6 Local/regional materials.
.7 Low-emitting materials.

3.05 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 34 00

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 23 33 00 – Air Duct Accessories.

1.02 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: Obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.03 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.6 Trim

.7 Mounting details

.8 Frame details

.9 Backdraft damper or other balancing device where applicable.

.2 Samples:

.1 Submit samples in accordance with Division 01.

.3 Quality assurance submittals: Submit following in accordance with Division 01.

.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: Submit manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

.1 Health and Safety Requirements: Do construction occupational health and safety in accordance with Division 01.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 MAINTENANCE

.1 Extra Materials:
  .1 Provide maintenance materials in accordance with Division 01 and to suit Close-out Submittals.
  .2 Include:
    .1 Keys for volume control adjustment.
    .2 Keys for air flow pattern adjustment.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01

2.02 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.
.2 Frames:
  .1 Full perimeter gaskets.
  .2 Plaster frames where set into plaster or gypsum board.
  .3 Concealed fasteners.
.3 Concealed manual volume control damper operators.
.4 Colour: as directed by Consultant.

2.03 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.04 REGISTERS, GRILLES, DIFFUSERS

.1 Provide registers, grilles and diffusers by manufacturer and sizes, styles and finishes as scheduled on the Drawings.
.2 Ensure that the items supplied will be compatible with ceiling or wall construction.
.3 All linear diffusers to be provided with manual concealed volume control damper.
.4 All supply air diffusers to be provided with opposed blade damper.
.5 Equipment as manufactured by E.H. Price, Carnes, Barber Coleman, Titus, Nailor Industries, Tuttle & Bailey, Metalaire and Krueger is acceptable.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.
.2 Install with flat head screws in countersunk holes where fastenings are visible.
.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
.4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms.

3.03 GRILLES, REGISTERS AND DIFFUSERS

.1 Fit frame with gasket to prevent leakage, and smudging.
.2 Install with oval head plated screws in countersunk holes where fastenings are visible.
.3 Ensure unit is compatible with ceiling or wall construction.
.4 Make connections of rigid or flexible ductwork to diffusers, VAV terminals and air distribution boots using a minimum of 3 self tapping screws and seal with glass fab tape and high velocity duct sealer.

3.04 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01, include:
  .1 Materials and resources.
  .2 Storage and collection of recyclables.
  .3 Construction waste management.
  .4 Resource re-use.
  .5 Recycled content.
  .6 Local/regional materials.
  .7 Low-emitting materials.

3.05 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 37 13

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Mechanical louvres, intakes, vents and reinforcement and bracing for air vents, intakes and gooseneck hoods.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Refer to Architectural Specification and drawings for exterior louvres.

.2 Section 23 33 00 – Air Duct Accessories

1.02 REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)

.1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.5 Society of Automotive Engineers (SAE)

1.03 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.04 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01.

.2 Indicate following:
.1 Pressure drop.
.2 Face area.
.3 Free area.

.2 Quality assurance submittals: Submit following in accordance with Division 01.
.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.2 Instructions: Submit manufacturer's installation instructions.

.3 Test Reports:
.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.05 QUALITY ASSURANCE

.1 Health and Safety Requirements: Do construction occupational health and safety in accordance with Division 01.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01.

2.02 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

.1 Factory manufactured hinged at curb line.
.1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire.
.2 Horizontal backdraft dampers on two faces.
.3 Maximum throat velocity: 3.3 m/s
.4 Maximum loss through unit: 15 Pa static pressure.
.5 Maximum velocity through damper area: 1.5 m/s.
.6 Shape: as indicated on drawings.

2.03 GOOSENECK HOODS

.1 Thickness: To SMACNA.
.1 Kitchen: To ANSI/NFPA 96.
.2 Elsewhere: To SMACNA.

.2 Fabrication: To SMACNA.
  .1 Kitchen: To ANSI/NFPA 96.
  .2 Elsewhere: To SMACNA.
.3 Joints: To SMACNA.
.4 Supports: As indicated.
.5 Complete with integral birdscreen of 2.7 aluminum wire. Use 12 mm mesh on exhaust 19 mm mesh on intake.
.6 Vertical or Horizontal backdraft dampers on two faces.

2.04 FIXED LOUVRES

.1 Exterior louvres are specified in Division 08.
.2 Mechanical louvres are in Parking Levels and were indicated on Architectural and Mechanical drawings:

Stationary, extruded aluminum, site proof, weatherproof as manufactured by Airolite Type K 6776, 150mm (6") deep, 35º blades, complete with 12mm (2") mesh 16 ga. aluminum removable bird screen 50% minimum free area.

.3 Other acceptable manufacturers: Nlailor, Ruskin, Ventex, Construction Specialities.

2.05 ROOF MOUNTED LOUVRED ASSEMBLIES (EXHAUST AND INTAKE)

.1 As described on the Drawings, provide rainproof roof mounted louvred aluminium alloy exhaust and intake assemblies complete with bird screens as manufactured by Penn, Airolite or Greenheck.

2.06 WALL BOXES

.1 Provide where indicated on drawings single, double or triple weather proof wall boxes. Exhaust wallbox to be provided integral backdraft damper. A single coat of epoxy paint applied to the interior surface of the box and two coats of epoxy paint applied to the exterior to match mullion colour, coordinate with Architectural division. Tested to Static Test ASTM E331-00 and Cyclic Static Test ASTM E547-00 tested @ 700 Pa.
.2 Wall box to be provided with extruded aluminum grille.
.3 Insulate wall box on interior with closed cell polyurethane foam to achieve an R-value equal to that of the adjacent wall.
.4 Acceptable manufacturer Reversomatic model SWBW-8, DWBW-8, and TWBW-8 or equivalent.
.5 For combined intake and exhaust boxes provide Reversomatic model SVE 50.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.
.2 Reinforce and brace as indicated.
.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.03 OUTSIDE AIR AND EXHAUST LOUVRES

.1 Install to ULC requirements. Locate in fire walls, ceilings and partitions were indicated. Coordinate with and provide ULC installation details to drywall installer.
.2 Seal around fire damper assembly.
.3 After completion, have installation approved prior to concealment.

3.04 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01, include:
  .1 Materials and resources.
  .2 Storage and collection of recyclables.
  .3 Construction waste management.
  .4 Resource re-use.

3.05 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 37 20

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Filters and filter gauges for various types of mechanical air handling equipment.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 20 05 10 – Basic Mechanical Materials and Methods.

.2 Section 23 33 00 – Air Duct Accessories.

.3 Section 23 73 10 – Air Handling Units.

.4 Section 23 81 40 – Air & Water Source Unitary Heat Pumps

1.02 REFERENCES

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)

.1 ANSI/NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 52.1, Gravimetric and Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.

.3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.

.4 CAN/CGSB-115.13, Filter Media, Automatic Roll.

.5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.

.6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.

.7 CAN/CGSB-115.16-M82, Activated Carbon for Odour Removal from Ventilating Systems.

.8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.

.9 CAN/CGSB-115.20 Polarized Media Air Filter.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Underwriters' Laboratories of Canada ULC -S111, Standard Method of Fire Tests for Air Filter Units.

.1 ULC-S649, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

1.03 SUBMITTALS

.1 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01.

.2 Shop Drawings:
- .1 Submit shop drawings in accordance with Division 01.
- .2 Indicate the following:
  - .1 Filter construction
  - .2 Filter media
  - .3 Face velocity
  - .4 Pressure drop

.3 Quality Assurance Submittals: Submit following in accordance with Division 01.
- .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: Submit manufacturer's installation instructions.

.4 Close-out Submittals
- .1 Provide maintenance data for incorporation into manual specified in Division 01.

1.04 QUALITY ASSURANCE

.1 Health and Safety Requirements: Do construction occupational health and safety in accordance with Division 01.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials in accordance with Division 01.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
- .3 Spare filters: In addition to filters installed immediately prior to acceptance by the Consultant, supply one complete set of filters for each filter unit or filter bank in accordance with Division 01.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01.

2.02 GENERAL

.1 Media: Suitable for air at 100% RH and air temperatures between minus 40 and 50 degrees C.
.2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
.3 Pressure drop when clean and dirty, sizes and thickness: As indicated on schedule and other mechanical specification sections.

2.03 ACCESSORIES

.1 Holding frames: Permanent channel section construction of galvanized steel or extruded aluminum
1.6 mm thick, except where specified.

.2 Seals: To ensure leak-proof operation.
.3 Blank-off plates: As required, to fit all openings and of same material as holding frames.
.4 Access and servicing: through doors/panels on each side and/or from upstream face of filter bank.

2.04 FIBROUS GLASS PANEL FILTERS

.1 Disposable fibrous glass media: To CAN/CGSB-115.10 with adhesive.
.2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.
.3 Performance: minimum average synthetic dust weight arrestance 70 % to ASHRAE 52.
.4 Fire-rated: To ULC -S111.
.5 Nominal thickness: 100 mm.

2.05 FILTER SECTIONS

.1 Provide filter banks for built up air handling systems as shown on the Drawings consisting of framed units field assembled.
.1 Prefilter: 50mm (2") thick disposable ULC Class 2 listed and labelled with 85% to 90% arrestance.
.2 After Filter: ULC Class 2, 100mm (4") deep disposable filters with non-woven cotton fabric media pleated over a welded wire support grid bonded to a rigid high wet strength beverage board enclosing frame.
.3 Performance: 25% to 35% efficiency and 90% to 92% arrestance to ASHRAE arrestance
test standard 52 76.

.4 Maximum Face Velocity 2.54 m/s (500 ft./min.).
Holding Frame: Factory fabricated 16 ga. galvanized steel with gaskets and four spring type positive sealing fasteners per unit fasteners to be attached and removable without use of tools.
.5 Acceptable Manufacturers: Farr, Cambridge, American Air Filter.

2.06 GREASE FILTERS

.1 Media: washable, 50 mm thick: to ULC- S649 and ANSI/NFPA 96.
.2 Holding frame: 1 mm thick galvanized or stainless steel V or inclined as indicated.
.3 Stainless steel blank-off plates.
.4 Individual, removable drip trays with handles.

2.07 RIGID, SUPPORTED BAG TYPE FILTERS, 30-35 % EFFICIENCY

.1 Media: Disposable preformed fibrous glass, acrylic fibre 100 mm thick cartridge.
.2 Holding frame: Galvanized steel with bracing.
.3 Media support: Welded wire grid.
.4 Performance:
.1 Average atmospheric dust spot efficiency 30% to ASHRAE 52.1.
.2 Average synthetic dust weight arrestance 90% to ASHRAE 52.1.
.5 Fire-rated: To ULC -S111.

2.08 CARTRIDGE TYPE FILTERS, 80-85 % EFFICIENCY

.1 Media: Deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.
.2 Holding frame: Galvanized steel with bracing.
.3 Media support: Welded wire grid.
.4 Performance: Average atmospheric dust spot efficiency 80-85 % to ASHRAE 52.1.
.5 Fire-rated: To ULC -S111.

2.09 CARTRIDGE TYPE FILTERS 95 % EFFICIENCY

.1 Media: Disposable, high efficiency, to CAN/CGSB-115.15.
.2 Holding frame: Galvanized steel with bracing.
.3 Media support: Welded wire grid.
.4 Performance: Average atmospheric dust spot efficiency 95 % to ASHRAE 52.1.
.5 Fire-rated: To ULC-S111.

2.10 BAG TYPE FILTERS, 80-85% EFFICIENCY

.1 Disposable media bag type of self-inflating ultrafine glass:
  .1 High efficiency to CAN/CGSB-115.11.
  .2 Medium efficiency to CAN/CGSB-115.12.
.2 Holding frame: Galvanized steel.
.3 Media support: Welded galvanized steel.

2.11 HEPA ABSOLUTE PACKAGE FILTERS 99.97 % EFFICIENCY

.1 Media: Water resistant fibrous glass.
.2 Holding frame: Cadmium plated steel by unit manufacturer.
.3 Housing and sealing system: Manufacturers' standard, suitable for pressure application.
.4 Unit bank installation: Class 100 level, to US Federal Standard 209A.
.5 Efficiency: Minimum **99.97** % overall on hot DOP test, using 0.003 mm particles MIL-STD-282.

2.12 HIGH EFFICIENCY FILTERS

.1 Provide a high efficiency filter assembly consisting of a prefilter and extended surface pocket type after filter.
.2 Prefilters: ULC Class 2, 50mm thick disposable pleated type.
.3 Capacity: 25% to 30% efficient to ASHRAE standard 52 76 at 2.54 m/s (500 ft./Min) face velocity.
.4 After Filter: 300mm (12") deep cell type ULC Class 1 as detailed on the Drawings with 90% average efficiency based on ASHRAE standard 52 76 and conforming to Section 7-4 of ARI Standard 850-
78. Max. face velocity: 2.54 m/s (500 ft./min.)

.5 Acceptable Manufacturers: Farr, Cambridge, American Air Filter.
.6 Filter efficiency:
  .1 One pass efficiency of 60% when using particulate of 3.0 micron or larger and tested in accordance with CEA 906 U 708.
  .2 Submit copies of test reports with shop drawings.

2.13 FILTER GAUGES - DIAL TYPE

.1 Diaphragm actuated, direct reading.
.2 Range: 0 to 2 times initial pressure 0 to 250] Pa].

2.14 FILTER GAUGES - MANOMETER TYPE

.1 Inclined acrylic tube.
.2 Complete with levelling screws.
.3 Range: 0 to 2 times initial pressure

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION GENERAL

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.03 ACTIVATED CARBON TYPE FILTERS

.1 During testing, adjusting and balancing, install substitute media.
.2 Install permanent media only after painting is completed.

3.04 REPLACEMENT MEDIA

.1 Replace media with new upon acceptance.
.2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.05 HEPA FILTERS

.1 Use components and devices recommended by manufacturer to ensure complete integrity and to ensure easy removal and replacement, even when dressed in anti-contamination clothing.
.2 Provide proper permanent facilities for challenging integrity with aerosol injector downstream of pre-filters and test sampling manifold downstream of HEPA filter. Location of injector and sampling manifold approved by manufacturer.
.3 During TAB, install substitute media having similar pressure drop.
.4 Before acceptance, perform tests to demonstrate integrity of complete installation.

3.06 FILTER GAUGES

.1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.07 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01, include:
  .1 Materials and resources.
  .2 Storage and collection of recyclables.
  .3 Construction waste management.
  .4 Resource reuse.
  .5 Recycled content.
  .6 Local/regional materials.
  .7 Low-emitting materials.

3.08 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 44 00

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

.1 Comply with Requirements of Division One, General Requirements and all documents referred to therein.

.2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 SUMMARY

.1 Section Includes:
- .1 Materials and application of electric duct heaters.
- .2 Sustainable requirements for construction and verification.

.2 Related Sections:
- .1 Division 01
  - .1 Submittal Procedures
  - .2 Health and Safety Requirements
  - .3 Environmental Procedures
  - .4 Sustainable Requirements
  - .5 Construction/Demolition Waste Management and Disposal
  - .6 General Commissioning (Cx) Requirements
- .2 Division 26

1.03 REFERENCES

.1 Canadian Standards Association (CSA International).
- .1 CSA C22.2 No.46, Electric Air-Heaters.

.2 Department of Justice Canada (Jus).
- .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .2 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.04 SUBMITTALS

.1 Make submittals in accordance with Division 01 to suit Submittal Procedures and Section 20 05 00.

.2 Co-ordinate submittal requirements and provide submittals required by Division 01.

.3 Submit product data and include:
- .1 Element support details.
- .2 Heater: Total kW rating, voltage, phase.
- .3 Number of stages.
- .4 Rating of stage: Rating, voltage, phase.
- .5 Heater element watt/density and maximum sheath temperature.
- .6 Maximum discharge temperature.
- .7 Physical size.
- .8 Unit support.
- .9 Performance limitations.
- .10 Clearance from combustible materials.

.11 Internal components wiring diagrams.
.12 Minimum operating airflow.
.13 Pressure drop operating and minimum air flow.

1.05 QUALITY ASSURANCE

.1 Health and Safety
.1 Do construction occupational health and safety in accordance with Division 01.
.2 Sustainable Requirements.
.1 Construction requirements: In accordance with Division 01 to suit Sustainable Requirements: Construction.
.2 Verification: Contractor's verification in accordance with Division 01 to suit Sustainable Requirements: Contractor's Verification.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS
.1 Materials and products in accordance with Division 01 to suit Sustainable Requirements: Construction.

Electric duct coils: All duct heaters to be CSA approved and ULC listed. Each completely rewired with:

.1 Air pressure differential switch.
.2 Fused control circuit and transformer.
.3 Single or multistage type contactors as indicated.
.4 Over temperature protection.
.5 Prewired terminals for connection of power and control circuits.
.6 Incaloy sheathed elements.
.7 SCR controls for make-up air application.
.8 3 minutes time delay interlocking with fan controls
.9 Main isolators disconnect switches

2.02 DUCT HEATERS

.1 Elements:
.1 Helical coils of nickel chrome alloy resistance wire.
.2 Finned tubular.
.3 Incoloy sheathed.
.2 Staging:
.1 Staged heaters: Balanced line current at each stage.
.2 Each stage: Uniform face distribution.

.3 Maximum temperature at discharge: 35 degrees Celsius.
.4 Controls:
  .1 Factory-mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.
  .2 Remote mounted as indicated with terminal strips in heater terminal box for power and control wiring.
  .3 Controls mounted in a CSA Type enclosure and to include:
    .1 Magnetic contactors.
    .2 Pneumatic electric relays.
    .3 Control transformers.
    .4 SCR controller.
  .4 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.
  .5 High temperature cut-out and air proving switch.
.5 Acceptable Manufacturers: Chromalox & FPE

PART 3 - EXECUTION

3.01 INSTALLATION

.1 Make power and control connections to CSA C22.2 No. 46.

3.02 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Division 01.and Division 26.
.2 Perform tests in presence of the Consultant.

  .1 Provide test report and include copy with Operations and Maintenance Manuals.

.3 Verification requirements in accordance with Division 01, include:
  .1 Materials and resources.
  .2 Storage and collection of recyclables.
  .3 Construction waste management.
  .4 Resource re-use.

3.03 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 55 01

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Section 23 33 00 – Air Duct Accessories.

1.02 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: Obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.03 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.6 Trim

.7 Mounting details

.8 Frame details

.9 Backdraft damper or other balancing device where applicable.

.2 Samples:

.1 Submit samples in accordance with Division 01.

.3 Quality assurance submittals: Submit following in accordance with Division 01.

.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: Submit manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

.1 Health and Safety Requirements: Do construction occupational health and safety in accordance with Division 01.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 MAINTENANCE

.1 Extra Materials:
  .1 Provide maintenance materials in accordance with Division 01 and to suit Close-out Submittals.
  .2 Include:
    .1 Keys for volume control adjustment.
    .2 Keys for air flow pattern adjustment.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01

2.02 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.
.2 Frames:
  .1 Full perimeter gaskets.
  .2 Plaster frames where set into plaster or gypsum board.
  .3 Concealed fasteners.
.3 Concealed manual volume control damper operators.
.4 Colour: as directed by Consultant.

2.03 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.04 REGISTERS, GRILLES, DIFFUSERS

.1 Provide registers, grilles and diffusers by manufacturer and sizes, styles and finishes as scheduled on the Drawings.
.2 Ensure that the items supplied will be compatible with ceiling or wall construction.
.3 All linear diffusers to be provided with manual concealed volume control damper.
.4 All supply air diffusers to be provided with opposed blade damper.
.5 Equipment as manufactured by E.H. Price, Carnes, Barber Coleman, Titus, Nailor Industries, Tuttle & Bailey, Metalaire and Krueger is acceptable.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.
.2 Install with flat head screws in countersunk holes where fastenings are visible.
.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
.4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms.

3.03 GRILLES, REGISTERS AND DIFFUSERS

.1 Fit frame with gasket to prevent leakage, and smudging.
.2 Install with oval head plated screws in countersunk holes where fastenings are visible.
.3 Ensure unit is compatible with ceiling or wall construction.
.4 Make connections of rigid or flexible ductwork to diffusers, VAV terminals and air distribution boots using a minimum of 3 self tapping screws and seal with glass fab tape and high velocity duct sealer.

3.04 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01, include:
  .1 Materials and resources.
  .2 Storage and collection of recyclables.
  .3 Construction waste management.
  .4 Resource re-use.
  .5 Recycled content.
  .6 Local/regional materials.
  .7 Low-emitting materials.

3.05 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 37 13

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this section.

1.02 REFERENCES

.1 Definitions:
- .1 Catalogued or published ratings: Ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.

.2 Reference Standards:
- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
  - .1 ANSI/NFPA-90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2009 Edition.
- .2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
  - .1 ANSI/ASHRAE 90.1, (I-P) Energy Standard for Buildings except Low-Rise Residential Buildings.
  - .2 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .3 Air Conditioning and Refrigeration Institute (ARI)
- .4 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .5 Master Painters Institute (MPI)
  - .1 MPI-INT 5.3, Galvanized Metal.
- .6 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
- .7 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
  - .1 SCAQMD Rule 1113, Architectural Coatings.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Division 01.

.2 Product Data:
- .1 Provide manufacturer's printed product literature and datasheets for refrigerant, insulation, filters, and paints, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 Indicate following:
  - .1 Unit dimensions, weight loading, required clearances.
  - .2 Construction details and filed connection details.
  - .3 Product data shall indicate capacities, ratings, fan performance, motor electrical characteristics, finishes and materials.
  - .4 Actual cooling and heating fluid entering and leaving conditions for stated air side requirements.
  - .5 Fan performance, motor, damper, air volume, total cooling, sensible cooling, heating.

.6 Provide fan curves with specified operation point clearly plotted.
.7 Product data of filter metis, filter performance data, filter assembly and filter frames.
.8 Electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory installed and field install wiring.
.9 Manufacturer’s installation instructions.
.10 Operation and Maintenance data, including instructions for lubrication, filter replacement, motor and drive replacement, spare parts list and wiring diagrams.

.4 Sustainable Design Submittals:
.1 LEED Submittals: In accordance with Division 01.

1.04 CLOSE-OUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Division 01.

1.05 MAINTENANCE MATERIAL SUBMITTALS

.1 Provide maintenance materials in accordance with Division 01.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.06 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

.1 Warranty periods for air handling equipment to start on the date of verification of acceptance issued in writing by the Consultant.

.2 The date of verification of acceptance is independent of Substantial Performance of the Work and may occur after certification of Substantial Performance.

.3 Air handling equipment will be accepted after start up, a minimum of six hours of logged operation and submission of written verification of same by manufacturer's representative. The Consultant may also witness a portion of any of these this procedure.

.4 Include verification of acceptance certificates with the maintenance and operating manuals in the appropriate sections.

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:
- .1 Materials and installation for split HVAC system.
- .2 Sustainable requirements for construction and verification.

.2 Related Sections:
- .1 Division 01
  - .1 Construction Progress Schedules
  - .2 Submittal Procedures
  - .3 Health and Safety Requirements
  - .4 Quality Control
  - .5 Sustainable Requirements
  - .6 Construction/Demolition Waste Management and Disposal
  - .7 Close-out Submittals
  - .1 General Commissioning (Cx) Requirements
- .2 Division 02
  - .1 Hazardous Materials: Submission Requirements for WHMIS MSDS.
- .3 Section 20 05 70 – Water Treatment.

1.02 REFERENCES

.1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)
- .1 ANSI/ARI 210/240, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- .2 ARI 270, Sound Rating of Outdoor Unitary Equipment.

.2 ANSI/UL, Standard for Heating and Cooling Equipment.

.3 Canadian Standards Association (CSA International)
- .1 CSA B52, Mechanical Refrigeration Code.
- .2 CSA C22.1 HB, Canadian Electrical Code Handbook.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.5 National Fire Protection Association
- .1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

.1 Submittals in accordance with Division 01.

.2 Co-ordinate submittal requirements and provide submittals required by Division 01.

.3 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet for split HVAC units.

.4 Submit WHMIS MSDS in accordance with Division 01 and Division 02. Indicate VOC's for adhesive and solvents during application and curing.

.5 Shop Drawings:

.1 Submit shop drawings to indicate project layout and dimensions; indicate:

.1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

.2 Piping, valves, fitting shipped loose showing final location in assembly.

.3 Control equipment shipped loose, showing final location in assembly.

.4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

.5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.

.6 Pump and fan performance curves.

.7 Details of vibration isolation.

.8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.

.9 Type of refrigerant used.

.6 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.7 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.8 Instructions: Submit manufacturer's installation instructions.

.9 Manufacturer's Field Reports: Manufacturer's field reports specified.

.10 Close-out submittals: Submit maintenance and engineering data for incorporation into manual specified in Division 01. include data as follows:

.1 Indicate brief description of unit, indexed, with details of function, operation, control and service for components.

.2 Provide for units, manufacturer's name, type, year, number of units and capacity.

1.04 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting **one** week prior to beginning work of this Section and on- site installations in accordance with Division 01 to suit Construction Progress Schedules.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Division 01 to suit Health and Safety Requirements.
.3 Construction requirements: In accordance with Division 01 to suit Sustainable Requirements.
.4 Verification: Contractor's verification in accordance with Division 01 to suit Sustainable Requirements: Contractor's Verification.
.5 The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
.6 All wiring shall be in accordance with the Canadian Electrical Code (C.E.C.), provincial and local codes as required.
.7 The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210/240 and bear the ARI Certification label.
.8 The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
.9 A dry air holding charge shall be provided in the indoor section.
.10 The outdoor unit shall be pre-charged with refrigerant for 70 feet (21 meters) of refrigerant tubing; for units 3 tons or greater shall be pre-charged for 100 feet (30 meters) of refrigerant tubing.

1.05 DELIVERY, STORAGE AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

PART 2 - PRODUCTS

2.01 MATERIALS

.1 Materials and products in accordance with Division 01 to suit Sustainable Requirements: Construction.

2.02 GENERAL

.1 The system shall consist of a horizontal discharge, single phase outdoor unit, a matched capacity indoor section that shall be equipped with a -mounted wired wall-mounted wall, wireless, wireless handheld, or other remote controller.

.2 Provide commercial air cooled split systems consisting of wall mounted or ceiling suspended fan coil terminals and remote air cooled condensing units with capacities and characteristics as described in the Equipment Schedules and in the following:

.1 Remote condensing unit:

.1 Cabinet:

.1 The casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a Munsell 3Y 7.8/1.1 finish.

.2 Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability.

.3 Easy access shall be afforded to all serviceable parts by means of removable panel sections.

.4 The fan grill shall be of ABS plastic.

.2 Fan:

.1 The fan blade(s) shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated and internal thermal overload protection with Class A insulation.

.2 The fans shall be statically and dynamically balanced.

.3 The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.

.3 Coil:

.1 The condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up and allow maximum airflow. The coil shall be protected with an integral metal guard.

.2 Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be control by a microprocessor controlled step motor.

.3 All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ACR Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes. Refer to section 20 05 25 for details.

.4 Compressor:

.1 The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings.

.2 To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant at low outdoor ambient temperature. No crankcase heater is to be used.

.3 The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

.5 Electrical:
.1 Power for the indoor unit shall be supplied from the outdoor unit using three (3) fourteen (14/12) gauge AWG conductors plus ground wire connecting the units.
.2 The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
.3 The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.
.4 The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.
.6 Removable access panels for access to all components.
.7 Controls: Short cycling protection, automatic restart on power failure, high temperature and freeze protection, system diagnostics, compressor motor overcurrent, over-temperature protection.

.3 Indoor fan coil section:
.1 Ceiling Suspended Type:
.1 The Ceiling Suspended type indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor.
.2 The unit, in conjunction with the remote controller, shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry air before shipment from the factory.
.3 Cabinet:
.1 The casing shall be ABS plastic and have a Munsell 6.4Y 8.9/0.4 white finish. Cabinet shall be designed for suspension mounting from above and horizontal operation. Indoor unit shall have removable mounting brackets. A mounting template with suspension bolt locations shall be furnished with indoor unit. Mounting bolts or threaded rod of 3/8” diameter shall be used to suspend unit and unit shall not require direct contact with ceiling or panel for proper operation. Mounting support shall be of sufficient strength and design to support full weight of indoor unit.
.2 The rear cabinet panel shall have knock-out provisions for a field installed filtered 4-5/16 diameter ventilation air intake connection.
.4 Fan:
.1 The indoor unit fan shall have multiple high performance, double inlet, forward curve fans driven by a single motor.
.2 The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
.3 The indoor fan shall consist of four (4) speeds: Low, M1, M2, and Hi plus AUTO fan setting. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and sensed space temperature.
.5 Vane:
.1 There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall provide a choice of five (5) vertical airflow patterns selected by remote control: 100% horizontal flow, 80% horizontal flow (plus 20% downward airflow), 60% horizontal airflow (plus 40% downward airflow), 40% horizontal airflow (plus 60% downward airflow), and swing.
.2 The horizontal vane shall significantly decrease downward air resistance for lower sound levels, and shall close the outlet port when

operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.

.6 Filter:

.1 Return air shall be filtered by means of an easily removable, washable filter. [An optional MERV 8 filter shall be furnished].

.7 Coil:

.1 The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. A drain pan level switch, designed to connect to the control board, shall be provided and installed on the condensate pan to prevent condensate from overflowing. Provide a drain lift mechanism, capable of lifting condensate 23-5/8”(600mm) above the drain pan, shall be provided**.**

.8 Electrical:

.1 The power to the indoor unit shall be supplied from the outdoor unit. A three (3) conductor AWG-14/3 wire with ground shall provide power feed and bi- directional control transmission between the outdoor and indoor units.

.9 Controls:

.1 Microprocessor based for space temperature, optimum fan speed, run self- diagnostics with test button, automatic restart after power failure, 15 hour timer cycle for system on/off, high discharge temperature shut-down. Also provide automatic change-over heat pump control with heat relay to enable operation of perimeter heating hot water convector valve for

.2 Wired remote system controller complete with interconnecting cable.

.2 Wall Mounted Type:

.1 The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

.2 Cabinet:

.1 All casings, regardless of model size, shall have the same white finish

.2 Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.

.3 There shall be a separate back plate which secures the unit firmly to the wall.

.3 Fan:

.1 The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.

.2 A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).

.3 A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

.4 Filter:

.1 Return air shall be filtered by means of an easily removable, washable filter.

.5 Coil:

.1 The indoor coil shall be of nonferrous construction with smooth plate

fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

.2 The coils shall be pressure tested at the factory.

.6 Electrical:

.1 The power to the indoor unit shall be supplied from the outdoor unit. A three (3) conductor AWG-14/3 wire with ground shall provide power feed and bi- directional control transmission between the outdoor and indoor units.

.7 Controls:

.1 Microprocessor based for space temperature, optimum fan speed, run self- diagnostics with test button, automatic restart after power failure, 15 hour timer cycle for system on/off, high discharge temperature shut-down. Also provide automatic change-over heat pump control with heat relay to enable operation of perimeter heating hot water convector valve for

.2 Wired remote system controller complete with interconnecting cable.

2.03 OTHER ACCEPTABLE MANUFACTURERS

.1 Other Acceptable manufacturers: Toshiba, Mitsubishi or Carrier.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

.1 Install as per manufacturers' instructions.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

3.03 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.3 Upon completion of work, after cleaning is carried out.

.2 Obtain reports within **3** days of review and submit immediately to Consultant.

.3 Verification requirements in accordance with Division 01 to suit Sustainable Requirements: Contractor's Verification, include:

.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource reuse.
.5 Recycled content.
.6 Local/regional materials.
.7 Certified wood.
.8 Low-emitting materials.

.4 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.5 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.

.6 Performance Verification:

.1 Verify accessibility, serviceability of components including, filters coils, fans, motors, operators, sensors, electrical disconnects.

.2 Verify accessibility, clean ability, drainage of drain pans for coils.

3.04 COMMISSIONING REPORTS

.1 In accordance with Division 01 to suit General Commissioning (Cx) Requirements: Reports supplemented as specified herein. Include:

.1 Report forms as specified Division 01 to suit General Commissioning (Cx) Requirements: Report Forms and Schematics.

3.05 DEMONSTRATION

.1 Training: In accordance with Division 01 to suit General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

3.06 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 74 10

PART 1 - GENERAL

1.01 RELATED SECTIONS
- .1 Division 01
  - .1 Submittal Procedures.
  - .2 Construction/Demolition Waste Management and Disposal
- .2 Section 23 23 00 – Refrigerant Piping

1.02 REFERENCES

- .1 Air-Conditioning and Refrigeration Institute (ARI)
  - .1 ARI 210/240, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
  - .2 ARI 325, Standard for Ground Water - Source Heat Pumps.
- .2 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
  - .1 ANSI/ARI 320, Standard for Water-Source Heat Pumps.
- .3 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  - .1 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .4 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE Standard 15, Safety Standard for Refrigeration Systems.
- .5 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-C13256-1-03 (R2016), Water-Source Heat Pumps - Testing and Rating for Performance.
  - .2 CAN/CSA-C656-14, Performance Standard for Single Package Central Air Conditioners and Heat Pumps.
- .6 Environment Canada, (EC)/Environmental Protection Services (EPS)
  - .1 EPS 1/RA/2, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
  - .2 Environment Canada, Ozone-Depleting Substances Alternatives and Suppliers List.

1.03 SUMMARY

- .1 Section includes: single package units, and their accessories

1.04 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Division 01. Submit letter of conformance indicating specified items selected for use in project
- .2 Indicate:
  - .1 Capacities.
  - .2 All specialties & accessories for each model indicated
  - .3 Duct mounted electric heater and controls

.4 ARI Ratings.
.5 Sound Power levels.
.6 Installation instructions.
.7 Start-up Instructions.
.8 O&M, Instructions.
.9 Detail layout and installation of wall penetrations
.10 Wiring diagrams detailed wiring for power signal and control systems and differentiate between manufactured installed and fueled installed wiring

1.05 QUALITY ASSURANCE

.1 fabricate and label refrigeration system to comply with ASHRAE 15 safety code for mechanical refrigeration and UL regulations listing and labeling provide electrically operated components specified in the section that are listed labeled Terms listed in the NEC article 100
.2 Unit shall be rated in accordance with ARI standard 210 / 240 and certified by UL

1.06 COORDINATION

.1 coordinate layout and installation of units and wall construction where the unit penetrates wall or is supported by it.

1.07 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
.3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
.4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Consultant.

1.08 WARRANTY

.1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.
.2 Standard warrenty manufacturer shall warrant all components for one full year from substantial completion date with an additional four years for the compressor contracts are shall be responsible for installation start up and 1st year labour

PART 2 - PRODUCTS

2.01 GENERAL

.1 Heat pumps: EPS 1/RA/2, CSA approved and carry ARI or CSA certification seal.

2.02 HEAT PUMPS – AIR SOURCE

.1 Provide ARI certified Air sourced packaged type heat pump units in locations as shown on the Drawings and as described in the Equipment Schedules, factory assembled and tested as a complete unit with fan assembly, piping, valves, wiring, controls, coils, refrigeration system , electric duct heater and other components required for specified operation after connection of power.
.1 Cabinet: 100% aluminium with factory bake-on enamel finish with easily removed access panel for access to refrigeration components, fan/motor assembly and controls and provided in single or twin arrangements as shown on the Drawings.

Refrigeration system compartment to be separate from other parts of the cabinet and to be provided with acoustic insulation on all sides.

.2 Compressors to be rotary type provided with spring vibration isolators and thermal overload protection. Refrigerant type is to be R-410a. The coil to be constructed of copper tubes and aluminium fins. The heat exchanger to be rated at 2760kPa (400 psig) on the water side and 3450 kPa (500 psig) on the refrigerant side. Resetting of safety cut-outs to be via power supply interruption to the unit only - reset from wall thermostat not acceptable.

.3 Refrigeration system: Consisting of a fully sealed refrigeration circuit with hermetic compressor, air- to - refrigerant finned tube heat exchanger, air to refrigerant coaxial heat exchanger, reversing valve, capillary expansion tubes, low and high pressure cut-outs with remote reset switches.

.4 Heat pumps equipped with external electric resistance heaters or air conditioning units shall have controls that prevent supplemental heater operation when the space heating load can be met by the heat pump alone during both steady state operation and set back recovery.

.5 Filters: merv 8 and merv 15.

.6 Fan/motor assembly: resiliently mounted, direct driven centrifugal forward curved type, dynamically balanced with motor provided with thermal overload protection and a quick disconnect plug for attachment to the control section.

.7 Controls:

.1 Electrical: Unfused disconnect, fan and compressor operating and safety controls, reversing valve and lockout relay.

.2 Thermostat: remote mounted automatic changeover with system ON/OFF and fan ON/AUTO switches.

.8 Noise Requirement: Provide necessary acoustical treatment for a noise level of **NC35** in occupied space.

.9 Acceptable Manufacturers: Minotair

PART 3 - PART 3 – EXECUTION

3.01 INSTALLATION

.1 Install where indicated and in accordance with manufacturer's instructions.

.2 Secure with hold-down bolts.

.3 Make duct connections through flexible connections.

.4 Level unit with fans running. Align ductwork. flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.

.5 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.02 EQUIPMENT INSTALLATION

.1 Heat pumps (air source): Install all components and equipment to Manufacturer’s instructions. Install, wire and test and commission entire system. A complete commissioning and test report to be provided as a condition of acceptance by the

Consultant.

3.03 DRAIN PANS

.1 Install so that no water can accumulate and arrange for easy access for cleaning.

3.04 START-UP AND COMMISSIONING

.1 Manufacturer to certify installation.
.2 Manufacturer to be present during test and start-up of units and certify performance.
.3 Manufacturer to provide verbal and written instructions to operating personnel.
.4 Submit written report to Consultant.

3.05 CLEANING

.1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 81 40