VICTORIA PARK COMMUNITY HOMES

155 Queen St North, Hamilton, ON L8R 2V6

Project Number: 12228
Specifications Issued for: Tender

CONSTRUCTION DOCUMENTS
PROJECT MANUAL

Volume 2

Mechanical and Electrical

Issued for Tender

www.dpai.ca

DPAI Architecture Inc.

25 Main Street West Suite 1800
Hamilton, Ontario L8P 1H1

VOLUME 1

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MCW Consultants Ltd.

A member of the MCW Group of Companies
www.mcw.com

207 Queen's Quay West, Suite 615
Toronto, Ontario
M5J 1A7

MECHANICAL SPECIFICATIONS

FOR

VICTORIA PARK COMMUNITY HOMES – OFFICE EXPANSION

TO

DPAI ARCHITECTURE

DATED

SEPTEMBER 8, 2023

ISSUED FOR TENDER

Contact Person: Jonathan D'Andrade
Phone: 416-598-2920
Email: JDAndrade@mcw.com

MCW Project No. 21424

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PART 1 - GENERAL

1.01 DESCRIPTION

.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 TOR.ShopDrawings@mcw.com; 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, MCW requests that all shop drawings be submitted electronically in pdf format. Upon MCW'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 Make all submittals in accordance with Division 01 submittal procedures.

.10 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 co-ordinated 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 co-ordinated. 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 MCW, 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 MCW 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 20 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 TOR.ShopDrawings@mcw.com 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 co-ordinated 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 and Division 01 submittal procedures.
.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 are to be provided in accordance with Division 01.

.2 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.

.3 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 and Division 01 submittal procedures.

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 kick off 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 01 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: MCW Consultants Ltd.
207 Queen's Quay West, Suite 615
Toronto, Ontario
M5J 1A7

MECHANICAL GENERAL REQUIREMENTS SECTION 20 05 01 – APPENDIX 'B' PROJECT: _____ _____ PROJECT No: _____	**SHOP DRAWING SUBMITTAL SCHEDULE** DIVISION 20, 21 22, 23 & 25								Date: _____
SECTION	DESCRIPTION (List Equipment Example only Edit to Suit)	MANUFACTURER	SHOP DRAWING SUBMITTED		RETURNED		DELIVERY		COMMENTS
			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 Motor Control Centres								
20 05 70	Water Treatment Equipment								
21 05 05	Sprinkler Design Layouts Hose Cabinets Fire Department Connections								
21 13 00	Valves Sprinkler Heads Dry Valves Pressure and Flow Switches Pressure Gauges								
21 23 00	Extinguishers								
22 10 10	Domestic Water Pumps								
22 30 05	Domestic Hot Water Heaters								
22 42 01	Drains and Specialties Water Hammer Arrestors Backflow Preventers Backwater Valves Hose Bibs Water Meters Trap Seal Primers Mixing Valves								
23 23 00	Refrigeration Piping								

MECHANICAL GENERAL REQUIREMENTS SECTION 20 05 01 – APPENDIX 'B' PROJECT: _____ _____ PROJECT No: _____	**SHOP DRAWING SUBMITTAL SCHEDULE** DIVISION 20, 21 22, 23 & 25								Date: _____
SECTION	DESCRIPTION (List Equipment Example only Edit to Suit)	MANUFACTURER	SHOP DRAWING SUBMITTED		RETURNED		DELIVERY		COMMENTS
			SCHED	ACTUAL	SCHED	ACTUAL	SCHED	ACTUAL	
23 31 13	Ductwork								
23 33 10	Dampers								
23 74 11	VRF Systems								
23 74 20	Packaged Outdoor ERV - Manufacturer								

CONTENTS

PART 1 - GENERAL

1.01 DESCRIPTION

.1 Comply with requirements of Division 01, 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.

.10 "Basis of Design" refers the mechanical design inherent in the Contract Documents to establish a specific performance requirement and may refer to specific Equipment or Products that have been used to establish an energy performance benchmark, space constraint, or structural load, or may refer to a specific duct or piping arrangement, or may refer to a particular operating sequence, or other similar consideration specific to the design. Basis of Design Equipment or Products are detailed in the Equipment Schedules and drawings.

.11 "Acceptable Manufacturer", "Standard of Acceptance", "Alternative Manufacturer", "Acceptable Alternative" and similar language that describes manufacturers other than the manufacturer used as the Basis of Design shall all have the same meaning throughout the Contract Documents. Acceptable Manufacturers may be used in the Work in lieu of the Basis of Design manufacturers subject to conditions stipulated elsewhere in the Mechanical Division Contract Documents. Refer to section 20 05 05 – 1.14.

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 15	Seismic Control and Restraint
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 40	Demolition and Revision Work
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 13 00	Wet and Dry Pipe Sprinkler Systems
21 23 00	Fire Extinguishers

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 53	Duct Liners
23 33 55	Acoustic Silencers
23 34 00	HVAC Fans
23 37 13	Diffusers, Registers & Grilles
23 44 00	HVAC Air Filtration
23 55 01	Duct Heaters
23 74 11	VRV AND VRF SYSTEMS
23 74 20	Packaged Outdoor ERV

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 The Ontario Electrical Safety 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	–	American Conference of Governmental Industrial Hygienists
AMCA	–	Air Moving & Conditioning Association
ADC	–	Air Diffusion Council
ANSI	–	American National Standards Institute
ARI	–	Air Conditioning & Refrigeration Institute
ASCII	–	American Standard Communication Information Interchange
ASHRAE	–	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	–	American Society of Mechanical Engineers
ASTM	–	American Society for Testing and Materials
AWWA	–	American Water Works Association
CGA	–	Canadian Gas Association
CGSB	–	Canadian General Standards Board
CIRI	–	Canadian Industrial Risk Insurers
CSA	–	Canadian Standards Association
CTI	–	Cooling Tower Institute
EIA	–	Electronic Industry Association
FCC	–	Fire Commissioner of Canada
FM	–	Factory Mutual
ISA	–	Instrument Society of America
IAO	–	Insurers Advisory Organization
MMC	–	Marsh McLennan Insurance Protection Consultants
MTC	–	Ministry of Transportation and Communication
NBCC	–	National Building Code of Canada
NFPA	–	National Fire Protection Association
OBC	–	Provincial Ontario Building Code
OFM	–	Local Fire Codes or Standards Ontario Fire Marshall
MOEE	–	Ontario Ministry of Environment And Energy
OML	–	Ministry of Labour and Workmen's Compensation Requirements
OWRA	–	Ontario Plumbing Code
TSSA	–	Technical Standards & Safety Authority
UL	–	Underwriter's Laboratories Inc.
ULC	–	Underwriter's Laboratories of Canada

.4 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.

1.06 STANDARDS

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

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

.1 Water Chiller - To meet the requirements of CSA C743.
.2 Electric Water Heater - To meet the requirements of CAN/CSA C191-00.
.3 Gas Fired Water Heater - To meet the requirements of CSA – P.3-04.
.4 Large Air Conditioner, Heat Pumps and Condensing Units - To meet the requirements of CAN/CSA –C746 (current edition).

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

.5 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 Divisions 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 Divisions 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 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.

.5 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 existing Mechanical and Electrical components and Architectural and Structural details.

1.09 EXAMINATION OF THE PLACE OF THE WORK AND DOCUMENTATION

.1 Prior to submitting tender, carefully examine conditions at the place of the work which 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.

.4 Refer also to room finish schedules to determine finished, partially finished and unfinished areas of the building.

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 model 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 model 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 the existing building, new construction, and all new and existing 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.

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 ACCEPTABLE MANUFACTURERS AND ALTERNATES

.1 The manufacturers as listed in the equipment schedules and drawings are listed as the Basis of Design.

.2 All manufacturers differing from the Basis of Design who are listed as "Acceptable Manufacturer", "Standard of Acceptance", "Alternative Manufacturer", "Acceptable Alternative" and similar language are considered as alternates.

.3 Whenever the contractor intends to provide a product different than the Basis of Design it will be considered an alternate, regardless of it being listed as an "Acceptable Manufacturer", "Standard of Acceptance", "Alternative Manufacturer", "Acceptable Alternative". It is the contractor's responsibility to verify that the equipment performance, weight, connection, wiring, power requirements and dimensions are in line with the characteristics of the product listed as the Basis of Design. If different than the Basis of Design, the contractor shall coordinate with other trades and cover all costs associated with any modifications required to accommodate the proposed equipment/product.

1.15 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.

1.16 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.

1.17 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 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.

1.18 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.

1.19 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.

1.20 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.

1.21 WORK IN EXISTING BUILDING AREAS

.1 Perform work in existing areas to best suit available space and not interfere with or obstruct use of existing facilities.

.2 Cut, modify and extend, as shown in the Contract Documents or as directed by the Consultant, existing materials and equipment to be reused or relocated to suit the Work. Use new materials to match existing systems that are modified or extended.

.3 Scan and/or x-ray all concrete slabs to identify the appropriate location to cut, trench and/or core prior to commencing any work. Submit the results of the scan and/or x-ray in a report format to the structural engineer for review prior to cutting, trenching and/or coring. This contractor shall ensure that there are no interferences with other existing services prior to commencing any work.

.4 Refer to Section 20 05 40.

1.22 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.

1.23 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 A third party Integrated Systems Testing (IST) firm will be retained as specified in Division 01 General Requirements.
.2 The third party IST firm will appoint an Integrated Testing Coordinator (ITC) responsible for preparation of an Integrated Testing Plan (ITP), which will be issued after contract award, but prior to IST.
.3 All fire protection and life safety functions shall be tested as a whole in accordance with CAN/ULC-S1001, “Integrated Systems Testing of Fire Protection and Life Safety Systems”, to verify that the systems have been properly integrated.
.4 The cost of the third party IST firm, ITC or ITP are not to be carried by this Division. This Contractor shall include all costs associated with participation in testing with the ITC and other Divisions, including re-testing of failed integrations, meeting attendance, scheduling and coordination.

1.24 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,fan coil unit, 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.

1.25 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 Divisions 20, 21, 22, 23, 25 for further warranty requirements.

1.26 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.

1.27 OPERATING AND MAINTENANCE MANUALS AND CLOSE-OUT DOCUMENTS

.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) along with equipment manufacturer’s recommended spare parts lists.
.4 Maintenance, operating and lubricating instructions and schedules 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 complete sets of “Reviewed” or “Reviewed as Modified” Shop Drawings and other Submittals including Interference/ Coordination Model, Embedded Mechanical System’s Drawings, and Sleeving Drawings.

.8 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.

.9 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

.10 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, non-potable, 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.

1.28 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 After tender close, and within 24 hours of being advised, submit another copy of this form showing all requested information.

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

1.29 VALUATION OF CHANGES

.1 All changes for additional work shall include the following; the actual cost of labour and materials plus where the work is performed by a Subcontractor to the Trade Contractor shall include no more than 5% for overhead and 5% for Profit.

.2 Where the work is performed by the Trade Contractor's own forces the Trade Contractor shall include no more than 5% for overhead and 10% for Profit.

.3 All credits for deleted work shall include the actual cost of labour and materials and no less than 5% of such amount for overhead and profit where the work is performed by the Trade Contractor.

.4 Where the work is performed by a subcontractor credits for deleted work shall include the subcontractors actual cost of labour and materials plus no less than 5% of such amount for overhead and profit. The Trade Contractor shall provide for an additional no less than 5% credit of the subcontractors total credit on account of the Trade Contractor's overhead and profit.

.5 The Trade Contractor shall at the request of the Owner or Consultant provide all required supplementary documentation for any change (the amounts shall be exclusive of HST).

.6 Hourly labour rates must be included with the tender submission and be done at MCA rates and include a discount rate as negotiated with the owner.

1.30 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 to suit Common Product Requirements.

.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, to suit Construction/Demolition Waste Management and Disposal
.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 in appropriate on-site bins 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 the Consultant.
.6 Place materials defined as hazardous or toxic in designated containers.
.7 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, and 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.

1.31 CLEANING

.1 General

.1 Comply with General Conditions of the Contract, Supplementary Conditions and other Sections of Division 01.
.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 01 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.
.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

CONTENTS

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.

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 in accordance with Section 20 01 05.

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 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.

.4 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.

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

.6 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 Specialties 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.

.1 Piping:

.1 Working Pressure up to and including 1035 kPa (150 psi): Schedule 40 ASTM specification A53 [seamless] 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 of 1035 to 2070 kPa (150 to 300 psi): Schedule 80 ASTM specification A53 seamless Grade A or B wrought steel black pipe threaded fittings rated at 2070 kPa (300 psi WOG) for pipe sizes up to and including 50mm (2").]

.3 [Working Pressure of 2070 to 2760 kPa (300 to 400 psi): Schedule 160 ASTM specification A53 seamless Grade A or B wrought steel black pipe with heavy cast iron double extra strong threaded fittings rated at 2,760 kPa (400 psi) for pipe sizes up to and including 50mm (2").]

.4 Working Pressure up to and including 1035 kPa (150 psi): Schedule 40 ASTM specification A53 [seamless] 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.

.5 [Working Pressure of 1035 to 2070 kPa (150 to 300 psi): Schedule 40 ASTM specification A53 Grade A or B seamless or ASTM A106 Grade A or B wrought steel black pipe with schedule 40 black steel welding fittings rated at 2070 kPa (300 psi WOG) for pipe sizes 65mm (2½") and up to 600mm (24").]

.6 [Working Pressure of 2070 to 2760 kPa (300 to 400 psi): Schedule 40 ASTM specification A53 Grade B seamless or ASTM A106 Grade B wrought steel black pipe with schedule 40 black steel welding fittings rated at 2,760 kPa (400 psi WOG) for pipe sizes 65mm (2½") and up to 600mm (24"). Use standard weight welding rings at pipe joints 150mm (6") and larger.]

.7 Type L copper to ASTM B88 with 95/5 soldered wrought copper pressure fittings to ANSI B16.22 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 Victaulic couplings to CSA Standard B242 for fire protection, heating, chilled water 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.

.4 For pipe sizes 100mm (4") and smaller (for heating and cooling application only):

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

.1 Viega MegaPress shall conform to ASTM F3226, IAPMO PS117, ICC LC1002, ASME B31.1, B31.3, or B31.9. MegaPress fittings ½-inch thru 4-inch for use with schedule 5 thru 40 ASTM A53 carbon steel pipe.

.2 MegaPress fittings shall only be used for system pressure up to 1379 kPa (200 psi).

.3 Press Connect Fitting shall carry CRN numbers

.4 Press Connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting.

.5 1/2 inch thru 2 inch fittings shall have stainless-steel grip ring with bidirectional teeth, 304 stainless separator ring, EPDM or FKM sealing element at each press connection. 2-1/2 inch thru 4 inch shall have stainless-steel grip ring with bidirectional teeth, PBT separator ring, and FKM sealing element at each press connection

.6 There shall be no mixing of manufacturers.

.7 The manufacturer’s installation instructions shall be strictly adhered to.

.8 Special attention shall be given to the required two step pressure test.

.9 Initial test for unpressed fitting detection per manufacturer’s installation manual

.10 Full pressure test in accordance with code requirements

.11 Installers shall be field trained by Viega factory representative. .

.12 Approved manufacturer: Viega

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

.1 Viega ProPress Bronze, or copper shall conform to ASTM F3226, ICC LC 1002, ASME B16.51, IAPMO PS 117, NSF 61, and NSF 61-G or NSF 372. . ProPress fittings ½-inch thru 4-inch for use with ASTM B88 copper tube type L and ½-inch up to include 1-1/4-inch annealed copper tube.

.2 ProPress fittings shall only be used for system pressure up to 2068 kPa (300 psi).

.3 Press Connect Fitting shall carry CRN numbers.

.4 Cast copper alloy fittings Alloy: Copper alloy - UNS C12200 Zero Lead silicon bronze alloy - C87710 (cast) or C87700 (machined) Shall not be bismuth bronze or yellow brass.
.5 EPDM elastomeric sealing element shall be peroxide cured for resistance to chloramines
.6 Press Connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting
.7 2-1/2 inch thru 4 inch fittings shall have stainless-steel grip ring with bidirectional teeth, PBT separator ring, and EPDM sealing element at each press connection.
.8 There shall be no mixing of manufacturers.
.9 The manufacturer's installation instructions shall be strictly adhered to.
.10 Special attention shall be given to the required two step pressure test. Initial test for unpressed fitting detection per manufacturer's installation manual. Full pressure test in accordance with code requirements.
.11 Installers shall be field trained by Viega factory representative.
.12 Approved manufacturer: Viega

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

.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.

.5 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.

.6 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.

.7 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.

.8 Domestic Water:

.1 System pressure rated for [1380 kPa, 2070 kPa or XXX (200 psi, 300 psi or XXX)].
.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 Above Grade:
.1 Type L [K] 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.
.2 Stainless Steel:
.1 304L stainless steel, Schedule 10 marked certified for compliance with ASTM A312/ASME SA-312 Standard for pipe sizes 75mm (3”) and larger.
.2 Fittings: 304L stainless steel fittings to ASTM A-774 and A-403.
.3 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.
.4 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.
.5 For pipe sizes 100mm (4") and smaller (for heating and cooling application only):
.1 Press fittings by Viega Model Pro Press and MegaPress is acceptable for use in copper and stainless steel piping.
.1 Copper Press-Connect Fittings:
.1 Viega ProPress Bronze, or copper shall conform to ASTM F3226, ICC LC 1002, ASME B16.51, IAPMO PS 117, NSF 61, and NSF 61-G or NSF 372. . ProPress fittings ½-inch thru 4-inch for use with ASTM B88 copper tube type L and ½-inch up to include 1-1/4-inch annealed copper tube.
.2 ProPress fittings shall only be used for system pressure up to 2068 kPa (300 psi).
.3 Press fittings shall have a valid Ontario Building Material Evaluation Commission Authorization (BMEC).
.4 Press Connect Fitting shall carry CRN numbers.

.5 Cast copper alloy fittings Alloy: Copper alloy - UNS C12200 Zero Lead silicon bronze alloy - C87710 (cast) or C87700 (machined) Shall not be bismuth bronze or yellow brass.
.6 EPDM elastomeric sealing element shall be peroxide cured for resistance to chloramines
.7 Press Connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting
.8 2-1/2 inch thru 4 inch fittings shall have stainless-steel grip ring with bidirectional teeth, PBT separator ring, and EPDM sealing element at each press connection.
.9 The manufacturer's installation instructions shall be strictly adhered to.
.10 Special attention shall be given to the required two step pressure test. Initial test for unpressed fitting detection per manufacturer's installation manual. Full pressure test in accordance with code requirements.
.11 Installers shall be field trained by Viega factory representative.
.12 Approved manufacturer: Viega (no exceptions).

.2 Stainless Steel Press-Connect Fittings:
.1 Viega LLC; MegaPress Stainless 316
.2 Viega MegaPress Stainless 316 shall conform to ASTM F3226, ICC LC 1002, IAPMO PS 117, ASME B31.1, B31.3, or B31.9, NSF 61, and NSF 61-G or NSF 372. MegaPress Stainless 316 fittings ½-inch thru 2-inch for use with schedule 5 thru 40 ASTM A 312 stainless steel pipe. MegaPress Stainless 316 fittings 2½-inch thru 4-inch for use with schedule 10 thru 40 ASTM A 312 stainless steel pipe ProPress fittings shall only be used for system pressure up to 2068 kPa (300 psi).
.3 Press Connect Fitting shall carry CRN numbers.
.4 EPDM elastomeric sealing element shall be peroxide cured for resistance to chloramines
.5 Press Connect fitting shall have Viega Smart Connect technology to detect unpressed fittings shall be integrated into the body of the fitting
.6 1/2 inch thru 2-inch fittings shall have stainless-steel grip ring with bidirectional teeth, 304 stainless separator ring, and EPDM sealing element at each press connection. 2-1/2 inch thru 4 inch shall have stainless-steel grip ring with bidirectional teeth, PBT separator ring, and EPDM sealing element at each press connection
.7 The manufacturer's installation instructions shall be strictly adhered to.
.8 Special attention shall be given to the required two step pressure test. Initial test for unpressed fitting detection per manufacturer's installation manual. Full pressure test in accordance with code requirements.
.9 Installers shall be field trained by Viega factory representative.
.10 Approved manufacturer: Viega (no exceptions).

.4 Buried piping:
.1 Soft temper type K with soldered fittings to the previously mentioned standards.

.5 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).
.6 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.

.9 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 B16.22: (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 B16.22. Use brass flanges, nuts and bolts at equipment connections.

.10 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 B16.22 or ANSI B16.18 with 50 50 solder. Where buried, use PVC class 150 to CSA B137.3.

.11 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%.

.12 Natural gas piping: Provide as required by the Authorities having jurisdiction as follows:

.1 Buried:
.1 ASTM A53 Schedule 40 seamless wrought steel with Schedule 40 wrought steel butt welding fittings to ANSI B16.9. Provide complete with Shaw Pipe Yellow Jacket® high density dual layer polyethylene coating for external protection, and yellow insulated tracer wire for future location.
.2 Provide continuous 75 mm (3") wide yellow PVC warning tape with "CAUTION BURIED PIPELINE BELOW" wording at 750 mm (30") intervals located above pipe approximately 250 mm (10") below grade.
.2 Suspended:
.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.

.4 MegapressG:

.1 MegapressG as manufactured by Viega shall only be used for piping up to and including 2" upon acceptance by the local authority.

.2 Pipe: Carbon steel pipe shall conform to ASTM A53. Pipe schedule (pipe wall thickness) shall conform to the standard referenced dimensions for Schedule 40.

.3 Fittings: Cold Press Mechanical Joint Fitting shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria ANSI LC-4/CSA 6.32. Sealing elements for press fittings shall be HNBR. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect™) technology design (leakage path). MegaPress fittings with Smart Connect technology assure leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection.

.4 Piping and fittings shall comply with ANSI LC-4/CSA 6.32 and the latest edition of NFPA-54.

.5 Fittings shall comply to the requirements of ASTM F3226.

.13 Reverse osmosis (RO) system water piping: Provide PVC pressure pipe and fittings as follows:

.1 Pipe: Type 1, grade 1, schedule 40 to ASTM D1785.

.2 Fittings: Socket type to ASTM D2466. Threaded type to be schedule 80 to ASTM 2464.

.3 Solvent cement: To ASTM D2564.

.4 Valves: Socket type grade 1, type 1, PVC to ASTM D1784 with full port ball, union connections, EPDM seals, reversible teflon seats, adjustable seal retainers and rated at 1550 kPa (225 psi). Acceptable Manufacturer: Hayward.

.14 Acid waste drainage and vent piping:

.1 Installation at sink: Provide Enfield flame retardant polypropylene pipe and fittings to ASTM F1412 with mechanical joints. Provide Enfield W501 universal 75mm (3") deep trap with clear base (pencil trap).

.2 Where installed in walls and ceiling spaces: Provide Kimax tempered glass (available from Smillie McAdams Summelin Ltd.) as manufactured by Owens - Illinois complete with stainless steel compression couplings with Buna-N rubber liner and tetra-fluoro-ethylene gasket. Provide Kimax adaptors for joints to connections at sink drain and at acid interceptor. Provide tempered glass piping for all vents and drains for all lab sinks and fume hood sinks connected to the acid interceptor.

.3 Acceptable alternative to tempered glass: Duriron piping with MJ couplings consisting of sintered non porous teflon inner sleeve, neoprene outer sleeve and stainless steel clamp. Duriron to conform to ASTM A 518-80 and A-861-86.

.4 Provide Polypropylene acid resistant Fuseseal below grade up to the acid interceptor installed in accordance with manufacturers recommendations. Pipe to be certified in accordance with CSA B181.2. All joints to be thermally welded with the applicable adaptors to transition to tempered glass or duriron at floor level.

.15 Humidifier Low Pressure Steam:

.1 Use type 'L' copper. Steam condensate if applicable can be the same.

.2 When applicable use manufacturer supplied hoses at humidifier.

.16 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.

2.03 VALVES

.1 All valves to have minimum certified rating of 1380 kPa (200 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.

.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),

.2 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.

.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 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.

.3 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.

.4 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.

.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 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

.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.

.10 Viega Valves (Propress, Megapress and MegapressG):

.1 MegaPress Press-Connect Valves (Hydronic systems only):

.1 Approved for use with carbon steel pipe shall conform to ASTM A53, A106, A135 or A795. Pipe schedule (pipe wall thickness) shall conform to the standard referenced dimensions for Schedule 5 to 40. Valves shall conform to MSS-110, ASME B31 and IAPMO Z1157. Ball valve shall be equipped with a full port, 316 stainless steel ball, blowout-proof 316 stainless steel stem, adjustable packing nut, PTFE stem seals, 304 stainless steel locking handle, 3-piece body and zinc nickel coated steel press ends.

.2 EPDM:

.1 Temperature range 0-250 F and max CWP 250. EPDM sealing element at each press connection

.3 FKM (Pipe Size 2" and smaller)

.1 Temperature range 14-284 F (with temperature spikes up to 356 F) and max CWP 250. FKM sealing element at each press connection

.4 FKM (Pipe Size 2 ½" to 4)

.1 Temperature range 14-284 F (with temperature spikes up to 356 F) and max CWP 200. FKM sealing element at each press connection

.5 Sealing element shall be uniform in size/thickness and shall be free from manufactured deformities or indentations.

.6 Press ends shall have 420 stainless steel grip & 304 stainless steel separator rings.

.7 Press Connect valves shall have the Viega Smart Connect feature integral to the fitting body to detect unpressed valves during the testing process.
.8 Color-coded markings on exterior of fitting for readily identifying/inspecting sealing element type.
.9 Approved manufacturer: Viega LLC (no exceptions).

.2 ProPress and Cast Copper Alloy Press-Connect Valves (Domestic water only):
.1 Approved for use with copper tubing conforming to ASTM B88 or B75. When pressing onto B88 copper tube, types K, L, and M may be used. Tempers O60 and O50, known as “soft copper”, are limited to nominal sizes 1/2" to 1-1/4”. Temper H58, known as “hard copper”, may be used with nominal sizes 1/2” to 4".
.2 Valves shall conform to IAPMO Z1157, NSF 61-372, NSF U.P. Code and listed by NSF to Commercial Hot water. Temperature range 0-250 F and max CWP 250.
.1 Ball valve shall be equipped with a full port, 316 stainless steel ball, blowout-proof Eco Brass® stem, reinforced PTFE seats, lockable metal handle, 2-piece zero lead bronze body with press ends.
.2 Peroxidically cured EPDM elastomeric sealing element
.3 Sealing element shall be uniform in size/thickness and shall be free from manufactured deformities or indentations.
.4 420 stainless steel grip & PBT separator rings for 2-1/2” to 4” sizes.
.5 Press Connect valves shall have the Viega Smart Connect feature integral to the fitting body to detect unpressed valves during the testing process.
.6 Color-coded markings on exterior of fitting for readily identifying/inspecting sealing element type.
.3 Approved manufacturer: Viega LLC (no exceptions).

.3 MegaPress 316 Stainless Steel Press-Connect Valves (Domestic water only):
.1 Approved for use with stainless steel pipe conforming to ASTM A312. MegaPress 316 ½” to 2 fittings can be used with Schedule 5 to Schedule 40 stainless steel pipe and 2½ to 4 fittings can be used with Schedule 10 to Schedule 40 stainless steel pipe.
.2 Valves shall conform to MSS SP-110, ASME B31, IAPMO Z1157, NSF 61-372, NSF U.P. Code and listed by NSF to Commercial Hot water. Temperature range 0-250 F, max CWP 250 up to 2”, and max CWP 200 from 2 ½” to 4”
.1 Ball valve shall be equipped with a full port, 316 stainless steel ball, blowout-proof 316 stem, reinforced PTFE seats, lockable metal handle, 3-piece stainless steel body with stainless steel press ends.
.2 Peroxidically cured EPDM elastomeric sealing element
.3 Sealing element shall be uniform in size/thickness and shall be free from manufactured deformities or indentations.
.4 420 stainless steel grip & 304 stainless steel separator rings.
.5 Press Connect valves shall have the Viega Smart Connect feature integral to the fitting body to detect unpressed valves during the testing process.
.6 Color-coded markings on exterior of fitting for readily identifying/inspecting sealing element type.
.3 Approved manufacturer: Viega LLC (no exceptions).

.4 MegaPressG Carbon Steel Press-Connect Valves (Natural Gas only):
.1 Approved for use with ASTM A53 Schedule 10 to 40 carbon steel pipe.
.2 Shall be listed to CSA 6.32 / ANSI LC-4 or CSA 6.32a / ANSI LC-4a
.3 1/2“ to 2“ Iron Pipe Size.

.4 Sealing Element: HNBR elastomeric sealing element rated to 125 psi (max) with a temperature range of -40 to 180 degrees (F). Sealing element shall be uniform in size/thickness and shall be free from manufactured deformities or indentations.
.5 420 stainless steel grip ring.
.6 304 stainless steel separator ring
.7 Press Connect valves shall have Smart Connect Technology to detect unpressed fittings during the testing process.
.8 Color-coded markings on exterior of fitting for readily identifying/inspecting sealing element type.
.9 Approved manufacturer: Viega LLC (no exceptions).

.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”): Hattersley #170M. 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 circuit balancing valves. Each valve to have features as follows:
.1 Manual Balancing Valves:
.1 All manual balancing valves shall incorporate the following features:
.1 ‘Y’ pattern, equal percentage globe style.
.2 With tamperproof balance setting, positive shut-off and drain.
.3 Valves shall provide precise flow measurement, precision flow balancing, positive drip-tight shut-off.
.4 Valves shall provide multi-turn 360° adjustment with micrometer type indicators located on the valve handwheel.
.2 Up to 50 mm (2”):
.1 Bronze, brass or brass alloy body.
.2 2068 kPa (300 psi) maximum working pressure, 121°C (250°F) maximum operating temperature.
.3 Armstrong model CBV, Victaulic TA Series 78KH (male NPT x female NPT), 786H (solder end), 787H (female NPT threaded end), Bell & Gossett model CB, Hattersley model 1732.
.3 65 mm (2.5”) and over:
.1 Cast or ductile iron body.
.2 ANSI 125 [250] flanged connections or grooved connections.
.3 Armstrong model CBV, Victaulic TA Series 788 (flanged end), 789 (grooved end), Bell & Gossett model CB, Hattersley model MH737.
.2 Automatic Balancing Valves:

.1 All automatic balancing valves shall incorporate the following features:
  .1 Valve shall be accurate to within +/-5% of set GPM within the valve's pressure control range.
  .2 Valve shall have a maximum differential pressure control range of 60 psi.
  .3 Valve body shall include tow integrated pressure/temperature ports.
  .4 Valve shall maintain a constant flow rate, regardless of pressure fluctuations in the system (pressure independent operation).
.2 Up to 50 mm (2"):
  .1 Ductile iron body.
  .2 2517 kPa (365 psi) maximum working pressure, 121°C (250°F) maximum operating temperature.
  .3 Victaulic TA Series 76T (female x female threaded NPT / solder), 76B (female x female threaded NPT / solder, with ball valve kit), 76K (male x female threaded NPT / solder / union), 76V (male x female threaded NPT / solder / union, with ball valve kit), Bell & Gossett Circuit Sentry Flo-Setter II model FS (NPT female) or AF (NPT female/solder with union tailpiece).
.3 65 mm (2.5") and over:
  .1 Ductile iron body.
  .2 2517 kPa (365 psi) maximum working pressure, 110°C (230°F) maximum operating temperature.
  .3 Victaulic TA Series 76G (grooved ends)

2.04 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.
  .3 For corrosive environments (pool areas) shall be stainless steel.

.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.

2.05 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.

2.06 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.

2.07 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.

2.08 EXPANSION TANKS

.1 Provide in sizes as shown 1380 kPa (200 psi) in equipment schedules [prepressurized diaphragm type] expansion tanks meeting current ASME and CSA code requirements designed for a maximum working pressure of [500 kPa (75 psi)] [1035 kPa (150 psi)] constructed of mild steel with prime painted finish and complete with sight glass and all necessary tappings in combination with Filtrol valve and automatic vent.

.2 Acceptable Manufacturers: O'Connor, Clemmer, Amtrol, Expanflex.

2.09 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 and horizontal piping for all services including but not limited to, heating, cooling, domestic water (all), drainage (all), fuel oil, 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 ensure 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

Victaulic
123 Newkirk Road
Richmond Hill, ON L4C 3G5
(905) 780-5418

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

.3 Strainer baskets:

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

.4 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.

2.11 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 [brass] [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 Provide liquid filled thermometers complete with [brass] [stainless steel] separable wells as shown on the Drawings and as manufactured by Weis, vari-angle with 230 mm (9") scale. 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.]

.3 [Provide Photo electronic type thermometers with LCD display complete with brass separable wells as shown on the Drawings and as manufactured by Weiss. 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]

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

.5 Provide brass, bronze or copper fittings only.

2.12 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.

2.13 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] [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 [ODP]. 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 Acceptable electric motor manufacturers: Westinghouse, CGE, Reliance, Brook-Crompton, Marathon, US Motors, WEG and Siemens.

2.14 MOTOR STARTERS – LOW VOLTAGE

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

2.15 MOTOR CONTROL CENTERS – LOW VOLTAGE

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

2.16 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.
tempered domestic water	Green	TEMP. DOM. 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
ground water	Green	GROUNDWATER
acid sanitary drainage	Yellow	ACID DRAIN
acid drainage vent	Yellow	ACID VENT
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
propane gas	to Code	to Code, c/w pressure
propane gas vent	to Code	to Code
fuel oil supply	Yellow	FUEL OIL SUPPLY
fuel oil return	Yellow	FUEL OIL RETURN
fuel oil vent	Yellow	FUEL OIL VENT
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
Glycol heat reclaim return	Yellow	GLY. HTG. RECLAIM R.
Glycol heat reclaim supply	Yellow	GLY. HTG. RECLAIM S.
Heat pump geothermal loop – source side supply	Green	GEO. LOOP SOURCE SUPPLY

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
Heat pump geothermal loop – source side return	Green	GEO. LOOP SOURCE RETURN
Heat pump geothermal loop – load side supply	Green	GEO. LOOP LOAD SUPPLY
Heat pump geothermal loop – load side return	Green	GEO. LOOP LOAD RETURN
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Chilled water drain	Green	CH. WTR. DRAIN
Low pressure steam	Yellow	….kPa STEAM
Medium pressure steam	Yellow	….kPa STEAM
High pressure steam	Yellow	….kPa STEAM
Low pressure condensate	Yellow	L.P. CONDENSATE
Medium pressure condensate	Yellow	M.P. CONDENSATE
High pressure condensate	Yellow	H.P. CONDENSATE
Pumped condensate	Yellow	PUMPED CONDENSATE
Steam vent	Yellow	STEAM VENT
Boiler feedwater	Yellow	BLR. FEEDWATER
Boiler blowdown	Yellow	BLR. BLOW-OFF
Refrigerant suction	Yellow	REFRIG. SUCTION
Refrigerant liquid	Yellow	REFRIG. LIQUID
Refrigerant hot gas	Yellow	REFRIG. HOT GAS
Diesel engine exhaust	Yellow	ENGINE EXHAUST
Gasoline	Yellow	GASOLINE
Distilled water	Green	DISTILL. WATER
Demineralized water	Green	DEMIN. WATER
Compressed air (< 700 kpa)	Green	….kPa COMP. AIR
Compressed air (>700 kpa)	Yellow	….kPa COMP. AIR
Control air	Green	CONTROL AIR

.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 Steam 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 Steam and Condensate Piping: Install steam piping level, or where possible, grade in direction of flow. On branch lines from mains feeding risers, pitch branch lines towards the horizontal mains to prevent water hammer. Grade all condensate piping in direction of flow.

.16 Compressed air piping: slope piping in direction of air flow. Provide drip points at all low points in the piping system consisting of a line size or 25 mm (1") minimum diameter 300 mm (12") long down leg with a reducer to a 12 mm (½") ball valve with nipple and cap.

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

.18 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.

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

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

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

.22 Acid waste and vents: Vents to be taken directly to roof vents and installed separately from non-acid waste systems. Vents to be C.I. where they pass through building roof. Provide fibreglass protective packing at sleeves. Provide rigid fibreglass pads (sections of pipe covering) at all support points in accordance with manufacturer's instructions.

.23 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.

.24 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.

.25 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.

.26 Viega Propress, Megapress and MegapressG Installation:

.1 Installers shall attend a manufacturer's installation training course and obtain certification as having been trained and qualified to join piping with press-connect valves. On-site training and credentialing by manufacturer's representative is acceptable.
.2 Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of press-connect bronze, copper, carbon steel or stainless steel valves.
.3 Press-connect bronze, copper, carbon steel or stainless steel valves shall be installed using proper tool, actuator, jaws, and rings as instructed by the manufacturer.
.4 A Viega factory trained representative shall periodically visit the job site and review the installation for best practices. Viega product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Viega Inspection Services prior to the completion of the project. The installing Contractor shall correct any identified deficiencies.
.5 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. Viega 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.

.27 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 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. Supply flashing for roof drains and vents to Division 07 Subcontractor for installation.

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 07. Equipment bases and curbs for openings to be supplied and set in place by Divisions 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.

-- OR --

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

.4 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.

.5 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 At VAV terminal inlets for access to air flow measurement devices and for cleaning and servicing.
.5 Unitary heating/cooling equipment, such as heat pumps and fan coils, in ceiling spaces.
.6 Duct mounted smoke detectors (for inspection of in-duct sensors).
.7 Control valves and temperature control components.
.8 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 08 Subtrade with panels, doors or the frames therefore, complete with all pertinent information and pay that trade 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] [portions] of [excavation], [bedding], [backfill] and related work required for mechanical Work in accordance with requirements of Division 02 except as supplemented by this Article. Ensure all services are buried a minimum of 2 ft (0.6m) below the frost line where piping is located outside the building perimeter walls.

.2 [Where excavation and backfill is required outside perimeter foundation walls, provide all required layout of mechanical services trenches.]

.3 [Provide all required information to Division 02 Subtrade during excavation.]

.4 [Perform carving and trimming of final 150 mm (6”) of trench bottom excavation.]

.5 [Perform bedding, installation of services, backfilling and testing to 300 mm (12”) above uppermost buried service.]

.6 The balance of backfilling to be performed by Division 02 Subtrade after receiving clearance from Divisions 20, 21, 22, 23 and 25.

.7 Grade the bottom of the pipe trench excavation as required.

.8 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.

.9 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.

.10 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.

.11 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.

.12 Provide support over at least the bottom one third segment of the pipe in all bedding methods.

.13 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.

.14 Perform all, or required portions of backfilling as specified in [Division 03] 150mm (6") layers with clean selected materials acceptable to the Consultant.

.15 Backfill and compact to the following standard Proctor percentages:

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

.16 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 09. 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 SYSTEMS CLEANING

.1 System Preparation for Chemical Treatment

.1 During construction:
.1 Ensure reasonable care is exercised to prevent debris, dirt and other foreign material from entering the pipe.
.2 This is to include proper protection of piping on site prior to installation, temporary caps on partial systems, and complete evacuation of moisture within systems being hydrostatically pressure tested.
.2 Review connections for complete draining and venting of the systems with Division 20, 21, 22 23 and 25 Subtrades.
.3 Upon initial filling, utilize water meter to record capacity within each system.
.4 Do not install instrumentation components such as flow meters, orifice plates, pitot tubes, turbine meters until system flush is complete and confirmed by water treatment specialists.
.5 Control Valves:
.1 Prior to flushing and cleaning remove all terminal unit control valves 25 mm or smaller.
.2 Coordinate with Divisions 20, 21, 22 23 and 25 Subtrades to provide temporary connections to ensure complete system circulation during cleaning.
.3 Reinstall the control valves when the system flush and cleaning is complete.
.4 Coordinate with Divisions 20, 21, 22 23 and 25 Subtrades to ensure that all control valves 25mm and larger and all other system valves are 100% open to ensure all pipes have flow.
.6 Bypass plate heat exchangers, boilers, chillers, etc. during flushing and chemical treatment procedure.
.7 Hydronic Terminal Units:
.1 Radiant panels, terminal box coils, unit heaters, heat pumps, radiation, force flows are not to be connected to heating piping during system flush.

.2 Install temporary connection between supply and return branch lines and connect to heating system after flushing is completed.

.8 Construction Screens and filters

.1 Install all filter cartridges, beginning with larger micron size filters. The first few filter changes may be required every few hours to remove any suspended solids not removed by the final flushing. Filters changes will become less frequent as filter inspections reveal clean filters. Repeat this process with smaller micron filters.

.2 Remove construction screens from pumps and any other equipment once this process is complete.

.9 Strainers:

.1 Remove, inspect and replace strainers on all systems before initial fill.

.2 Provide temporary strainers on systems without permanent strainers. Remove, clean and replace strainers until no further fouling occurs.

.2 General Procedures for Systems Cleaning and Inhibiting

.1 Perform cleaning and chemical treatment activities in a continuous process without interruption.

.2 Perform a complete water analysis of the domestic water source before cleaning and filling. Submit report to Consultant.

.3 Submit a detailed written procedural report to Consultant before system cleaning, outlining the following:

.1 System status and description.

.2 Cleaning procedures, flow rates, elapsed time.

.3 Chemical cleaners and concentrations.

.4 Inhibitors and concentrations.

.5 Specific requirements to complete work.

.6 Special precautions for protecting piping system materials and components.

.4 Pipe cleaning to be completed after hydrostatic test.

.5 Flush through all low point drains of the piping system.

.6 Low Points:

.1 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed.

.2 Include disassembly of components as required.

.3 All cleaning and flushing of low points, coils and boilers shall be done prior to final fill and chemical treatment.

.7 Ensure flush velocity is adequate in all pipe mains and branches to ensure debris is removed.

.8 Where necessary, create a loop at the end of the system to ensure no dead legs.

.9 Circulation of Cleaning Solution:

.1 System pumps may be used for circulating cleaning solution provided velocities are adequate.

.2 If used for circulation, dismantle pump and inspect, replace worn parts, install new gaskets and seals. Turn over used seals.

.3 Hydronic Systems Cleaning and Inhibiting Procedures

.1 Open high point vent(s).

.2 Fill systems completely with clean water from system low points; ensure air is completely vented from systems.

.3 Draw one sample of water from the filled piping and test it for colour, clarity, pH and conductivity.

.4 Circulate the system for a minimum of four hours at full flow. Flush low point drains, etc., while circulating to help remove any debris that has been dislodged. Flush with constant circulation until the flush water conductivity, pH and turbidity are approximately equal to the fresh water source. If the water is unusually dirty, drain and refill.

.5 Add chemicals for cleaning and recirculate for 1 hour.

.6 Draw one sample of water and test to confirm addition of cleaning chemical product at appropriate concentration.

.7 For closed loop systems, recirculate system cleaner at 60°C for a minimum 48 hours. Ensure that required temperature and velocity is maintained throughout. Frequently flush all low point drains, etc. while circulating to remove loosened debris.

.8 Drain system as quickly as possible. Safely dispose of the cleaner solution. Prior to discharging into sanitary drain confirm that it is acceptable to do so with the Authorities having jurisdiction. If disposal by sanitary drain is not acceptable, provide alternative means of removal of chemically treated water from site, complying with the requirements of the Authorities having jurisdiction.

.9 Flush the pipe with clean water until all the cleaner is out. Allow at least one day for flushing. Flush until the effluent is clear and flush water conductivity, pH and turbidity are equal to the fresh water source.

.10 The inspection and cleaning of all strainers is recommended after flushing. A simultaneous flush and fill with system recirculation is best during the final stages of the flushing to ensure that all the air is removed and all the cleaner is out. This is best accomplished by draining from the low points and adding water at the makeup point while ensuring the required system pressure, so as not to cause recirculation pump cavitation, is maintained.

.11 Provide final flush samples in 2 x 250 ml bottles to verify the cleaner is out. All samples should be dated and labelled as to system and location of sample. If the samples are coloured or foamy upon agitation, further flushing will be required. A written sign-off report will be provided to the Consultant.

.12 Once cleaner is completely flushed from the system, corrosion inhibitor addition will take place. This must be done immediately following cleaning or the pipe will begin to rust and re-cleaning may be required.

.13 Refill with water (fill from low points, vent from high points) and add inhibitors.

.14 Circulate for 24 hours.

.15 Test concentrations and adjust to recommended levels defined in procedural report.

.16 Test glycol systems to prove concentration will resist freezing at intended freeze protection temperature.

.17 Test inhibitor strength and record in procedural report.

.4 Steam and Condensate System Cleaning and Inhibiting Procedure

.1 Isolate steam boiler(s) from piping system.

.2 Fill boiler to normal operating level.

.3 Add cleaner.

.4 Fire to 50% of design operating pressure.

.5 Blowdown boiler every 4 h including water columns, controls, skimmer lines and valves, test cocks and blowdown valves.

.6 Add water to return to operating level.

.7 Maintain procedure for 24 h.

.8 Allow boiler to cool, then drain, flush and inspect.

.9 Refill with clean softened water and immediately add chemical inhibitors.

.10 Condensate Dump:

.1 Dump condensate from steam system to sewer for a period of 96 h after initial operation.

.2 During this period, the boilers must be chemically treated with the inhibitors to assure complete removal of oils, grease and millscale from the steam/condensate system.

.3 Provide cooling water lines, if necessary.

.11 Open steam header to operating pressure and start continuous feed of an Octadecylamine (ODA) based filming amine blended with morpholine and or diethylaminoethanol based neutralizing amine, such as GE Water's Steamate NF4630 at 20 ppm to achieve a condensate pH of 7.5 to 8.0 for a period of not less than 48 hours. All condensate shall be discharged to drain.

.12 Collect condensate samples every twelve hours and retain for inspection by a qualified water treatment specialist.

.13 After 48 hours:

.1 In addition to the feed of Steamate NF4630, begin continuously feeding additional neutralizing amine blend of cyclohexylamine, morpholine and diethylaminoethanol, such as GE Water's Steamate NA5640 to achieve a pH of 8.3 to 9.0.

.2 Both products can be batched and fed together.

.3 pH measurements shall be supplemented with phenolphthalein ("P) alkalinity testing. The "P" alkalinity shall be maintained between 2 and 10 ppm in the condensate.

.14 Continue feeding the chemicals for another 48 to 96 hours.

.15 Continue to collect condensate samples every 12 hours and retain for inspection by a qualified water treatment specialist. All condensate shall continue to be dumped to drain.

.16 Testing:

.1 After minimum 7 days of steam and condensate purging, the condensate shall be tested for residual oil, hardness and iron.

.2 Approval shall be dependent on no detectable oil, not detectable calcium or magnesium hardness and suspended iron in the condensate of less than 100 ppb using a standard Babcock and Wilcox Millipore suspended iron test.

.3 Discontinue feed of filming amine blend (Steamate NF4630), but continue feeding neutralizing amine (Steamate NA5640) to maintain the 2-10 ppm "P" alkalinity the condensate.

.5 Domestic Hot, Cold and Recirculating Water System

.1 Flushing:

.1 Before disinfecting, flush all foreign matter from the pipeline.

.2 Provide hoses, pumps, temporary pipes, ditches, etc., as required to dispose of flushing water without causing damage to adjacent properties.

.3 The flushing velocities shall be at least 1 m/s, for a period of 10 minutes.

.4 Open and close valves, hydrants, and services connections to ensure thorough flushing.

.5 For large diameter pipe, where it is impractical or impossible to flush the pipe at 1 m/s velocity, the pipeline shall be cleaned in place from the inside by brushing and sweeping, then flushing the line at a lower velocity.

.2 Disinfection:

.1 Pipes intended to carry potable water shall be disinfected before being placed in service.

.2 Disinfection procedures shall conform to AWWA C651 as hereinafter modified or expanded, and the requirements of any governing agency having jurisdiction.

.3 Ensure that the disinfection solution is distributed throughout the entire domestic water system.

.3 Disinfection Mixture:

.1 The mechanical contractor shall prepare the disinfection mixture with a chlorine-water solution having a free chlorine residual of 40 - 50 PPM.

.2 The disinfection mixture shall be prepared by injecting calcium or sodium hypochlorite and water into the piping and allowing it to flow at a measured rate so that water-chlorine solution is of the specified strength.

.3 If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, then thin to approximately a one percent solution (10,000 PPM Chlorine).

.4 If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a one percent solution.

.4 Point of Application:

.1 The chlorine mixture shall be injected into the piping to be treated at the beginning of the line, and through a corporation stop or suitable tap in the top of the line.

.2 Water from the existing system or other approved sources shall be controlled so as to flow slowly into the newly installed pipe during the application of chlorine.

.3 The rate of chlorine mixture flow shall be in such proportion to the rate of water entering the pipe that the combined mixture shall contain 40-50 PPM of free available chlorine.

.4 Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

.5 Check valves shall be used if deemed necessary.

.6 The chemical treatment representative shall analyze and record the free chlorine residual at the farthest fixtures from the injection point.

.5 All valves, fixtures and other appurtenances shall be operated during disinfection to ensure that the disinfection mixture is dispersed into all parts of the line, including dead ends, new services and similar areas that otherwise may not receive the treated water.

.6 Retention Period:

.1 Treated water shall be retained in the pipeline long enough to destroy all nonspore-forming bacteria.

.2 With proper flushing and the specified solution strength, 24 hours is adequate.

.3 At the end of the 24-hour period, the disinfection mixture shall have a strength of at least 25 PPM of chlorine.

.4 The chemical treatment representative shall analyze and record the free chlorine residual at the farthest fixtures from the injection point.

.7 The above procedure shall be repeated at the mechanical contractor’s expense if the free chlorine level drops below the minimum requirements.

.8 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.

.9 After chlorination, the water from the line shall be flushed until it meets health department requirements.

.10 Disposal of Disinfection Water:

.1 Disposal of disinfecting water shall be done in an approved manner.

.2 Disinfecting water should not be allowed to flow into a waterway without adequate dilution or other satisfactory method of reducing chlorine concentrations to a safe level.

.6 When new systems are to be connected to existing systems

.1 Take samples of water in existing piping and submit to Chemical Treatment Subcontractor for water quality testing.

.2 Should the water quality in the existing piping not be sufficient, include the existing piping in the above flushing and cleaning scope.

.3 If flushing scope & cleaning is restricted to new piping only:

.1 Provide isolation valves as required to fully isolate new piping from existing piping during cleaning and flushing procedure.

.2 Create additional loops at the end of the system, as necessary to ensure no dead legs and that flushing only takes place in new piping.

.3 Complete one final water quality test for new piping prior to opening up to existing system.

3.27 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 domestic water piping hydraulically to a minimum pressure of 1100 kPa (150 psi) 2070 kPa (300 psi) 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.

.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.

3.28 AIR BALANCING AND TESTING

.1 Costs to perform air balancing to be included in the Tender for the Work of Divisions 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 the Drawings and Specifications, make site visits, prepare reports and take responsibility for measuring and adjusting all air supply, exhaust, return and transfer systems operate in accordance with specified requirements with tolerance of plus or minus five percent (5%).

.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 performance.

.4 When the work is adequately completed, inspect, check and test all systems and equipment. Cooperate with the controls systems subcontractor to achieve required flow rates where modulating dampers, valves etc., are installed.

.5 Prepare and submit testing and balancing reports to the Consultant for review. All reports shall include instrument calibration certificates, a report summary and remarks section explaining the rationale for how the system was configured for testing, and a listing of any deficiencies.

.6 Provide assistance to the Consultant for on-site spot verification of the testing and balancing 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. Specified and achieved air pressure differential across all pressurized stair shaft doors, and the door force required to open each door in accordance with MMAH Supplementary Standard SB-4

.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 Sheave 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 Acceptable Air and Water Balancing Contractors:

.1 Aerodynamics Inspecting Consultants Ltd.
.2 Dasstab Inc.
.3 Designtest & Balancing Co. Ltd.
.4 Dynamic Flow Balancing Ltd.
.5 VPG Associates Ltd.

3.29 DETAIL DRAWINGS, LEGENDS AND EQUIPMENT SCHEDULES

.1 Refer to legends and equipment schedules on the drawings and detail 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.

.2 Equipment Schedules No. of Pages

Unitary Heating/Cooling
Fan Coils
Air Cooled Condensers/Condensing
Pumps
Heat Pumps
Domestic Hot Water Heaters
Energy Recovery Ventilator

END OF SECTION 20 05 10

CONTENTS

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 Basic Mechanical Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide all vibration isolation and control equipment, properly selected to provide noise 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 Ensure isolators and restraining devices factory supplied with equipment meet the requirements of this Section.

.3 Provide all equipment to control noise and vibration such that the average noise criteria curves for the conditioned occupied space, do not exceed the NC levels and vibration levels specified in the acoustic report or, in the absence of such report, the table below:

Room Types		**Octave Band Analysis NC**
Office Buildings	Executive and private offices	30
	Conference rooms	30
	Teleconference rooms	25
	Open-plan offices	40
	Corridors and lobbies	40

.4 Engage the vibration isolation equipment manufacturer to provide inspection and supervision services during construction to ensure all equipment is installed as required to achieve effective vibration isolation and noise control.

.5 Finishes are to be ULC labelled and listed for flame spread rating of less than 25 and smoke development classification of less than 50.

.6 Types of isolators, types of equipment bases, and applications for various types of equipment specified herein are based on ASHRAE Handbook HVAC Applications.

.7 Coordinate with vibration isolation manufacturer and structural engineer of record to locate and size structural supports underneath vibration isolated equipment (e.g. roof curbs, cooling towers, chillers and other similar equipment).

.8 Health and Safety:

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

1.04 SUBMITTALS

.1 Submit shop drawings on all product/equipment specified in this Section. Include detailed dimension drawings, construction, performance and finishes in accordance with Section 20 01 05 – Shop Drawings, Product Data & Samples.

.1 Vibration Isolation Bases: Dimensional drawings including anchorage and attachments to structure and to supported equipment, if needed or required. Include auxiliary motor slides and rails, base weights, equipment static loads.
.2 Vibration Isolators: Vibration isolation selection must include quantities & layout of isolators for each equipment being isolated. Deflection calculations with rated & actual deflection and natural frequency under load as well as installation instructions for all isolators being supplied.
.3 Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

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

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 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATION – GENERAL

.1 All springs are to have a minimum additional travel to solid equal to 50% of the rated deflection. All springs, except internal nested springs, are to have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs are to be square and ground for stability. Laterally stable springs are to have k_x/k_y ratios of at least 0.9. Spring elements are to be colour-coded.

.2 Steel equipment bases are to be of welded construction with cross members to form an integral support platform. Design structural steel members to match supported equipment. Minimum clearance under steel equipment bases is 25 mm (1”).

.3 Concrete inertia bases are to be of welded steel construction with concrete in-fill supplied by the installing contractor on site, incorporate reinforcing bars, spaced 300 mm (12”) maximum on centres each way, and of sufficient weight to lower the center of gravity to or below the isolator support plane. Minimum thicknesses as follows:

.1 Up to 30 HP: 150 mm (6”);
.2 40 to 75 HP: 200 mm (8”);
.3 100 HP and greater: 300 mm (12”).

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

.5 Provide weatherproof coating on springs and housings for all isolation equipment exposed to outdoors.

.6 Isolators and seismic restraints to meet the requirements of the current **Ontario** 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).

.7 Provide seismic restraining devices for resiliently mounted equipment.

.8 Acceptable manufacturers are: Vibro-Acoustics, Kinetics Noise Control, Mason Industries, Isotech Industries.

2.02 VIBRATION ISOLATORS – TYPES

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

.2 Provide isolators as follows:

.1 Type 1 - Pad Isolators:

.1 Neoprene elastomer in-shear pads, used in conjunction with steel shims where required. Pads are 50 durometer, designed for a maximum of 4.2 kg./sq.cm (60 psi) loading, and designed for a maximum deflection of approximately 20% of its unloaded thickness, 0.38 cm (0.15"). All pads shall be molded using 2500 psi minimum tensile strength. Several layers of pads can be stacked for additional deflection when steel separation shim stock is used. All layers shall be affixed together using appropriate glue or double sided tape to prevent delamination. The elastomer is oil and water resistant, offers a long-life expectancy consistent with neoprene compounds, and has been designed to operate within the safe stress limits of the material. Pads are to be able to be easily cut-to-fit as needed.

.2 Type 2 - Rubber Floor Isolators or Hangers:

.1 Rubber Floor Isolators: Captive, bridge bearing quality neoprene mount selected for a minimum 4 mm (0.15") static deflection unless otherwise specified, with an integral ductile iron housing and integral equipment anchor bolt.

.2 Neoprene Hanger Isolators: Neoprene double deflection rod isolators with steel housing and hanger rod bushing, selected for a minimum 4 mm (0.15") static deflection unless otherwise specified.

.3 Type 3 - Spring Floor Isolators or Hangers:

.1 Open Spring Mounts: Base mount free-standing assemblies, each complete with a stable steel spring welded in place, drilled mild steel mounting plate bonded to a ribbed rubber or neoprene acoustical pad, and an external 16 mm (5/8") diameter level adjustment bolt.

.2 Closed Spring Mounts: Base mount free-standing enclosed assemblies, each complete with stable spring(s), 2-piece cast housing, non-binding rubber horizontal stabilizers, a ribbed rubber or neoprene acoustical pad bonded to base of the closed housing, and an external level adjustment bolt.

.3 Spring Hangers: Welded steel plate housing with top and bottom rod mounting holes and spring retainer, neoprene double deflection isolation element, stable colour-coded spring, and heavy-duty rubber washers.

.4 Type 4 - Restrained Spring Isolators:

.1 Restrained Spring Isolator: Base mount free-standing enclosed and retained assemblies to limit both vertical and lateral movement of mounted equipment, each complete with stable spring(s), drilled welded steel housing and top plate, ribbed rubber or neoprene acoustical pad bonded to bottom of housing, vertical limit adjusting hardware, and a level adjustment bolt.

.5 Type 5 - Thrust Restraints:

.1 High deflection, large diameter, laterally stable steel coil springs assembled into a threaded rod and angle bracket assembly complete with moulded neoprene end load plate assemblies for light capacities or stamped steel end cups for heavier capacities, threaded adjustment rod with zinc-plated hardware, polyester powder coated lateral spring stiffness greater than 1.0 times the rated vertical stiffness with a minimum of 50% overload deflection, and safe when temporarily loaded to solid capacity.

2.03 EQUIPMENT BASES – TYPES

.1 Type A – No base, isolators attached directly to equipment:

.1 Direct Isolation: Used when equipment is unitary and rigid and does not require additional support.

.2 Type B – Structural Steel Rails or Bases:

.1 Steel Equipment Base: Fully welded structural steel equipment and motor support bases, each complete with a wide flange steel frame, full depth cross members, brackets for spring mounts, and adjustable motor slide rails.

.3 Type C – Concrete Inertia Base:

.1 Concrete Inertia Type Base: Welded steel bases, each complete with a structural black steel channel frame, concrete reinforcing rods, and brackets for spring mounts welded to frame.

.2 Combination Steel/Concrete Inertia Base: Welded steel bases with a structural black steel channel frame, concrete reinforcing rods, bottom sheet steel pan, brackets for spring mounts welded to frame and adjustable motor slide rails.

.4 Type D – Curb-Mounted Base:

.1 Continuous Rail Type for Roof Mounted Equipment: Continuous rooftop isolation shipped completely assembled, consisting of:

.1 galvanized steel sections formed to fit roof curb and associated equipment with a flexible air and weather seal joining upper and lower rail sections;

.2 stable springs, cadmium plated and selected to provide minimum deflection with 50% additional travel to solid;

.3 neoprene cushioned and wind restraints allowing 6 mm (¼") movement before engaging and resisting wind loads in any lateral direction.

2.04 GENERAL VIBRATION ISOLATION SCHEDULES

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

Equipment	Base Type	Isolator Type	Equipment Installation	Static Deflection, mm (in.)	Notes
ERV Units	A	1	Floor Mounted	2.5 (0.1)	2
VRF Fan Coils	A	3	Ceiling Suspended	19 (0.75)	
Unit Heaters	A	3	Ceiling Suspended	25 (1)	
Condensing Units	A	1	Floor Mounted	2.5 (0.1)	1,3

Equipment	Base Type	Isolator Type	Equipment Installation	Static Deflection, mm (in.)	Notes
Hot Water Heaters	A	1	Floor Mounted	2.5 (0.1)	
Expansion Tanks	A	1	Floor Mounted	2.5 (0.1)	
Vertical Inline Pumps	A	1	Floor Mounted	2.5 (0.1)	
	N/A	3	Ceiling Suspended	25 (1)	4
Centrifugal Inline Fans, Cabinet Fans	A	2 or 3	Ceiling Suspended	6.4 (0.25)	
Small Fans, Fan Powered Boxes (up to 300 L/s)	A	2 or 3	Ceiling Suspended	13 (0.5)	
Small Fans, Fan Powered Boxes (301 L/s and up)	A	2 or 3	Ceiling Suspended	19 (0.75)	

1. Contractor to provide structural base if equipment is not suitable for direct isolation.
2. Unit to be provided with internal isolation.
3. Wind load calculations/restraints must be included for equipment located outdoors.
4. Provide inline pump suspension bracket if equipment is suspended.
5.

.2 Table above is for general reference only. Successful vibration isolation manufacturer is to review all equipment shop drawings and structural drawings in order to provide properly selected bases and isolators.

2.05 SPHERICAL TYPE FLEXIBLE CONNECTORS / EXPANSION JOINTS

.1 Double sphere or "twin sphere" complete with peroxide cured EPDM throughout with either Kevlar or Nylon tire cord, a ductile iron external ring between the two spheres, and either ductile iron or steel flanges. Provide control rods where required.

.2 Ensure materials are suitable for connecting piping and for service temperature and pressure.

.3 Acceptable manufacturers are: Mason Ind., Kinetics Noise Control, Vibro-Acoustics.

2.06 BRAIDED FLEXIBLE CONNECTORS

.1 Double wall, braided stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application.

.2 Acceptable manufacturers are: Mason Ind., Kinetics Noise Control, Vibro-Acoustics.

PART 3 - EXECUTION

3.01 INSTALLATION OF VIBRATION ISOLATION

.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 Refer to details on mechanical drawings for additional information.

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

.4 Do not install any rigid connections between equipment and building structure that degrades the noise and vibration isolation system herein specified. Electrical conduit connections to isolated equipment are to be looped to allow free motion of isolated equipment. Coordinate with Electrical Contractor as required.

.5 Ensure pipe, duct and electrical connections to isolated equipment do not reduce system flexibility. Ensure that pipe, conduit and duct passing through walls and floors do not transmit vibrations.

.6 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.

.7 Unless noted otherwise, provide flexible connectors for chillers, cooling towers and all pumps with motors higher than 3.7 kW (5 HP). Provide braided type for domestic water applications and for equipment located outdoors. Provide spherical type for all other equipment located indoors.

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

.9 Use the lowest RPM scheduled for 2-speed equipment.

.10 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.

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

.12 Use Type 3 spring hangers for a minimum static deflection of 25 mm (1") for all ceiling hung fans, air handling units and emergency generator exhaust silencers.

.13 Provide Type 3 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 (1-½") diameter. Provide the hangers for a distance of 4 m (13 ft.) plus 0.03 X (pipe diameter mm) from the vibrating source - e.g. for 250 mm (10") pipe, required distance is 4 m (13 ft.) plus 0.03 X 250 = 11.5 m (37.7 ft.). Use Type 1 pads under pipe pedestals on slab on grade. Bolt down equipment mounted on neoprene pad isolators using neoprene grommets.

.14 Provide thrust restraints (Type 5 isolators) for ceiling suspended or floor mounted units operating at 500 Pa (2" wc.) or more total static pressure.

.15 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.

.16 Vertical in-line pumps shall be supported by spring hangers having a static deflection of at least 32 mm (1-¼") plus an additional neoprene mount in the isolator. In addition, these pumps shall include a twin-sphere flexible connector 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.

.17 Cooling towers and/ or closed circuit fluid coolers are to be mounted on concrete piers extending above 1 m (3 ft.) above the slab and should be isolated form these piers using springs plus neoprene pads in series. Individual spring mounts with a minimum static deflection of 50 mm (2") 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.

.18 All boilers, including hot water boilers, are to be supported on 25 mm (1") thick 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 25 mm (1") of static deflection. This applies to all heating pipes over 50 mm (2") in diameter on the mechanical level. Pipes 50 mm (2") or smaller shall be isolated where clamped to shear walls using rubber or Armaflex sleeves.

.19 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.

.20 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.

.21 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).

.22 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.

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

3.02

3.03 CLEANING

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

END OF SECTION 20 05 20

CONTENTS

CONTENTS

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 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 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.

1.04 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 Health and Safety:

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

.4 Acceptable Manufacturers:

.1 Insulation: Fiberglas Canada Inc., Knauf Fiber Glass, Manson, Roxul.
.2 Preformed flexible elastomeric insulation: ARMACELL – AP Armaflex SS Pipe Insulation, Johns Manville, Rubatex.
.3 Tape: Avery Dennison, Mactac, Tuck, Compac.
.4 Canvas: Fattal Thermocanvas, Alpa-Maritex 3451-RW, Clairmont Diplag 60.
.5 Lagging adhesive: Childers CP.50A-HV2, Fosters 30-36 asbestos free.

1.05 SUBMITTALS

.1 Submit manufacturer’s printed product literature and datasheets for insulation adhesives, coatings and finishes, include product characteristics, performance criteria, physical size, finish and limitations in accordance with Section 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 - 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.

.7 Preformed flexible elastomeric closed cell insulation for installation on cold and dual temperature (hot and cold) system piping, valves and fittings: to ASTM C534. Thermal performance: 0.04 W/m/°C @ 24°C (0.28 btu/hr/in/sq ft/°F @ 75°F) established in accordance with ASTM C 177 or ASTM C 518 and CAN2-51.40-M80+Amendments. service temperature: -40°F to 203°F (-40°C to 95°C), tubular with self-sealing seams, noncombustible meeting 25/50 flame spread/smoke developed when tested to ASTM E84,a water vapour transmission rating of 0.08 in accordance with ASTM E96-90, Procedure A. Provide manufacturer specific sealer/adhesive.

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

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 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 50mm (2") thick rigid board or preformed. Score and mitre to fit contours of equipment and secure with 12mm x 0.38mm (2" 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 Chiller vessels and refrigerant suction lines: 20mm fire retardant closed cell Armaflex on evaporator, suction piping, and chilled water headers. Apply Armaflex with suitable adhesive and seal all joints with suitable plastic tape. For chiller heads, provide one or two piece slip-on field fabricated and fitted sections held in place with metal bands with screwdriver operated tightening devices. Cover all Armaflex with specified canvas. Do not insulate over registration and nameplates.

.4 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 (1/2" 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.

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

.6 Radiant Ceiling Panels: Provide 50mm (2") thick fibreglass batt insulation with a minimum of R-3.5 over all active sections of radiant ceiling panels.

.7 Radiant Floor Heating: Provide 50mm (2") thick fibreglass board insulation with a minimum of R-3.5 to the bottom surface of the floor structure.

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 including ERV outdoor air supply ductwork.

.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.
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 urinals and water closets and roof drain receptors and	0.033	25mm (1") pre-molded

Item	Conductivity Range W/mºC	Insulation Thickness & Type
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
Refrigeration suction and hot gas lines	0.04	40mm (1.5”) flexible elastomeric up to and including 25mm (1”). 45mm (1.75”) flexible elastomeric for pipe between 32mm (1-1/4”) to 50mm (2”). 50mm (2”) flexible elastomeric for pipe between 65mm (2-1/2”) to 100mm (4”).

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 and chilled water piping. Use mitred sections of the specified pipe covering or preformed insulation to suit fitting. 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:

.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 aluminium 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 Canvas over insulated items where exposed indoors.

.2 28 ga. aluminium over all insulated piping exposed to outdoors

.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 RADIANT PANELS

.1 Radiant ceiling panels: lay insulation over active sections only. Co-ordinate with Section 23 83 00 Sub-trade and follow panel Manufacturer’s instructions.

3.10 CLEANING

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

END OF SECTION 20 05 25

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

.1 This Section specifies requirements, criteria, methods and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

1.03 QUALITY ASSURANCE

.1 Qualifications: Execute work of this section only by skilled tradesmen regularly employed in the demolition of mechanical piping, equipment, ductwork, etc.

1.04 ASBESTOS AND HAZARDOUS MATERIALS

.1 If asbestos, PCBs or other hazardous materials are encountered in the course of the work, stop work in the vicinity of such materials and report their presence to the Owner and Consultant.

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 used for patching and finishing shall be of the same quality and texture as the adjacent undisturbed areas. Refer to Section 20 05 10 – Basic Mechanical Materials and Methods for additional information regarding cutting and patching.

PART 3 - EXECUTION

3.01 DISCONNECTION AND REMOVAL OF EXISTING MECHANICAL WORK

.1 Where indicated on drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight, unless otherwise specified.

.2 Contractor shall remove all abandoned piping, ductwork, insulation, hangers, equipment within project limits whether shown on drawings or not. Existing ductwork and piping rendered abandoned after demolition of equipment shall be removed.

.3 Drain down existing piping prior to demolition. Safely dispose of fluids within piping, unless specified otherwise.

.4 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.

.5 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.

.6 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused, except for following which are to be handed over to Owner at site. Materials which are to be handed over to the Owner shall be transported by the contractor to a location within the project site designed by the Owner. The contractor shall be liable for damage to existing salvaged equipment during removal and transporting.

.7 Where existing mechanical equipment, ductwork, piping, etc. penetrating walls is removed, leaving an opening in the wall, the wall shall be sealed and patched by the mechanical contractor. The opening shall be sealed commensurate with the rating of the rest of the wall.

.8 Perform cutting and patching on fire rated surfaces to maintain the existing fire rating.

.9 Contractor shall pay for all fees for disposal of equipment.

.10 Remove existing piping, ductwork, equipment, etc. as far back and as close to walls as possible, to leave the maximum amount of space for new construction activities.

.11 Removed materials shall not be reused in the new construction work unless specifically noted or approved.

3.02 EXAMINATION

.1 Verify that abandoned or removed apparatus and equipment serve only abandoned facilities.

3.03 DEMOLITION AND EXTENSION OF EXISTING HVAC WORK

.1 Remove, relocate and extend existing installation to accommodate new construction.

.2 Remove abandoned piping and ductwork to source of supply.

.3 Disconnect and remove existing apparatus and equipment where noted.

.4 Extend existing installations using materials and methods compatible with existing HVAC installations, or as specified.

3.04 PIPING

.1 All welded piping shall be cut off square at the locations indicated on the demolition drawings.

.2 All threaded piping shall be disconnected at the location indicated on the demolition drawings.

.3 All openings of an remaining valves, piping or fittings shall be closed off with weld caps or blind flanges to prevent debris from entering the existing systems.

.4 All pipe hangers, supports and/or anchors shall be removed along with all piping shown to be removed.

3.05 INSULATION

.1 Insulation shall be removed from all ductwork, piping, fittings, valves and equipment designated for demolition.

.2 Comply with all safety precautions related to insulation removal.

3.06 HAZARDOUS WASTE

.1 Be advised that items such as drainage sumps, catch basins, interceptors, and the like may contain unidentified hazardous waste and caution is to be taken when disconnecting and removing these items.

.2 If hazardous waste not listed in Specification is found, notify Owner and Consultant immediately and await directions.

3.07 INTERRUPTION TO AND SHUT-DOWN OF MECHANICAL SERVICES AND SYSTEMS

.1 Where disruptions of existing mechanical services are required, co-ordinate shut down with the Owner and do the work at a time and in a manner mutually acceptable.

.2 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.

.3 Submit a written concise schedule of each disruption at least 72 (seventy two) hours in advance and obtain Owner's written consent prior to implementation. Do not shut-down or

3.08 PIPE FREEZING

.1 Pipe freezing may be used to connect new piping to existing piping without draining existing piping. Pipe freeze equipment is to be equal to "NORDIC FREEZE" equipment supplied by Mag Tool Inc. or Rigid Tool Co. RIGID "SuperFreeze", or approved equal.

.2 Mechanical Line Stopping may also be utilized as an alternative to pipe freezing.

3.09 DECOMMISSIONING OR ALTERATIONS TO EQUIPMENT CONTAINING HAZARDOUS WASTE

.1 Remove and reclaim refrigerant, glycol and other hazardous waste materials from applicable equipment to be decommissioned and/or altered. Work is to be in accordance with Refrigerant Management Canada guidelines, and governing codes and regulations. Do not under any circumstances vent from existing equipment to atmosphere or drain into building drains.

.2 Use proper recovery equipment designed specifically to reclaim and recycle specific hazardous waste materials, and use only skilled mechanics to perform reclaim and recycle work.

.3 Provide approved, properly sized and sealable refrigerant containers for reclaimed hazardous waste.

.4 Dispose of reclaimed hazardous waste by engaging services of a licensed firm specializing in recycling of reclaimed hazardous waste. Submit copies of license of company performing work. Submit documentation to confirm hazardous waste has been properly removed from site and recycled or properly disposed.

3.10 ROOFING WORK

.1 Where roof revisions and/or replacements are part of project, include for disconnecting, lifting, or temporarily removing mechanical equipment on roof as required to permit completion of roofing work, and for re-installing equipment when roofing work is complete.

3.11 PROTECTIONS

.1 Contractor shall coordinate with all trades for all work specified in this project and shall provide the necessary barricades and dust control to protect Owner's personnel, the general public, etc. from injury, provide them safe passage to and from occupied portions of the building, and protect floors, walls, ceilings, furnishings, and equipment from damage or exposure to dust or debris.

3.12 CLEANING

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

END OF SECTION 20 05 40

CONTENTS

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 Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide all labour, material, methods and equipment to provide, where shown on the Drawings, 2-hour rated fire-resistive external insulation for ventilation and grease exhaust ductwork for zero mm clearance 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 in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples, include all 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

CONTENTS

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.

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 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.

1.04 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 **Hamilton** Building and Fire Department, the **Provincial** Building Code and the Owner's Insurance

.5 Arrange and pay for all inspections, examinations and tests required by all Authorities specified previously. Provide certificate, where given, to the Consultant.

1.05 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.

.5 Refer to: **Underwriters Laboratories and Factory Mutual for approved Fire Protection Equipment list: (ULC), (ULI) and (FM)**

1.06 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.

1.07 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 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 Divisions 26, 28.

.3 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.

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

.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 Divisions 26, 28.

.3 Co-ordinate and co-operate with Division 28 regarding required interconnections for alarm points.

3.04 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".

3.05 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.

3.06 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.

3.07 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.

3.08 HYDRAULIC DESIGN

.1 Confirm with the Authorities the allowable flow test data to be used in the design calculations.

.2 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.

3.09 TESTS

.1 Cooperate and co-ordinate with Divisions 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).

3.10 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

CONTENTS

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 Requirements 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

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 Submit shop drawings in accordance with Section 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, chrome plated couplings attached, 40mm (1½") A156 pressure restricting chrome plated valve with hydrolater, 65mm (2½") chrome plated angle hose valve with cap and chain, 40mm (1½") chrome plated Lexan straight stream fog nozzles and 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.

.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 are 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

CONTENTS

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 Requirements 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 underground parking areas; dry sprinkler system in loading dock area and preaction system for the elevator machine room and communications/IT room.

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 Submit shop drawings 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 Wet System: Level 1 Existing
.3 Wet System : Level 2 New

.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 gasketted 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 same manufacturer.
.7 Side outlet tees using rubber gasketted fittings are not permitted.
.8 Sprinkler pipe and fittings: Metal.
.9 Provide schedule 40 galvanized pipe and fittings for dry and preaction sprinkler systems.
.10 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.
.11 In pool areas provide galvanized sprinkler piping and fittings. Paint piping and fittings with corrosion resistant paint, color to be confirmed by architect. Provide stainless steel pipe hangers and rods for all exposed piping.

.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 with fusible links, except where noted, 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, and parking garage.
.12 Window sprinklers: Refer to architectural drawings to coordinate mullion locations and coordinate number and location of sprinkler heads to cover each section of window between mullions.
.13 FM and ULC listed and labelled sprinkler heads manufactured by Viking, Reliable and Star will also be accepted.
.14 Extended sprinkler heads are not allowed.
.15 In pool areas provide corrosion resistant UL listed sprinkler heads with polyester finish.

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 variable pressure type alarm valve complete with retarding chamber, alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories, and appurtenances for proper operation of system.

.4 Provide valve complete with internal components that are replaceable without removing the valve from the installed position.

2.06 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 where 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.

2.07 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.

2.08 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 Provide electrical power supply connections for pump and pilot light panel at supply side of building service panel.

.3 Provide separate fused safety-type switch with locked lever for each connection.

.4 Provide pressure pump sensing piping in supply piping.

.5 Pump operation switch: to operate excess pressure pump with pressure differential as indicated on drawings.

.6 Shut-off valve and strainer on pump inlet. Relief valve, check valve and shut-off valve on discharge connections.

2.09 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.

2.10 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.

2.11 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.

2.12 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.

2.13 SIGNS

.1 Attach properly lettered 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.

2.14 ANTI-FREEZE

.1 Anti-freeze loops to NFPA 13, locations as indicated.

2.15 RELIEF VALVE

.1 ULC listed.

2.16 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.

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 mechanical rooms to accommodate ductworks.

.6 Install chrome plated escutcheons for heads flush with wall and ceiling surface.

.7 Install all piping to provide maximum headroom.

.8 FM Approved equipment are to be used and details of the installation to conform to FM Global recommended good practices and FM Global Data Sheet 2-8N.

.9 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 and existing 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 - 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, to suit Sustainable Requirements. Contractor's Verification 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 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

CONTENTS

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, Stelpro, Wilson & Cousins.

1.05 SUBMITTALS

.1 Submit shop drawings in accordance with Section 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 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 CE-950-3 (for 6” wall) or 950-3-2 (for 4” wall) as indicated. All fronts: 5mm (3⁄16") Clear Float Glass.

.3 Use class K fire extinguishers in kitchen with commercial kitchen hood.

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 Fire blankets to be wall mounted within easy access to hazard area.

.5 Provide fire blankets for all labs, science rooms, biology room and physics rooms.

.6 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

CONTENTS

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 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, 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.

.2 Provide Municipal and Utility street services connections (Domestic and fire protection water, sewers, natural gas) as indicated on the site plan.

.3 Provide all compressed air and welding gas systems as shown.

.4 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 plumbing and drainage piping systems and site water supply and drainage services.

.2 Other acceptable manufacturers to specified items:

Plumbing Fixtures: Crane, Eljer, Kohler
Plumbing Brass: American Standard, Delta, Crane
Water Closet Seats: Moldex, Beneke, Olsonite
Drains and Specialities: Zurn, Watts

.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.

1.04 SUBMITTALS

.1 Submit shop drawings in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

.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, to suit Close-out Submittals and in accordance with Section 20 05 05, 20 05 01 and 20 05 10, 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, 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 START-UP AND COMMISSIONING

.1 Follow start-up and commissioning procedures in accordance with Section 20 05 10.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 22 05 00

CONTENTS

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 Requirements and Section 20 05 10 Mechanical Basic Materials and Methods.

.3 Comply with requirements of Section 22 05 00 Common Work Results for Plumbing.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide all potable and non-potable water pumps for plumbing systems.

.2 Section Includes:

.1 Materials and installation for plumbing pumps.
.2 Sustainable requirements for construction and verification.

.3 Related Sections:

.1 Division 01
.2 Division 02

1.03 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.

1.04 QUALITY ASSURANCE

.1 Materials and products in accordance with Division 02, to suit Sustainable Requirements.

1.05 SUBMITTALS

.1 Submit shop drawings in accordance with Section 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 DOMESTIC HOT WATER CIRCULATING PUMPS

.1 Capacity: as indicated on equipment schedules.

.2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. Design for the appropriate temperature and pressure and temperatures as indicated on equipment schedules for continuous service.

.3 Motor: as indicated on equipment schedules, drip-proof, with thermal overload protection.

.4 Supports: provide as recommended by manufacturer.

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 to suit Sustainable Requirements. Contractor's Verification 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 START-UP

.1 General:

.1 In accordance with Division 01, to suit General Commissioning (Cx) Requirements: 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). 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.

3.06 REPORTS

.1 In accordance with Division 01 and Sections 20 05 05 and 20 05 10 - 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.

3.07 TRAINING

.1 In accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.

3.08 CLEANING

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

END OF SECTION 22 10 10

CONTENTS

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 Requirements and Section 20 05 10 Mechanical Basic Materials and Methods.

.3 Comply with requirements of Section 22 05 00 Common Work Results For Plumbing.

1.02 WORK PERFORMEND BY THIS SECTION

.1 This section includes the requirements for all domestic water heaters and associated equipment, instrumentation and accessories to provide a complete working system.

1.03 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 CAN/CSA-B139, Installation Code for Oil Burning Equipment.
.3 CAN/CSA-B140.0, Oil Burning Equipment: General Requirements.
.4 CAN/CSA-B149.1, Natural Gas and Propane Installation Code.
.5 CAN/CSA-B149.2, Propane Storage and Handling Code.
.6 CSA B140.12, Oil-Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools.
.7 CAN/CSA C22.2 No.110, Construction and Test of Electric Storage Tank Water Heaters.
.8 CAN/CSA-C191, Performance of Electric Storage Tank Water Heaters for Household Service.
.9 CAN/CSA-C309-M90, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

1.04 QUALITY ASSURANCE

.1 Materials and products in accordance with Division 02, to suit Sustainable Requirements.

.2 Acceptable manufacturers: As detailed in each individual section.

1.05 SUBMITTALS

.1 Submit shop drawings in accordance with Section 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 DOMESTIC HOT WATER HEATERS

.1 Provide where shown on the Drawings and detailed in the equipment schedules, electric domestic hot water heater(s) with enameled steel jacket over CFC free insulated storage tank complete with thermostatically controlled immersion heater, storage tank and heater capacities as detailed in the equipment schedules. Provide hose end drain valve, ASME rated relief valve and heavy-duty anode rod as manufactured by GSW/Rheem/Ruud. Tank(s) of equivalent capacity and quality as manufactured by John Wood are also acceptable.

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 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 Provide structural steel for horizontal mounted tanks and for instantaneous heater.

.3 Provide insulation between tank and supports.

.4 Install oil burning domestic water heaters in accordance with CAN/CSA-B139.

3.03 FIELD QUALITY CONTROL

.1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

3.04 CLEANING

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

END OF SECTION 22 30 05

CONTENTS

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 Requirements and Section 20 05 10 Mechanical Basic Materials and Methods.

.3 Comply with requirements of Section 22 05 00 Common Work Results For Plumbing.

1.02 WORK PERFORMED BY THIS SECTION

.1 Section Includes:

.1 Materials and installation for plumbing specialties and accessories.
.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Division 01
.2 Division 02

1.03 REFERENCES

.1 American Society for Testing and Materials International (ASTM).

.1 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
.2 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA).

.1 AWWA C700, Cold Water Meters-Displacement Type, Bronze Main Case.
.2 AWWA C701, Cold Water Meters-Turbine Type for Customer Service.
.3 AWWA C702-1, Cold Water Meters-Compound Type.

.3 Canadian Standards Association (CSA International).

.1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.
.2 CSA-B79, Floor, Area and Shower Drains, and Clean-outs for Residential Construction.
.3 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 Plumbing and Drainage Institute (PDI).

.1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
.2 PDI-WH201, Water Hammer Arresters Standard.

1.04 QUALITY ASSURANCE AND REGULATORY COMPLIANCE

.1 Qualifications: Execute work of this section only by licensed tradesmen regularly employed in the installation of plumbing and drainage piping systems and site water supply and drainage services.

.2 Provide all Barrier Free Fixtures and Fittings to CAN/CSA-B651.
.3 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.
.4 Provide domestic hot water generation systems in compliance with ASHRAE 90.1 (latest version).
.5 Where stops or shut-off valves are specified for fixtures, provide ball type valves - rough brass where concealed and chrome plated where exposed.
.6 Acceptable manufacturers: Refer to Section 22 05 00.

1.05 SUBMITTALS

.1 Submit shop drawings in accordance with Section 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 FLOOR DRAINS

.1 Floor drains - finished areas (and showers) (FD-1):

Smith Series 2005A Floor Drain, all duco coated cast iron body, reversible clamp device and adjustable 5" diameter (127mm) nickel bronze ¼" (6.35mm) thick strainer, secured with SS screws, 4" (100mm) throat on strainer. In quarry or mosaic tiled areas, provide square 'B' - 5" x 5" (127mm x 127mm) polished bronze (PB) square strainer. Floor Drain with Hub provide 2005A-3580NB.

.2 Floor drains - mechanical rooms and unfinished areas (FD-2):

Smith Series 2320 Floor Drain, all duco coated cast iron body, seepage flange, adjustable collar, clamping device and 8" (200mm) diameter grate.

.3 Floor drains with combination funnel (unfinished areas) (FD-3):

Smith Series 2320-3591 Floor Drain, all duco coated cast iron body, seepage flange, adjustable collar, clamping service and 8½" (216mm) with 4" x 9" (101.6mm x 228.6mm) oval funnel.

.4 Line cleanouts:

.1 Smith Series 4420 Line Cleanout, in cast iron pipe with taper thread cover secured to body with full size pipe opening.

.5 Stack Cleanout:

.1 Smith Series 4510 Stack Cleanout, in base of cast iron stacks with neoprene gasketed secured cover. Where cleanouts are concealed behind finished walls access shall be made by 4530 round stainless steel plate and slotted flat head stainless steel screws.

.6 Floor cleanouts:

In unfinished areas and outside areas, Smith 'Twist to Floor' Series 4220 Floor Cleanout, duco coated cast iron body with integral clamp device, and removable positive seal closure plug and heavy duty 6" (150mm) adjustable cover secured with stainless steel screws, C.O. cast in cover. (For water proofed areas provide 'FC' flange with flashing clamp).

.1 In tiled areas, Smith Series 4140 Floor Cleanout, same as above with square nickel bronze cover and frame recessed for tile. Cover can be adjusted to suit floor lines when installing finished floor. (Mosaic tile provide series 4160 with square cover).
.2 In terrazzo areas, Smith Series 4180 Floor Cleanout, same as above with square nickel bronze cover and frame recessed for terrazzo. Cover can be adjusted to suit floor lines when installing finished floor.
.3 In carpeted areas, Smith Series 4020Y Floor Cleanout, same as above with nickel bronze cover and frame.
.4 In other finished areas, Smith Series 4020 Floor Cleanout, same as above with nickel bronze frame and cover (for medium load traffic).
.5 For heavy traffic areas, Smith Series 4100 Floor Cleanout, same as above with extra heavy nickel bronze cover and frame.

2.02 WATER HAMMER ARRESTORS

.1 P.P.P. INC. 'Water Hammer Arrestors' Series 'SC' with brass piston in a type 'K' copper casing size according to manufacturer's recommendations chart below to eliminate water hammer and shock from piping system. Provide Water Hammer Arrestors on hot and cold water supplies to all quick valves, solenoids, and plumbing fixtures, and locate in an upright position between the last two fixtures on a line, or horizontally at the end of line closest to supply source.

.2 On projects exceeding five stories in height, provide water hammer arrestors on domestic water risers as follows. Locate arrestors at the end of riser opposite supply source. Arrestor shall be two pipe sizes larger than the riser is at the connection point, not exceeding the largest pipe size diameter in the riser.

Size	Fixture Units	Model No.	Connection Size
A	1 - 11	SC - 500	½" (12mm)
B	12 - 32	SC - 700	¾" (20mm)
C	33 - 60	SC - 1000	1" (25mm)
D	61 - 113	SC - 1250	1¼" (32mm)
E	114 - 154	SC- 1500	1½" (38mm)
F	155 - 330	SC- 2000	2" (50mm)

2.03 BACK FLOW PREVENTERS

.1 Preventers: To CSA-B64 Series, **application as indicated, double check valve assembly.**

2.04 PRESSURE REGULATORS

.1 Capacity: as indicated.

.1 Inlet pressure: as indicated
.2 Outlet pressure: as indicated

.2 Up to NPS1-1/2 bronze bodies, screwed: To ASTM B62.

.3 NPS2 and over, semi-steel bodies, Class 125, flanged: To ASTM A126, Class B.

.4 Semi-steel spring chambers with bronze trim.

.5 For natural gas, provide CGA approved pressure regulating valves as manufactured by Fisher or Canadian Meter.

2.05 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Interior HB-1: Acorn 8121CR Chicago Faucets #5T-E27 12mm (½") wall type, C.P. rough bronze with hose end and vacuum breaker.

.2 Exterior HB-2: Smith Series 5509QT box type hydrant, 20mm (¾") non-freeze wall type with ¼ turn ceramic disc cartridge, bronze face and box, adjustable wall flange, operating key and self-draining integral vacuum breaker. Length to suit wall thickness.

.3 Interior Washdown HB-3: Smith 5509QTSAP 20mm (¾") size wall faucet with ¼ turn ceramic disc cartridge, nickel bronze face and box, wall flange, operating key and vandal proof lock assembly and self-draining vacuum breaker.

.4 Exterior Ground Hydrant HB-4: Smith series 5810HNB 20mm (¾") non freeze with bronze face and box, operating key and self-draining vacuum breaker. Length to suit frost depth.

.5 Washing machine hot/cold supply W-1.

Symmons 'Eliminator' #W-600-X single lever operated valve, hose end outlets, copper liner, service stops, ½" (12.7mm) H & CW connection, 1½" (38mm) drain outlet, provide 'P' Trap cast brass, 1½" (38mm) (concealed in wall).

2.06 WATER MAKE-UP ASSEMBLY

.1 Complete with backflow preventer pressure gauge on inlet and outlet, pressure reducing valve to CSA B356, pressure relief valve on low-pressure side and gate valves on inlet and outlet.

2.07 TRAP SEAL PRIMERS

.1 P.P.P. INC. Model PR-500 Automatic Cast Brass Trap Seal Primer Valve, serving individual or remote area drains with ½" (12mm) NPT (M to F) connections with strainer and integral back flow preventer and vacuum breaker. Complete with YS-8 Supply Tube.

.2 Electronic trap priming manifold: P.P.P. INC model [PT-4, PT-8, PT-12, PT-16, PT-20 or PT-24]. Electronic Trap Priming Manifold, where four or more traps requiring priming are within 100 feet proximity to each other, the unit shall supply a minimum of 10 oz. (0.10L) of water per opening, once in each 24 hour period based on a system pressure of 60 PSI (420 kPa). Factory assembled with a bronze body ball valve, water hammer arrestor, solenoid valve, atmospheric vacuum breaker and A type L copper manifold. Electronic single point power connection 120V 1 AMP Draw, manual override switch, and a 24 hour timer. Provide access panel if required.

.3 For areas with 4 or fewer drains within 30 meters proximity, provide MP-500-115V series electronic primers in conjunction with appropriate DU series distribution units.

2.08 STRAINERS

.1 **860** kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.

.2 NPS2 and under, bronze body, screwed ends, with brass cap.

.3 NPS2 1/2 and over, cast-iron body, flanged ends, with bolted cap.

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 in accordance with National Plumbing Code of Canada ,provincial codes, andlocal authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

.3 Connect fixtures, complete with supplies and drains, separately trapped, supported level and square. Provide chrome plated piping for all exposed water supply, waste and vent connections complete with CP escutcheons.

.4 Provide supports to set fixtures square and level.

.5 Obtain Consultant's acceptance of mounting heights of all wall mounted fixtures.

.6 Fixtures mounted on glazed tile surfaces: Provide ground faces to finished surfaces.

.7 Install water hammer arrestors for each fixture or group of fixtures.

3.03 CLEAN-OUTS

.1 Install clean-outs at base of soil and waste stacks, and rainwater leaders, at locations required code and as indicated.

.2 Bring clean-outs to wall or finished floor unless serviceable from below floor.

.3 Building drain clean-out and stack base cleanouts: Line size to maximum NPS4.

3.04 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures where indicated.

3.05 BACK FLOW PREVENTORS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.2 Pipe discharge to terminate over nearest drain and/or service sink.

3.06 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.07 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of the Consultant.

.3 Install soft copper or plastic tubing to floor drain.

3.08 STRAINERS

.1 Install with sufficient room to remove basket.

3.09 FLOOR DRAINS

.1 Floor drains: Provide with trap primers connected to nearest cold water flush valve, or to automatic primer or flush tank. Prime all floor drain traps.

3.10 EQUIPMENT INSTALLATION

.1 Hot Water Heaters: Install according to Manufacturer's instructions. Ensure all components are accessible.

.2 Pumps: Install in-line pumps to manufacturer's requirements.

.3 Install catch basins and manholes in accordance with municipal standards and the detail drawings.

.4 Install the hydro-pneumatic tank in accordance with manufacturers' requirements.

.5 Provide copper (plastic if outdoors) condensate drains with traps from all air handling equipment with cooling coils. Traps to provide water seal depth of 25 mm (1 in.) in excess of air handling system operating static pressure at point of drain connection. Consult equipment Manufacturer for information on operating negative static pressure in the drain pan area or air handling unit.

3.11 PIPE INSTALLATION

.1 General: Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.

.2 Install groups of piping parallel to each other on trapeze hangers; Space piping to permit application of insulation, identification and service access.

.3 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

.4 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.

.5 Install brass and copper pipe and tubing free from surface damage. Replace damaged pipe or tubing.

.6 Provide vents to atmosphere for all gas regulators as required by Code.

.7 Ream ends of pipes and tubes before installation.

.8 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.

.9 Provide non-toxic lubricant or teflon tape applied to male thread on all threaded connections.

.10 Clean ends of pipes or tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.

.11 Sanitary and storm drainage: Run piping to main sewers with uniform grade.

.12 Jointing of pipe: Compatible with type of pipe used.

.13 Water piping: Run water piping from service connection and connect to fixtures and equipment. At lavatories install supplies as high as possible.

.14 Provide washroom groups and branch take offs from mains with isolating valves. Install stop valve in each fixture supply.

.15 Where two or more branch recirculating hot water lines are connected to main recirculating line, provide lockshield globe valve and check valve in each branch line for balancing water flow and for prevention of back flow in one branch. Adjust balancing valves to provide recirculation through each circuit. Turn over lockshield valve key to Owner.

.16 Provide hose end ball valves for complete system drainage.

.17 Provide branch take-offs from mains of domestic hot and cold water lines with water balancing valves and shut off valves.

.18 Provide all parts of the plumbing system including all required venting in accordance with Part 7 of the Ontario Building Code to current amendments.

.19 Indirectly connect, to the sanitary sewer only, all drains and overflow lines from cooling towers.

3.12 START-UP

.1 Timing: Start-up only after:

.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.
.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

3.13 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01, to suit Sustainable Requirements: Contractor's Verification 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 Wood.
.8 Low-emitting materials.

3.14 TESTING AND ADJUSTING

.1 General: In accordance with Division 01, to suit General Commissioning (Cx) Requirements - General Requirements, supplemented as specified.

.2 Timing:

.1 After start-up deficiencies rectified.
.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: +/- 70kPa.
.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.
.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.5 Floor drains:

.1 Verify operation of trap seal primer.
.2 Prime using trap primer. Adjust flow rate to suit site conditions.
.3 Check operations of flushing features.
.4 Check security, accessibility, removability of strainer.
.5 Clean-out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O&M of cover and of valve.
.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
.3 Verify visibility of discharge from open ports.

.7 Access doors: Verify size and location relative to items to be accessed.

.8 Cleanouts: Verify covers are gas-tight, secure, yet readily removable.

.9 Water hammer arrestors: Verify proper installation of correct type of water hammer arrester.

.10 Wall, Ground hydrants:

.1 Verify complete drainage, freeze protection.
.2 Verify operation of vacuum breakers.

.11 Pressure regulators, PRV assemblies: Adjust settings to suit locations, flow rates, pressure conditions.

.12 Strainers:

.1 Clean-out repeatedly until clear.
.2 Verify accessibility of cleanout plug and basket.
.3 Verify that cleanout plug does not leak.

.13 Commissioning Reports: In accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements: reports, supplemented as specified.

.14 Training:

.1 In accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified.
.2 Demonstrate full compliance with Design Criteria.

3.15 CLEANING

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

END OF SECTION 22 42 01

CONTENTS

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 Requirements and Section 20 05 10 Mechanical Basic Materials and Methods.

.3 Comply with requirements of Section 22 05 00 Common Work Results For Plumbing.

1.02 WORK PERFORMED BY THIS SECTION

.1 Plumbing fixtures requirements including all trim and accessories to provide a complete working system.

1.03 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-B45 Series, Plumbing Fixtures.
.2 CAN/CSA-B125.3, Plumbing Fittings.
.3 CAN/CSA-B651, Accessible Design for the Built Environment.

.2 Green Seal Environmental Standards (GSES)

.1 Standard GS-36, Commercial Adhesives.

.3 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

1.04 QUALITY ASSURANCE

.1 Sustainable Requirements: Materials and resources in accordance with Division 01 to suit Sustainable Requirements.

.2 Fixtures: Manufacture in accordance with CAN/CSA-B45 series.

.3 Trim, fittings: Manufacture in accordance with CAN/CSA-B125.3.

.4 Exposed plumbing brass to be chrome-plated.

.5 Provide all Barrier Free Fixtures and Fittings to CAN/CSA-B651.

.6 Qualifications: Execute work of this section only by licensed tradesmen regularly employed in the installation of plumbing and drainage piping systems and site water supply and drainage services.

.7 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.

.8 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 SUBMITTALS

.1 Submit shop drawings in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

.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:

.1 Dimensions, construction details, roughing-in dimensions.
.2 Factory-set water consumption per flush at recommended pressure.
.3 (For water closets, urinals): Minimum pressure required for flushing.

.4 Provide operation and maintenance data for washroom fixtures, for incorporation into manual in accordance with Section 20 05 05 - Mechanical Work General Instructions.

.5 Include:

.1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
.2 Details of operation, servicing, maintenance.
.3 List of recommended spare parts.

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 MANUFACTURED UNITS

.1 Number, locations: as indicated.

.2 Fixtures in any one location to be product of one manufacturer and of same type.

.3 Trim in any one location to be product of one manufacturer and of same type.

.4 Fixture piping:

.1 Hot and cold water supplies to fixtures: Chrome-plated flexible supply pipes with handwheel stop, reducers, escutcheon.
.2 Waste:
.1 Brass p-trap with clean-out on fixtures not having integral trap.
.2 Chrome-plated in exposed places.

.5 Chair carriers: Factory manufactured floor-mounted carrier systems for wall-mounted fixtures.

2.02 PLUMBING FIXTURES AND BRASS

.1 Water Closet Floor Mounted Flush Valve (wheelchair use) (WC-1):

Kohler Highcliff Ultra Elongated bowl 428mm high K-96057-B-0 toilet, white vitreous china, floor mounted siphon jet flush action, operates in the range of 4.2L to 6L (1.1 US Gal to 1.6 US Gal) per flush, 54mm (2-1/8") fully glazed trapway, floor outlet, bolt caps, 38mm (1-1/2") top spud. Co-ordinate F.V. height with grab bars. (see arch. drawings). Kohler K-7531, exposed hybrid flushometer for top spud toilet, chrome plated, electronic infrared sensor with tripoint technology for accurate activation, 4.85L (1.28 US Gal) factory set flow, slow closing piston technology, A. D. A oscillating handle, back-check angle stop (screwdriver operated), flush tube for 292mm (11½") rough-in, vacuum breaker.

Centoco #820STS.001 heavy duty toilet seat, for elongated bowl open front, white solid plastic, with cover, reinforced stainless steel check hinges, metal flat washers stainless steel posts and nuts for public use. Provide Floor Flange with all brass bolts and with rubber gasket. Provide all items to Can/CSA-B651-M90.

.2 Lavatory Wall Hung (L-1):

Kast Flor Mini A1 RHS Concrete Basin, 530mm x 270mm x 80mm high (20-7/8" x 10-5/8" x 3-1/8" high), rectangular, concrete, stone finish. Kohler Purist K-T11840-CP wall-mount touchless faucet, lead free chrome plated solid brass body, vandal-resistant 1.9 LPM (0.5 GPM) aerator, 159MM (6-1/4") spout reach, K-11830 wall mount valve kit for touchless faucets, McGuire #8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32mm (1¼") size, shallow wall flange and seamless tubular wall bend. Jay R Smith Carrier series 0700-M31M, Heavy duty Basin Carrier, epoxy coated cast iron concealed arms with sliding adjustable arm brackets, heavy gauge steel uprights with integral welded feet. Minimum space required: for one unit: 102mm (4") for two to six units in a row: 152mm (6") finished metal stud wall to back of pipe space. Provide all items to Can/CSA-B651.

.3 Lavatory Wall Hung (L-2):

Kast Flor Mini C6 RHS Concrete Basin, 830mm x 350mm x 130mm high (32-5/8" x 13-3/4" x 5-1/8" high), rectangular, concrete, stone finish. Kohler Purist K-T11840-CP wall-mount touchless faucet, lead free chrome plated solid brass body, vandal-resistant 1.9 LPM (0.5 GPM) aerator, 159MM (6-1/4") spout reach, K-11830 wall mount valve kit for touchless faucets, McGuire #8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32mm (1¼") size, shallow wall flange and seamless tubular wall bend. Jay R Smith Carrier series 0700-M31M, Heavy duty Basin Carrier, epoxy coated cast iron concealed arms with sliding adjustable arm brackets, heavy gauge steel uprights with integral welded feet. Minimum space required: for one unit: 102mm (4") for two to six units in a row: 152mm (6") finished metal stud wall to back of pipe space. Provide all items to Can/CSA-B651.

.4 Lavatory Wall Hung (Wheelchair) (L-3):

Refer to architectural package. Complete with McGuire #LFH170BVRB, Faucet Supplies, chrome plated polished brass, commercial duty ¼ turn ball valve angle stops, 13mm (½") I. D. Inlet x 127mm (5") horizontal extension tubes, combination V. P. Loose key handle, escutcheons and stainless steel braided flexible riser. McGuire #8872C P-Trap, heavy cast brass adjustable body, with slip nut, 32mm (1¼") size, shallow wall flange and seamless tubular wall bend. Jay R Smith Carrier series 0700-M31M, Heavy duty Basin Carrier, epoxy coated cast iron concealed arms with sliding adjustable arm brackets, heavy gauge steel uprights with integral welded feet. Minimum space required: for one unit: 102mm (4") for two to six units in a row: 152mm (6") finished metal stud wall to back of pipe space. Provide all items to Can/CSA-B651.

.5 Janitors Mop Sink (MS-1):

Stern Williams SB-900- 'Serviceptor' Mop Sink, 24" x 24" x 12" (610mm x 610mm x 305mm) deep, floor mounted, Precast Terrazzo, with one piece stainless steel cast integral cap on all four sides and Integral Cast Brass Drain with S.S. strainer, 3" (75mm) outlet. Chicago Faucets #305VB-R-XK-Hose Faucet, C.P. 8" (203mm) C.C., wall mounted, solid cast brass leadfree body, ¼ turn ceramic disc valve cartridges, cast brass lever handles, body mounted vacuum breaker, integral stops, 36" (915mm) hose and hanger. Stern Williams #T-40 S.S. Mop Hanger, triple. Stern Williams #TC-3 Mop Sink Drain Gasket, connection for 3" (75mm) pipe. Stern Williams #BP S.S. Back Splash Panels, number of panels to suit installation. Provide 'p' Trap, same material as the connecting pipe drain.

.6 Single Compartment Stainless Steel Sink (S-1):

Blanco Quatrus R15 U 1 #401516 Single bowl countertop mount sink, 508mm x 413mm x 230mm deep (20” x 16” x 9” deep), counter mounted, 18-gauge type 304 stainless steel, stainless steel brushed finish, mounting kit provided, 90mm (3-1/2”) stainless steel strainer. Kohler Purist K-7505 Pull-out kitchen sink faucet with three function spray head, single lever handle, single hole installation, counter mounted, premium metal construction matte black (BL) finish, KOHLER ceramic disc valves, quiet braided hose and swiveling ball joint, three function pull-out spray head with touch-control, high-arch gooseneck spout and 360 degree spout rotation, temperature memory, 5.7 LPM (1.5 GPM) flow rate. McGuire #LFH170BV, Faucet Supplies, chrome plated polished brass, commercial duty ¼ turn ball valve angle stops, 13mm (½") I. D. Inlet x 127mm (5") horizontal extension tubes, combination V. P. Loose key handle, escutcheons and flexible copper riser. McGuire #8912CB P-Trap, heavy cast brass adjustable body, with slip nut, 38mm (1½") size, box flange and seamless tubular wall bend.

.7 Shower Cabinet (SH-1):

Refer to architectural package. Complete with Jay R. Smith #2005A, epoxy coated cast iron c/w water proofing flange, anchor flange, 5" (127mm) adjustable round nickel bronze strainer. Provide P-Trap same material as the connecting pipe drain. Provide "Aquaproof" polyethylene sheet floor safe as manufactured by G.F. Thompson Ltd. (905) 773 6420. Acceptable alternative floor safing: 24 ga. copper sheet or lead sheet at 0.08 kg per m^2.

.8 Mixing valve (MV 1):

Provide tempered water mixing valve –Symmons 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).

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:

.1 Standard: to manufacturer's recommendations or as indicated in architectural / Interior design drawings.
.2 Wall-hung fixtures: as indicated.
.3 Barrier free: To most stringent NBCC or CAN/CSA B651.

3.03 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.
.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
.3 Adjust flush valves to suit actual site conditions.
.4 Adjust urinal flush timing mechanisms.
.5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.

.3 Checks:

.1 Water closets, urinals: Flushing action.
.2 Aerators: Operation, cleanliness.
.3 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

CONTENTS

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 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, chillers, cooling towers, condenser, tanks, coils, unit heaters, air handling units, heat exchangers, rooftop HVAC units and other heating/cooling systems piped components.

.2 Air Distribution

.1 Provide a complete installation of ventilation systems as shown of the Drawings and Detail Drawings including ductwork, grilles, and diffusers, fans, VAV terminals, 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 Chillers to meet the energy efficiency requirement of CSA C743-02 Standard (latest edition). 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).

1.04 SUBMITTALS

.1 Submit shop drawings in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

.2 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, to suit Close-out Submittals and in accordance with Section 20 05 05, 20 05 01 and 20 05 10, 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 Pitch coils for air handling systems 18mm/m (3"/ft) toward access end of unit.

.7 Provide branch take-offs from mains of heating and cooling pipes with shut off valves.

.8 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.

.9 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.

.10 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

CONTENTS

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 Basic Mechanical Materials and Methods.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

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.

.3 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.

1.03 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 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.

.3 Health and Safety:

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

.4 The specifications are based on Raychem XL-Trace System.

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.

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 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
.1	3 in or less	5 watts
.2	4 in	5 watts
.3	6 in	8 watts
.4	8 in	2 strips – 5 watts
.5	12 in to 14 in	2 strips – 8 watts

.6 Provide power connection, end seal, splice and feed kit components to be applied in the field.

.7 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 **line** 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
Drainage Systems		
Storm	No	Yes
Sanitary	No**	Yes
Pumped pressure lines	Yes	Yes
Non-potable water systems	Yes	Yes

Notes:
.1 * Heat tracing used for fire protection system to be UL and ULc listed meeting the requirements of NFPA 13 and 14. Refer to Section 15500.
.2 ** Sanitary P-traps are required to be heat traced and insulated in unheated spaces.

3.05 CLEANING

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

END OF SECTION 23 05 33

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.1 Provide all refrigerant piping, fitting and accessories to provide a complete working system.

.2 Section includes:

.1 Materials and installation for refrigerant piping.
.2 Sustainable requirements for construction and verification.

1.03 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).

1.04 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Pre-Installation Meeting:

.3 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 suppliers and manufacturer's installation instructions and warranty requirements.

.4 Health and Safety:

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

.5 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.

.6 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

1.05 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

.2 Submit WHMIS MSDS in accordance with Section 20 05 01 and Division 02, to suit Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Provide maintenance and operation data for incorporation into manual as specified in Sections 20 05 01, 20 05 05 and 20 05 10.

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 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 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 CSA B52, EPS1/RA/1 and ASME B31.5 and Section 20 05 10 Basic Mechanical Materials and Methods.

3.03 REFRIGERATION SYSTEM

.1 Submit application to the Authority Having Jurisdiction and pay for all required fees. Obtain approval from 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 the 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 the 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 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, 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 the Consultant

.10 Verification requirements in accordance with Division 01 and 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 Section 20 05 05 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

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.1 Section includes:

.1 Materials and installation for ductwork and accessories including plenums and casings.
.2 Materials and installation of flexible ductwork, joints and accessories.
.3 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Division 01
.2 Division 02

1.03 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.

1.04 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Manufacture in accordance with SMACNA HVAC Duct Construction Standards.

.3 Flexible Ducts:

.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.

.4 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01, for construction and preoccupancy phases of building.

.5 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

.6 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, 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.

.7 Health and Safety:

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

.8 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.

.9 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

1.05 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and data sheet, indicate flexible connections, thermal properties, friction loss, acoustical loss, leakage, fire rating, smoke development in accordance with Section 20 05 01.

.2 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.

.3 Samples: Submit samples with product data of different types of flexible duct being used in accordance with Section 20 05 01.

.4 Manufacturer's Field Reports: Manufacturer's field inspection reports specified.

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 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.

.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 provided seam is sealed or caulked with high velocity duct sealer.

.4 Shower room exhaust ductwork: constructed of 316 stainless steel. Provide stainless steel hangers and stainless steel screws.

.5 Fume hood exhaust ductwork: constructed of 316 stainless steel and welded. Provide stainless steel hangers and stainless steel screws.

.6 Swimming pools exhaust ductwork: constructed of aluminium. Provide aluminium hangers and aluminium screws.

.7 Spin-on type connections from main trunk to VAV terminals may be used. Provide balancing dampers at all connections to ceiling diffusers.

.8 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.

2.02 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 Plenums for kitchen exhaust systems to be of same type of material as the system ductwork. Refer to kitchen exhaust duct section for material and installation requirements.

.3 Refer to detail drawings regarding air handling unit plenum access doors, drip trays and coil mounting, construction details.

.4 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.

2.03 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.

2.04 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. Refer to Section 23 33 53 for insulation requirement of flexible ducts. Use Flexmaster model T/L-VT and T/L-A for insulated and acoustic flexible ducts. 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 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 Ventilation ducts for refrigeration exhaust systems of chiller rooms to be extended to 300mm (12”) above finished floor.

.15 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 FLEXIBLE DUCTWORK 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"). Do not bend flexible ductwork any greater than 1.5 X diameter.

3.04 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 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 the Consultant

.2 Verification requirements in accordance with Division 01 and 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.

3.05 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

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.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
.2 Division 02

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 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Manufacture in accordance with SMACNA HVAC Duct Construction Standards.

.3 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01, for construction and preoccupancy phases of building.

.4 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

.5 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, 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.

.6 Health and Safety:

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

.7 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.

.8 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

1.05 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate flexible connections, duct access doors, turning vanes, instrument test ports in accordance with Section 20 05 01.

.2 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.

.3 Manufacturer's Field Reports: Manufacturer's field reports specified.

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 FLEXIBLE CONNECTIONS

.1 Frame: Galvanized sheet metal frame 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.

2.02 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. Refer to Detail Drawings.

.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 or foam rubber.

.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.
.6 300 x 300 mm glass viewing panels.

2.03 TURNING VANES

.1 Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.04 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.

2.05 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.

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 As indicated.
.1 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 the Consultant

.2 Verification requirements in accordance with Division 01 and 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

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.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 23 31 13 – Ductwork
.2 23 33 00 – Air Duct Accessories

1.03 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Health and Safety Requirements:

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

.3 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

1.04 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, 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.

1.05 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and datasheet. Indicate performance data, fire dampers, smoke dampers, fire stop flaps, operators, fusible links, design details of break-away joints in accordance with Section 20 05 01.

.2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Closeout Submittals

.1 Refer to Section 20 05 05.

.5 Spares:

.1 Provide maintenance materials in accordance with Division 01 and Section 25 05 01.
.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.

1.07 WARRANTY

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

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 or parallel blade type as indicated.

.2 Structurally formed steel, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel 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 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:brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.

.2 Disc: 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, actuator, zinc-aluminum foundry alloy casting cam follower.

2.05 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.

2.06 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").

2.07 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 Section 25 01 01 and are to be provided by Division 25 contractor. Coordinate actuator requirements with Division 25 contractor.

2.08 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 bronze end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.09 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: Configuration, metal thickness and construction to recommendations of SMACNA.

2.10 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 A B or C, listed and bear label of ULC meet requirements of provincial fire authority. 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 , round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section as indicated.

.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.

2.11 SMOKE DAMPERS

.1 Smoke Dampers: To be ULC or UL listed and labelled.

.2 Smoke dampers meeting or exceeding the following specifications shall be furnished and installed at locations shown on plans or as described in schedules. AMCA Certified smoke dampers shall meet the requirements of NFPA80, 90A, 92A, 92B, 101 and 105 and shall be classified as Smoke Dampers in accordance with the latest version of UL555S. The leakage rating under UL555S shall be Leakage Class 3. Smoke dampers shall be produced in an ISO 9001 certified factory and warrantied to be free from defects in material and workmanship for a period of 5 years after date of shipment.

.3 Square Damper frame shall be minimum 16 (1.6) gauge galvanized steel formed into a structural hat channel. Top and bottom frame members on dampers less than 13" (330) high shall be low profile design to maximize the free area of these smaller dampers. Damper blades shall be single skin galvanized steel 16 (1.6) gauge minimum with three longitudinal grooves for reinforcement. Bearings shall be stainless steel, permanently lubricated sleeve type turning in an extruded hole in the frame for maximum life. Jamb seals shall be stainless steel compression type.

.4 Round Damper frame shall be a minimum of 20 (.9) gage galvanized steel and blade shall be two piece 14 (19) gage equivalent thickness galvanized. Bearings shall be stainless steel, permanently lubricated sleeve type pressed in the frame. Damper seals shall be silicone rubber mechanically fastened between damper blades.

.5 Smoke dampers and their actuators shall be qualified in accordance with UL555S to an elevated temperature of 250°F (121°C) or 350°F (177°C). Appropriate electric shall be installed by the damper manufacturer at time of damper fabrication. Electric actuators, factory installed on dampers, shall have been tested for prolonged periods of holding (minimum 1 year with no evidence of reduced spring return performance). Each damper shall be rated for leakage and airflow in either direction through the damper. In addition to the leakage ratings already specified, the dampers shall be AMCA licensed for Air Performance.

.6 Actuator: Electrical control system actuated from smoke sensor or smoke detection system. Coordinate final termination with Division 26.

.7 Dampers to be as manufactured by Ruskin model SD35 or SDRS25

.8 Other Acceptable manufacturers: Kerr Hunt, Nailor Industries, EH Price.

2.12 COMBINATION FIRE AND SMOKE DAMPERS

.1 Provide as shown on drawings and as required by the Authority Having Jurisdiction, combination fire/smoke dampers meeting the requirements of NFPA90A, 92A, and 92B. Dampers shall have a fire rating in accordance with the latest edition of UL555 and shall be classified as Leakage Class I Smoke Dampers in accordance with the latest version of UL555S.

.2 Dampers to be complete with factory installed, tested, certified, listed and labelled 120v actuator (fail position: close), Ruskin electronic fusible link and switch package EFL/SP100 fully wired and connected to the required devices as one complete system and ready to be connected to the 120v electrical power.

.3 Damper: Similar to smoke dampers specified above.

.4 Combined actuator: Electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

.1 Inline duct application:
.1 Dampers to be as manufactured by Ruskin model FSD60-1.5 (1.5HR, leakage Class 1) and FSD60-3 (3 HR, leakage Class 1) to meet or exceed the wall and or floor fire-rating requirement that is shown on the architectural life safety drawings.
.2 Damper to be complete with built in smoke detector.
.3 Damper to close upon receiving a signal form the built-in smoke detector or upon sensing rise in temperature above the code required settings.
.4 Coordinate final termination with Division 26.

.2 Off the wall application:
.1 Dampers to be as manufactured by Ruskin model FSD60FA. 1.5 (1.5HR, leakage Class 1) and FSD60FA-3 (3 HR, leakage Class 1) to meet or exceed the wall and or floor fire-rating requirement that is shown on the architectural life safety drawings.
.2 Damper to close upon receiving a signal form the built-in smoke detector or upon sensing rise in temperature above the code required settings.
.3 Coordinate final termination with Division 26.

.5 Other Acceptable manufacturers: Kerr-Hunt, Nailor Industries, EH Price.

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 demonstrate that system is functioning as specified.

.2 Verification requirements in accordance with Division 01 and 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

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.1 Section Includes:

.1 Materials and installation for acoustic duct lining.

1.03 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, 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.

.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.

1.04 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01, for construction and preoccupancy phases of building.

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

.4 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

.5 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 Administrative, temporary and procedural requirements for the use of materials and methods of construction.

1.05 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 20 05 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.

PART 2 - PRODUCTS

2.01 DUCT LINER

.1 Flexible coated glass fibre blanket with noise absorbing properties to ASTM C1071 with NRC not less than .70 for rigid type and not less than 0.65 for flexible type based on Type A mounting to ASTM C423, thermal performance of .70 m2 C/W for 25mm (1”) thickness, in conformance to ASHRAE 62 and in compliance with CAN/ULC S102 and NFPA 90A and 90B.

.2 Surface burning characteristics: flame spread not exceed 25 and smoke development not to exceed 50 in accordance with CAN/ULC S102, NFPA 90A and NFPA 90B.

.3 Maximum velocity: 20.3 m/sec (4000 fpm).

.4 Non supportive of microbial growth, in accordance with ASTM C1338, when surfaces maintained in clean condition.

.5 Use fibrous glass rigid board type duct liner for rectangular ducts and flat surfaces. Minimum density is 48 kg/m3.

.6 Use flexible fibrous glass blanket type duct liner for round or oval ducts and surfaces. Minimum density is 24 kg/m3.

.7 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 as well as ASTM G-21 and G-22 for prevention of fungus and bacterial growth.

.8 Acceptable Manufacturers: Schuller, Knauf, Microtex, Certainteed, Owens-Corning.

2.02 ADHESIVE

.1 Adhesive: To NFPA 90A, NFPA 90B and ASTM C916.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -29°C to +93°C.

.3 Water-based fire retardant type.

2.03 FASTENERS

.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Polymer, nylon or metal retaining clips, 32 mm square.

2.04 JOINT TAPE

.1 Poly vinyl treated open weave fibreglass membrane 50mm wide.

2.05 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 -68°C to +93°C.

2.06 METAL INNER LINING

.1 22 gage (0.85mm) galvanized steel with 2.4mm (3/32”) diameter holes on 4.8mm (3/16”) or 6.4mm (1/4”) centers.

PART 3 - EXECUTION

3.01 GENERAL

.1 Do work in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible except as specified otherwise.

.2 Line inside of ducts where indicated.

.3 Duct dimensions, as indicated, are clear inside duct lining. Increase duct dimensions as necessary to compensate for liner thickness.

3.02 LINER INSTALLATION

.1 Install, with facing on the air stream side, to SMACNA HVAC Duct Construction Standards 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.

.4 Provide metal inner lining where indicated on drawings. Install in accordance with manufacturer's instructions and in accordance with SMACNA Duct Construction Standards.

3.03 LINER SCHEDULE

.1 Except where noted otherwise, provide ductwork liner as indicated in the following table:

.2 APPLICATION THICKNESS

Application	Thickness
1. Transfer air elbows and fan coil return air inlet ducts	25mm (1")
2. Exhaust within 3m (10 feet) of fan inlet	50mm (2")
3. Sound isolation boots	25mm (1")
4. Exhaust within 1.5m (5 feet) of inlet grille	25mm (1")
. Interior of air handling unit plenums	25mm (1")

Note: 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 90% 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, liners are to be installed with mechanical fastening devices in accordance with SMACNA Duct Construction Standards. Type of fastening device used is to be compatible with the liner and adhesive used without damaging the liner or adversely affecting the fire resistance rating of the liner or adhesive.
.1 Spacing of mechanical fasteners in accordance with SMACNA HVAC Duct Construction Standards.
.2 Ducts with interior widths of 200mm (8") or less do not require mechanical fasteners in addition to adhesive.

.2 In systems where air velocities exceeds 20.3 m/sec or wherever duct liner if preceded by unlined metal, install galvanized sheet metal nosing to leading edges of duct liner. Nosing may be formed on duct or be channel or zee attached by screws, rivets or welds.

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 Owner and/or Consultant.

.3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15mm 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.

.2 Separate waste materials for recycling and/or disposal in accordance with Division 01 and in accordance with the Waste Management Plan.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Collect and separate all packaging material for disposal in appropriate on site bins for recycling in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.7 Ensure emptied containers are sealed and stored safely.

.8 Fold up metal banding, flatten and place in designated area for recycling.

END OF SECTION 23 33 53

CONTENTS

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 Basic Mechanical Materials and Methods.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

.4 Comply with the requirements of Sections 20 05 30 Variable Frequency Drives, 20 05 35 Motors Starters – Low Voltage and 20 05 36 Motor Starters MCC – Low Voltage.

.5 Comply with the requirements of Section 20 05 20 Mechanical Vibration Control.

.6 Comply with the requirements of Section 23 33 00 Air Duct Accessories.

1.02 WORK PERFORMED BY THIS SECTION

.1 Section Includes:

.1 Fans, motors, accessories and hardware.

1.03 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Fan manufacturers, as applicable, are to be current members of the Air Movement and Control Association International Inc. (AMCA), and fans are to be rated (capacity and sound performance) and certified in accordance with applicable AMCA Standards.

1.04 REFERENCES

.1 Air Movement and Control Association Inc. (AMCA)

.1 11, Method of Evaluating Load Ratings and Bearings.
.2 200, Air Systems.
.3 201, Fans and Systems.
.4 211, Certified Ratings Program - Product Rating Manual for Fan Air Performance.
.5 311, Publication Certified Ratings Program – Product Rating Manual for Fan Sound Performance.
.6 99-0401-86, Classification for Spark Resistant Construction.
.7 99-2408-69 – Operating Limits for Centrifugal Fans.

.2 American National Standards Institute (ANSI), Air Movement and Control Association Inc. (AMCA):

.1 Standard 99, Standards Handbook.
.2 Standard 204, Balance Quality and Vibration Levels for Fans.
.3 Standard 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
.4 Standard 300, Reverberant Room Method for Sound Testing of Fans.
.5 Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.3 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

.1 Handbook, HVAC Applications.
.2 Fundamentals Handbook, Sound-Vibration.
.3 Fundamentals Handbook, Duct Design.
.4 HVAC System and Equipment Handbook, Fans.

.4 National Fire Protection Association (NFPA)

.1 70 - National Electrical Code
.2 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems
.3 92A - Recommend Practice for Smoke-Control System
.4 92B - Standard for Smoke Management System in Malls, Atria, and Large Areas
.5 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

.5 Occupational Health and Safety Act (OHSA)

.6 Underwriters Laboratories (UL):

.1 507 - Electric Fans
.2 555 - Fire Dampers
.3 555S - Smoke Dampers
.4 705 - Standard Power Ventilators
.5 762 - Standard Power Roof Ventilators for Restaurant Exhaust Appliances
.6 793 - Snow Load

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.05 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01. Include product characteristics, performance criteria, and limitations. Fan performance curves showing point of operation, kW and efficiency, sound rating data at point of operation. Indicate motors, sheaves, bearings, shaft details, minimum performance achievable with variable speed controllers.

.2 Quality assurance submittals: Submit following in accordance with Division 01 and to include:

.1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.2 Close-out Submittals: Provide operation and maintenance data for incorporation into manual specified in Section 20 05 05.

.3 Spare parts to include:

.1 Matched sets of belts.

.4 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.

1.06 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 GENERAL

.1 Performance ratings: Conform to AMCA standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210 and AMCA Standard 300 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for air and sound performance seal.

.2 Classification for Spark Resistant Construction Conform to AMCA 99.

.3 Each fan shall be given a balancing analysis which is applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance is 0.05 ounces (Balance grade of G6.3).

.4 Comply with the National Electrical Manufacturers Association (NEMA), standards for motors and electrical accessories.

.5 Execute work of this section in accordance with the manufacturer's instructions by workers only experienced in the installation of equipment.

.6 Unless otherwise listed, acceptable fan manufacturers are: Greenheck, Loren Cook, Penn, Reversomatic (for residential applications only).

2.02 VANE AXIAL FANS

2.03 RESIDENTIAL BATHROOM EXHAUST FAN

.1 Super quite bathroom exhaust fan equal to Reversomatic, model QK-130E.

.2 Motor shall be high efficiency (Energy Star Rating).

.3 Accessories and Options:

.1 Off white grille, mounting brackets and metal collar with neoprene damper.

PART 3 - EXECUTION

3.01 MANUFACTURER’S INSTRUCTIONS

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

3.02 FAN INSTALLATION

.1 Provide fans as indicated on drawings and in accordance with drawing schedule.

.2 Install fans as indicated and in accordance with manufacturer's instructions.

.3 For fans hung from structure, secure each fan in place from structure with vibration isolation, independent of connecting ductwork and in accordance with fan manufacturer’s instructions. Refer to Section 20 05 20 Mechanical Vibration Control for vibration isolation requirements.

.4 For base mounted fans, secure fans in place on concrete housekeeping pad complete with vibration isolation, level and plumb, all in accordance with fan manufacturer's instructions. Refer to Section 20 05 20 Mechanical Vibration Control for vibration isolation requirements.

.5 For roof mounted fans, supply a roof mounting curb with each fan and hand curbs to roofing trade on roof for mounting and flashing into roof construction as part of roofing work. Secure fans in place on curbs. Install dampers in curb damper tray (if applicable) and secure in place.

.6 For sidewall propeller fans, coordinate location(s) and size(s) of wall opening(s) with trade preparing the opening(s). Rigidly secure each fan and accessories in place to structure in accordance with fan manufacturer's instructions.

.7 Provide flexible electrical leads and flexible connections in accordance with Section 23 33 00 Air Duct Accessories**.**

.8 Provide sheaves and belts required for final air balance.

.9 Bearings and extension tubes to be easily accessible.

.10 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 Tests:

.1 Tests to demonstrate that system is functioning as specified.

.2 Verification requirements in accordance with Division 01 and 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

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 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.

1.03 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Health and Safety Requirements:

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

.3 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

.4 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.

.5 Grilles, registers and diffusers of same generic type, products of one manufacturer.

1.04 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01. Include product characteristics, performance criteria, and limitations. Indicate capacity, throw and terminal velocity, noise criteria, pressure drop and neck velocity.

.2 Samples:

.1 Submit samples in accordance with Section 20 05 01.

.3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Spares:

.1 Provide maintenance materials in accordance with Division 01 and Section 25 05 01.
.2 Provide following:
.1 Keys for volume control adjustment.
.2 Keys for air flow pattern adjustment.

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 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as required to meet sound and performance..

.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.

.5 For corrosive environments (pool areas) construction, fasteners, screws and supports shall be stainless steel.

2.02 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 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 stainless steel screws in countersunk holes where fastenings are visible.

.3 Bolt grilles, registers and diffusers, in place, 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 and 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

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.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.

1.03 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Health and Safety Requirements:

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

.3 Certificates:

.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 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)

1.05 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01. Include product characteristics, performance criteria, and limitations. Indicate pressure drop, face area, free area.

.2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Test Reports:

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

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 FIXED LOUVRES

.1 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.

.2 Other acceptable manufacturers: Nlailor, Ruskin, Ventex, Construction Specialities.

2.02 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. 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 a 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 DV-200.

.6 For single intake and exhaust boxes serving ERV unit provide Reversomatic model SVI-50 and SVE-50 respectively.

.7 Coordinate on site for the required wall box height to suit the application.

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 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.

3.04 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01 and 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 20

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.1 Section Includes:

.1 Materials and application of electric duct heaters.
.2 Sustainable requirements for construction and verification.

.2 Related Sections:

.1 Division 01
.2 Division 26

1.03 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 Health and Safety Requirements:

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

.3 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

.4 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

.5 Acceptable Manufacturers: RenewAire, Chromalos & FPE

1.04 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).

1.05 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01. 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 at operating and minimum airflow.

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 DUCT HEATERS

.1 Duct heater

.1 Shall be open coil heaters.
.2 Voltage, size, wattage, control type and control voltage shall be as scheduled on the drawings.
.3 Manufacturer shall be capable of furnishing heaters. Refer to mechanical schedules.
.4 Heaters shall be UL listed for zero clearance and meet all applicable requirements of the NEC.
.5 Electric duct heaters shall be independently powered.
.6 Type: Heaters shall be of the slip-in mount type for duct mounting.
.7 Duct heaters shall be for indoor use only.

.2 Heating Elements

.1 Open coil of resistance wire, 60 percent nickel, 20 percent chromium, and 20 percent iron supported and insulated by floating ceramic bushings. Heating element support structure shall consist of galvanized steel wire formed and constructed to support ceramic bushings through which the heating element passes.

.2 All heating elements shall be made of nickel/chromium resistance wire with ends terminated by means of staking and heliarc welding to machine screws.

.3 Coil Layout

.1 Vertical (air flow horizontal).

.4 Casing Assembly

.1 Slip-in type, galvanized-steel frame

.5 Coil terminals

.1 Shall be nickel plated, terminal insulators and bracket bushings shall be of ceramic and securely positioned.

.6 Control Box

.1 Control cabinet shall have a solid cover also of heavy gauge galvanized steel and held in place with hinges and interlocking disconnect switch.

.7 Orientation

.1 Heaters shall be interchangeable for mounting in a horizontal or vertical duct.

.8 Built-in components shall include disconnecting break magnetic contactors, transformer with primary fusing, pressure-type airflow switch set at 0.05" + 0.02" WC all as required by UL, branch circuit fuses per NEC, interlocking disconnect switch and a single terminal block to accept the number, type and size of conductors as required.

.9 Over-Temperature Protection

.1 Serviceable through electric duct heater without removing heater from duct or unit.

.2 Disk-type, automatic reset, thermal-cutout safety devices for primary over-temperature protection.

.3 Secondary over-temperature protection by built in disc type manually resettable thermal cutouts. These devices must function independently of one another and are not acceptable if series connected in the control circuit wiring.

.4 All duct heaters will require either a fan interlock circuit or an airflow switch. The airflow switch shall be diaphragm operated differential pressure switch to prevent duct heater from operating when there is no air flow.

.10 A disconnecting magnetic control circuit is required.

.11 Over-current protection by means of factory-installed fusing within the control cabinet shall be provided. Heating elements shall be subdivided and fused accordingly.

.12 All wiring, component sizing, component spacing and protective devices within the control cabinet shall be factory installed and comply with NEC and UL standards.

.13 Control Panel: Mounted on unit, with means of a safety disconnect and overcurrent protection. Include the following controls:

.1 Magnetic contactor.
.2 Single-stage
.3 24V control voltage

.14 A wiring diagram depicting layout and connections of electrical components within the control cabinet shall be affixed to the inside of the control cabinet cover.

.15 A rating plate label shall be affixed to the exterior of the control cabinet cover which states model number, serial number, volts, amps, phase, frequency, control volts, volt-amps and minimum airflow requirements.

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 Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements and Division 26.

.2 Provide test report and include copy with Operations and Maintenance Manuals.

.3 Verification requirements in accordance with Division 01 and 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 55 01

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.1 Section Includes:

.1 Materials and installation for Variable Refrigerant Volume (VRV) and Variable Refrigerant Flor (VRF) systems.
.2 System shall be a variable capacity multi-split system as indicated on drawings.
.3 The system shall consist of multiple evaporators using PID control, connected to a single condenser unit or multiple condenser units.
.4 Systems shall provide cooling and heating heat pump modes of operation.
.5 The system shall be designed & installed for minimum piping and maximum design flexibility.
.6 Indoor fan coil units to be equipped with matched electric reheat coil where indicated and fitted with mated return plenum filter box complete with pleated MERV-8 disposable filters.
.7 The VRV/VRF system shall be provided with integrated system controls by the equipment manufacturer as well as BACnet integration with the building HVAC automation system.
.8 Sustainable requirements for construction and verification.
.9 All indoor units are each capable of operating separately with individual temperature control.
.10 A dedicated hot gas pipe shall be required to ensure optimum heating operation performance.
.11 Two-pipe, heat recovery systems requiring separation of the gas and liquid refrigerant are not acceptable.
.12 Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box.
.13 Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, 3rd party thermostat or a BMS interface.

.2 Related Sections:

.1 Division 01
.2 Division 02
.3 Section 25 01 01 – Building Automation System.

1.03 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 Environment Canada (EC)

.1 EPS 1/RA/1 15, 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).

.6 National Fire Protection Association

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.04 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 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, 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.

.3 Health and Safety:

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

.4 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.

.5 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

.6 The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

.7 All wiring shall be in accordance with the Canadian Electrical Code (C.E.C.), Canadian Standards Association (CSA), Underwriters Laboratories Inc. (UL) and provincial and local codes as required.

.8 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.

.9 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).

.10 A dry air holding charge shall be provided in the indoor section.

.11 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 SUBMITTALS

.1 Provide manufacturer's printed product literature and datasheets and include product characteristics, performance criteria, physical size, finish and limitations in accordance with Section 20 05 01. Shop Drawings to include:

.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 Complete internal panel pneumatic tube piping and wiring and external panel pneumatic tube piping and wiring, both as schematics and as actually assembled.
.5 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.
.6 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, and controllers.
.7 Pump and fan performance curves.
.8 Details of vibration isolation.
.9 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
.10 Type of refrigerant used.

.2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Manufacturer's Field Reports: Manufacturer's field reports specified.

.5 Closeout Submittals

.1 Refer to Section 20 05 05.
.2 Include:
.1 Description of equipment giving manufacturers name, type, model year, capacity.
.2 Start-up and commissioning procedures.
.3 Details of operation, servicing and maintenance.
.4 Recommended spare parts list.

.6 Spares:

.1 Provide maintenance materials in accordance with Division 01 and Section 25 05 01.
.2 Provide one spare set of filters for each filter unit or filter bank.
.3 Furnish spare parts data for each different item of equipment specified, after approval of detail drawings.
.4 Include with data complete list of parts and supplies, with current unit prices, source of supply, recommended spare parts list for 1 year of operation and list of parts recommended by manufacturer to be replaced on routine basis.

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 VRV/VRF equipment shall be warranted by the manufacturer's limited warranty for a period of one year from date of installation or 18 months from date of delivery whichever is shorter. An extended warranty including 1 additional year parts and 5 additional years compressor shall be granted upon submission to the manufacturer and acceptance by the manufacturer of proper installation with documentation including:

.2 Selection output and layout of the VRV/VRF system.

.3 60 minutes of operational history upon commissioning from the VRV/VRF service tool.

.4 Completed commissioning report as per the VRV/VRF equipment manufacturer.

.5 During this period, any part failing to function properly due to faulty workmanship or material shall be repaired or replaced by the VRV/VRF equipment manufacturer including labor.

.6 The VRV/VRF system shall be installed by a licensed mechanical contractor trained by the VRV/VRF equipment manufacturer or certified manufacturer's agent.

.7 Commissioning shall be performed by the manufacturer or certified manufacturer's agent.

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

PART 2 - PRODUCTS

2.01 GENERAL

.1 The VRV/VRF system shall be a variable capacity, heat pump/air conditioning variable refrigerant volume type split system.

.2 System shall be a unified Heat Pump/Heat Recovery type for simultaneous cooling and heating (heat pump/hot gas).

.3 The condenser shall be a direct expansion (DX), air-cooled, heat recovery/heat pump multi-zone split air-conditioning system, with inverter driven variable speed compressor(s), using R-410A refrigerant.

.4 The VRV/VRF system shall consist of air cooled outdoor condensing units designed for ultra-low ambient heat pump operation.

.5 The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipment with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.

.6 Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

.7 All refrigerant lines shall be insulated and all joints and seams sealed. Exterior insulation shall be complete with all-weather jacket for UV, moisture, and bird protection.

.8 The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.

.9 Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition.

.10 The indoor units sound pressure shall range from 29 dB(A) to 43 dB(A) at low speed measured 5 feet below the ducted unit.

.11 The refrigerant connections shall be flare connections and the condensate will be 1-1/4" outside diameter PVC.

.12 A thermistor will be located on the liquid and gas line.

.13 The indoor units shall be equipped with a return air thermistor.

.14 Transmission (control) network wiring between outdoor and indoor unit(s) shall be a maximum total length of 4,920 feet (1500m).

.15 Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet (500m).

.16 The unit shall be equipped with auxiliary control of SCR type modulating reheat coil.

.17 The unit shall be compatible with interfacing with a BMS system via BACnet gateways.

.18 The outdoor units shall be equipped with manufacturer provided weather baffle.

.19 The condensing unit may connect an indoor evaporator capacity up to 130% to that of the condensing unit capacity.

.20 The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls.

.21 The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, brazed plate heat exchanger, electronic expansion valves, solenoid valves, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and liquid receivers. Liquid and suction lines must be individually insulated between the condensing and indoor units.

.22 Each condensing system shall be able to support the connection of up to 36 indoor units, dependent on the model of the condensing unit.

.23 System shall have an operating outdoor ambient temperature range of 23°F to 115°F DB for standard operation and -4°F to 60°F WB for heating.

.24 Unit shall be compatible with a Manufacturer Touch Screen controller.

.25 The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.

.26 Each condensing unit shall incorporate contacts for electrical demand shedding from a central BMS, utility control or demand meter.

.27 The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.

.28 The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heater, fusible plug, overload relay, inverter overload protector, thermal protector for compressor motor, over current protection for the inverter and anti-recycling timer.

.29 To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.

.30 Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.

2.02 MATERIALS

.1 Materials and products in accordance with Division 01 to suit Sustainable Requirements: Construction.

2.03 4-WAY CEILING-RECESSED INDOOR UNIT

.1 General:

.1 The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

.2 Unit Cabinet:

.1 The cabinet shall be space saving, low profile height of 8-3/16” or less, ceiling-recessed—with four face-mounted supply air vanes and return air grille.
.2 The cabinet panel shall have provisions for a field installed filtered outside air intake.

.3 Fan:

.1 Indoor units shall feature adjustable external static pressure settings up to 0.20 in. WG.
.2 The indoor unit fan shall be an assembly with one statically and dynamically balanced Turbofan direct driven by a single motor with permanently lubricated bearings.
.3 The indoor fan shall consist of three (3) speeds, High, Mid, and Low.

.4 Filter:

.1 Return air shall be filtered by means of a standard factory installed return air 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.
.3 The unit shall be provided with an integral condensate lift mechanism able to raise drain water 19-11/16” inches above the condensate pan.

.6 Electrical:

.1 The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
.2 The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

.7 Controls:

.1 Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
.2 Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
.3 Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
.4 Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.04 CEILING-CONCEALED DUCTED INDOOR UNIT

.1 General:

.1 The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

.2 Unit Cabinet:

.1 The cabinet shall be ceiling-concealed, ducted with a fixed rear return and a horizontal discharge supply.
.2 The cabinet panel shall have provisions for a field installed filtered outside air intake.

.3 Fan:

.1 Indoor unit shall feature multiple external static pressure settings ranging from 0.14 to 0.60 in. WG.
.2 The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function.
.3 The indoor unit fan shall be an assembly with one or two statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.

.4 Filter:

.1 Return air shall be filtered by a field-supplied 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.
.3 Coil shall be provided with a sloped drain pan. Units without sloped drain pans which must be installed cockeyed to ensure proper drainage are not allowed.

.6 Electrical:

.1 The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
.2 The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

.7 Controls:

.1 Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.
.2 Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.
.3 Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
.4 Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.05 WALL MOUNTED INDOOR UNIT

.1 General:

.1 The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, 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 Unit 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 Basis of design indoor units include factory-installed LEV/EEV. Alternative brands which require field-installed, accessory LEV or EEV kits are permissible only with written Engineer and Architect approval for the location of kits being submitted two weeks prior to bid date. EEV kits mounted in cavities inside fire-rated interior walls shall be mounted inside three hour fire rated enclosures with access panels supplied by the manufacturer. Enclosure type and placement require prior approval.

.2 2The 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.

.3 The coils shall be pressure tested at the factory.

.4

.6 Electrical:

.1 The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

.7 Controls:

.1 The unit shall include an IR receiver for wireless remote control flexibility

.2 Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

.3 Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

.4 Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

.5 Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.06 0STANDARD EFFICIENCY (HEAT RECOVERY), AIR COOLED OUTDOOR UNITS

.1 General:

.1 The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

.2 Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

.3 Outdoor unit shall have a sound rating no higher than 66.5 dB(A) individually or 69.5 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 55 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

.4 Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

.5 The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.

.6 The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.

.7 The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.

.8 VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

.9 The outdoor unit shall be capable of operating in heating mode down to -18□F ambient temperatures or cooling mode down to 23□F ambient temperatures, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.

.10 The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.

.11 Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.

.12 While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature. Systems that keep fans running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

.13 In reverse defrost all refrigerant shall be bypassed in the main branch controller and shall not be sent out to the indoor units, systems that flow refrigerant through indoor units during reverse defrost shall not be allowed.

.14 The outdoor unit shall be capable of operating in cooling mode down to -10 degrees F with optional manufacturer supplied low ambient kit.

.1 Low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.

.2 Low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

.3 Low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.

.15 The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.

.16 VRF four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.

.2 Unit Cabinet:

.1 The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

.2 Outdoor unit components shall be coated with the Seacoast Protection Coating (Brine Spray – BS coating) to protect components from premature corrosion due to a seacoast environment. Coating shall be applied to components before original outdoor unit assembly to ensure manufacturer quality standards are not compromised and shall meet the following minimum requirements:

.1 ≥85µm thermoset polyester-resin powder coating on External Front Panel
.2 ≥70µm thermoset polyester-resin powder coating on External Panel Base, Pillar, Compressor Cover, Fan Motor Support, Electrical Box
.3 ≥1µm cellulose and polyurethane-resin coating on heat exchanger fins
.4 ≥10µm polyurethane coating on printed circuit boards
.5 The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.
.6 Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

.3 Fan:

.1 Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG. external static pressure, but capable of normal operation with a maximum of 0.32 in. WG. external static pressure via dipswitch.
.2 All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
.3 All fans shall be provided with a raised guard to prevent contact with moving parts.

.4 Refrigerant and Refrigerant Piping:

.1 R410A refrigerant shall be required for systems.
.2 Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
.3 Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
.4 All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
.5 Refrigerant line sizing shall be in accordance with manufacturer specifications. Future changes to indoor unit styles or sizes must be possible without resizing/replacing refrigerant piping to any other branch devices or indoor units.

.5 Coil:

.1 Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil.
.2 Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
.3 The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
.4 The coil fins shall have a factory applied corrosion resistant blue-fin finish. Uncoated aluminum coils/fins are not allowed.
.5 The coil shall be protected with an integral metal guard.
.6 Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

.7 Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.

.8 Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed in markets where the outdoor unit will see temperatures below freezing

.6 Compressor:

.1 Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.

.2 Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.

.3 Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturer's that utilize belly-band crankcase heaters will be considered as alternate only.

.4 Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.

.5 The compressor shall be equipped with an internal thermal overload.

.6 Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

.7 Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

.7 Controls:

.1 Outdoor unit shall include Variable Evaporator Temperature or comparable method of varying system evaporator (refrigerant) temperature in order to reduce compression ratio and power consumption during light load or mild ambient temperatures. Multiple evaporator refrigerant temperature settings shall be required in order to optimize efficiency within required system-specific performance and installation constraints. System shall reduce compression ratio only when/if all indoor units are within 1.8F of setpoint; reducing compression ratio based solely on ambient temperature risks discomfort and is not allowed. Variable Evaporator Temperature or comparable method shall incorporate override or disable capability based on external signal to allow for space humidity control or load demand.The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.

.2 Each outdoor unit module shall have the capability of 4 levels of demand control based on external input.

.8 Electrical:

.1 The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 575 volts, 3-phase, 60 hertz per equipment schedule.
.2 The outdoor unit shall be controlled by integral microprocessors.
.3 The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.07 BRANCH CIRCUIT (BC) CONTROLLERS AS REQUIRED FOR SIMULTANEOUS HEAT/COOL SYSTEMS

.1 General

.1 BC (Branch Circuit) Controllers (or comparable branch devices) shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices which do not include controlled refrigerant subcooling risk bubbles in liquid supplied to indoor unit LEVs and are not allowed.
.2 BC Controllers (or comparable branch devices) shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish and be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. BC Controllers (or comparable branch devices) shall be suitable for use in plenums in accordance with UL1995 ed 4.

.2 BC Unit Cabinet:

.1 The casing shall be fabricated of galvanized steel.
.2 Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
.3 The unit shall house two tube-in-tube heat exchangers.

.3 Refrigerant Piping (specifications in addition to those for outdoor unit):

.1 All refrigerant pipe connections shall be brazed.
.2 Future changes to indoor unit quantities or sizes served by BC Controller or comparable branch device must be possible with no piping changes except between the branch device and indoor unit(s) changing. Systems which might require future piping changes between branch device and outdoor unit—if changes to indoor unit quantities or sizes are made—are not considered equal and are not allowed.

.4 Refrigerant valves:

.1 Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.

.5 Future Use Branch:

.1 Each VRF system shall include at least one (1) unused branch or branch device for future use. Future-use branches or branch devices shall be fully installed & wired in central location with capped service shutoff valve & service port.

.6 Condensate Management:

.1 BC Controller (or comparable branch device) must have integral resin drain pan or insulate refrigeration components with removable insulation that allows easy access for future service needs. Cabinets filled with solid foam insulation do not allow for future service and are not allowed.

.7 Electrical:

.1 The unit electrical power shall be 208/230 volts, 1 phase, 60 Hertz. The unit shall be capable of satisfactory operation within voltage limits of 187-228 (208V/60Hz) or 207-253 (230/60Hz).
.2 The BC Controller shall be controlled by integral microprocessors
.3 The control circuit between the indoor units and outdoor units shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.08 STANDARD EFFICIENCY RAPID CHANGEOVER (HEAT PUMP), AIR-COOLED OUTDOOR UNITS

.1 General:

.1 The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
.2 Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.
.3 Outdoor unit shall have a sound rating no higher than 65 dB(A) individually or 70 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 54.5 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
.4 The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.
.5 The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.
.6 The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
.7 VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.
.8 The outdoor unit shall be capable of guaranteed operation in heating mode down to -13 degrees F ambient temperatures, simultaneous heating/cooling mode from 14-70 degrees F ambient temperatures, and cooling mode up to 109□F without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.

.9 The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.

.10 Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.

.11 While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

.12 The outdoor unit shall be capable of operating in cooling mode down to -10 degrees F with optional manufacturer supplied low ambient kit.

.1 Low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.

.2 Low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

.3 Low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.

.4 The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized snow /hail guard. The snow/hail guard protects the outdoor coil surfaces from hail damage and snow build-up in severe climates.

.5 VRF four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.

.2 Unit Cabinet:

.1 The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

.2 Outdoor unit components shall be coated with the Seacoast Protection Coating (Brine Spray – BS coating) to protect components from premature corrosion due to a seacoast environment. Coating shall be applied to components before original outdoor unit assembly to ensure manufacturer quality standards are not compromised and shall meet the following minimum requirements:

.1 ≥85µm thermoset polyester-resin powder coating on External Front Panel

.2 ≥70µm thermoset polyester-resin powder coating on External Panel Base, Pillar, Compressor Cover, Fan Motor Support, Electrical Box

.3 ≥1µm cellulose and polyurethane-resin coating on heat exchanger fins

.4 ≥10µm polyurethane coating on printed circuit boards

.3 The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.

.4 Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

.3 Fan:

.1 Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. wg external static pressure, but capable of normal operation with a maximum of 0.32 in. WG external static pressure via dipswitch.
.2 All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
.3 All fans shall be provided with a raised guard to prevent contact with moving parts.

.4 Refrigerant and Refrigerant Piping

.1 R410A refrigerant shall be required for systems.
.2 Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.
.3 Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.
.4 All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.
.5 Refrigerant line sizing shall be in accordance with manufacturer specifications.

.5 Coil:

.1 Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil.
.2 Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.
.3 The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
.4 The coil fins shall have a factory applied corrosion resistant blue-fin finish. Uncoated aluminum coils/fins are not allowed.
.5 The coil shall be protected with an integral metal guard.
.6 Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
.7 Unit shall have prewired plugs for optional panel heaters when operating below ambient conditions of 1F to prevent any residual ice buildup from defrost.
.8 Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.

.6 Compressor:

.1 Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.

.2 Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.

.3 Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.

.4 Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.

.5 The compressor shall be equipped with an internal thermal overload.

.6 Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

.7 Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

.7 Controls:

.1 Outdoor unit shall include Variable Evaporator Temperature or comparable method of varying system evaporator (refrigerant) temperature in order to reduce compression ratio and power consumption during light load or mild ambient temperatures. Multiple evaporator refrigerant temperature settings shall be required in order to optimize efficiency within required system-specific performance and installation constraints. System shall reduce compression ratio only when/if all indoor units are within 1.8F of setpoint; reducing compression ratio based solely on ambient temperature risks discomfort and is not allowed. Variable Evaporator Temperature or comparable method shall incorporate override or disable capability based on external signal to allow for space humidity control or load demand.

.2 The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed system controllers, control voltage transformers and/or signal boosters shall be provided by the manufacturer.

.3 The outdoor unit shall have the capability of 4 levels of demand control for each refrigerant system based on external input.

.8 Electrical:

.1 The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 575 volts, 3-phase, 60 hertz per equipment schedule.

.2 The outdoor unit shall be controlled by integral microprocessors.

.3 The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.09 CONTROLS

.1 The controller shall be a BACnet device with the capability of connecting to the BACnet-based BAS system via the BAS IP network.

.2 The BACnet device shall be BACnet Testing Laboratory (BTL) listed.

.3 This contractor is responsible for mapping the controller register information to the BACnet device.

.4 It is recognized that not all manufactures controller registers have the same configuration parameters and values. Also depending on the configuration of the equipment c/w options as determined by the engineer some objects made not be available. This contractor will provide in their shop drawing submittal the following information as required:

.5 Modbus listing of the values available in the controller register.

.6 BACnet Object list based on the Modbus register values. This contractor shall also indicate the objects not available from the minimum listing requirements provided below.

.7 This contractor shall provide all of the BACnet objects available that represent the configuration requirements of the equipment. This contractor shall provide the following Objects at a minimum.

Required Objects (Typical for each Zone)					
Object List	Read/ Write	Object Type	Alarm Y/N	Trend Y/N	Description (acceptable value range)
Typical Fan Coil					
Start/Stop Status	R	BI	Y	Y	
Cooling/Heating Operation Status	R	MSI	Y	Y	
Cooling/Heating Operation Setting	R	MSO			
Alarm	R	BI	Y	Y	
Error Code	R	MSI	Y	Y	
Fan Speed Setting	W	AO			
Filter time/Service Alert & Reset	R/W	BI	Y		
Active Htg/Cool Status Indoor Unit	R	MSI	Y	Y	“Thermo-On”
Space Setpoint	W	AO		Y	
Space Temperature	R	AI		Y	
Aux. Heater Operation Status	R	BI		Y	
Indoor Fan Speed Status	R	AI	Y	Y	
Outdoor Unit					
% Heat Load	R	AI		Y	
% (cc) Load	R	AI		Y	
Start/Stop Command	W	BO			
Start/Stop Status	R	BI	Y	Y	

2.10 ACCEPTABLE MANUFACTURERS

.1 Acceptable Manufacturers include: Mitsubishi, Daikin, LG.

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 on roof curbs.

.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 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 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 the Consultant

.2 Verification requirements in accordance with Division 01 and 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 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.4 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.

.5 Performance Verification:

.1 Verify accessibility, serviceability of components including motorized dampers, 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 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified herein. Include:

.1 Report Forms and Schematics.

3.05 DEMONSTRATION

.1 Training: Provide training in accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, 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

CONTENTS

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 Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

.3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

.1 Section Includes:

.1 Air-to-Air Energy Recovery Ventilators for rooftop installation.
.2 Within this document, these units may be referred to as Energy Recovery Ventilator (ERV) for brevity.
.3 Sustainable requirements for construction and verification:

.2 Related Sections:

.1 Division 01
.2 Division 02

1.03 REFERENCES

.1 American National Standards Institute (ANSI)/Air Conditioning, Heating and Refrigeration Institute (AHRI)

.1 ANSI/AHRI 1060, Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment.
.2 ANSI/AHRI 270, Sound Rating of Outdoor Unitary Equipment.

.2 American National Standards Institute (ANSI)/Air Movement and Control Association (AMCA)

.1 ANSI/AMCA 204**,** Balance Quality and Vibration Levels for Fans.

.3 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.

.4 Canadian Standards Association (CSA International)

.1 CSA C22.1 HB, Canadian Electrical Code Handbook.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 National Fire Protection Association

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.04 QUALITY ASSURANCE

.1 Materials in accordance with Section 20 05 05 and 20 05 10.

.2 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, 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.

.3 Health and Safety:

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

.4 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.

.5 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

1.05 SUBMITTALS

.1 Provide manufacturer's printed product literature and datasheets and include product characteristics, performance criteria, physical size, finish and limitations in accordance with Section 20 05 01. Shop Drawings to include:

.1 Unit performance data for both Supply Air and Exhaust Air, with system operating conditions indicated.
.2 Enthalpy plate performance data for both summer and winter operation.
.3 Motor ratings and unit electrical characteristics.
.4 Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
.5 Estimated gross weight of each installed unit.
.6 Filter types, quantities, and sizes
.7 Installation, Operating and Maintenance manual (IOM) for each model.

.2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Manufacturer's Field Reports: Manufacturer's field reports specified.

.5 Closeout Submittals

.1 Refer to Section 20 05 05.
.2 Include:
.1 Description of equipment giving manufacturers name, type, model year, capacity.
.2 Start-up and commissioning procedures.

.3 Details of operation, servicing and maintenance.
.4 Recommended spare parts list.

.6 Spares:

.1 Provide maintenance materials in accordance with Division 01 and Section 25 05 01.
.2 Provide one spare set of filters for each filter unit or filter bank.
.3 Furnish spare parts data for each different item of equipment specified, after approval of detail drawings.
.4 Include with data complete list of parts and supplies, with current unit prices, source of supply, recommended spare parts list for 1 year of operation and list of parts recommended by manufacturer to be replaced on routine basis.

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.

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

PART 2 - PRODUCTS

2.01 GENERAL

.1 Air-to-Air Energy Recovery Ventilators shall be fully assembled at the factory and consist of a fixed-plate cross-flow heat exchanger with no moving parts, an insulated single wall G90 galvanized 20-gauge steel cabinet, outdoor air hood with bird screen, filter assemblies for both intake and exhaust air, enthalpy core, supply air blower assembly, exhaust air hood, exhaust air blower assembly and electrical control box with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection. Entire unit with the exception of field-installed components shall be assembled and test operated at the factory.

.2 Acceptable Manufacturers: RenewAire, Cook, Trane

2.02 CABINET

.1 Materials: Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.

.2 Outside casing: 20 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish.

.3 Access doors shall be hinged with airtight closed cell foam gaskets. Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement.

.4 Unit shall have factory-installed duct flanges on all duct openings.

.5 Cabinet Insulation: Unit walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with a minimum R-value of 4.3 (hr-ft2-°F/BTU).

.6 Enthalpy core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing. The energy recovery core shall have a ten year warranty. Performance criteria are to be as specified in AHRI Standard 1060.

.7 Control center / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections to the non-fused disconnect.

.8 Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10ºF and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

.9 Motorized Isolation Damper(s): None included.

2.03 BLOWER SECTION

.1 Blower section construction, Supply Air and Exhaust Air: Blower assemblies consist of a 120V, 1 Phase, 60 HZ, ECM motor, and a direct driven forward-curved blower.

.2 Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

2.04 MOTORS

.1 Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be ECM and be shall be supplied with factory installed motor starters. Direct drive models (EV450 and HE1X models) shall be EISA-compliant for energy efficiency with open drip proof design and integral thermal protection.

2.05 UNIT CONTROLS

.1 Timeclock

.1 Digital Time Clock wall mount, with up to 8 on/off cycles per day or 50 per week, 24VAC power, with battery backup protection of program settings against power failure to energize unit

.2 Carbon Dioxide: Adjustable control from 600 - 2000 PPM for duct mounting with digital display

.3 Factory-installed microprocessor controller and sensors, Enhanced ERV controls that:

.1 The microprocessor controller shall be capable of operating at temperatures between -20F to 160F
.2 The microprocessor controller shall be a DIN rail mounting type
.3 Factory-installed microprocessor controller shall come with backlit display that allows menu-driven display for navigation and control of unit
.4 The microprocessor controller shall have integrated ethernet interface and a web server for displaying unit parameters
.5 The microprocessor shall have near field communication (NFC) capability for android devices
.6 The microprocessor controller shall have an internal programmable time clock that will allow the user to add up to different occupancy schedules and add holidays
.7 The microprocessor control shall be capable of integral diagnostics
.8 The microprocessor control shall be capable of IP or SI unit display
.9 The microprocessor controller shall have a battery powered clock
.10 The microprocessor controller shall at a minimum offer the ability for three modes of determining occupancy: a dry contact, the internal time clock or the BMS
.11 A remote user terminal to allow for remote monitoring and adjustment of parameters, allowing ease of control access without going outdoors or into the mechanical room if desired by the user
.12 The microprocessor controller shall have at a minimum (10) universal inputs/outputs (AI, DI, AO) and have (6) six relay outputs (DO)
.13 The microprocessor controller shall have an integrated fieldbus port
.14 The microprocessor controller shall have the capability for I/O expansion
.15 The microprocessor controller shall have a micro USB port to load the application program, the unit parameters, saving logs, etc.
.16 The sensors that will be required for control are:
    .1 (2) Temperature sensor for fresh air and exhaust air
    .2 (2) Temperature and humidity sensor for outside air, return air
    .3 (2) Differential pressure sensors for filter alarms
    .4 (2) Adjustable current switches
    .5 Field-installed room CO2 sensor
.17 The microprocessor controller shall have the capability to monitor the unit conditions for alarm conditions. Upon detecting an alarm, the microprocessor controller shall have the capability to record the alarm description, time, date, available temperatures, and unit status for user review. A digital output shall be reserved for remote alarm indication. Alarms to be also communicated via BMS as applicable. Provide the following alarm functions:
    .1 Outside air temperature sensor alarm
    .2 Outside air humidity sensor alarm
    .3 Return air temperature sensor alarm
    .4 Return air humidity sensor alarm
    .5 Fresh air sensor alarm
    .6 Exhaust air sensor alarm
    .7 Dirty filter alarm
    .8 Supply and exhaust air proving alarm
    .9 Outside airflow sensor alarm
    .10 Exhaust airflow sensor alarm
    .11 CO2 sensor alarm
.18 Display the following on the face of microprocessor controller:
    .1 Unit on
    .2 Heating status
    .3 Outdoor air temperature
    .4 Outdoor air humidity
    .5 Return air temperature
    .6 Return air humidity
    .7 Supply air temperature

.8 Unit on/off
.9 Fan on/off
.10 Damper status
.11 Alarm digital display

.19 The microprocessor controller shall have factory pre-programmed multiple operating sequences for control of the ERV. Factory default settings shall be fully adjustable in the field. Available factory pre-programmed sequences on operations are:

.4 SEQUENCE OF OPERATIONS

.1 DDC CONTROLLER:
.1 Controller with integral LCD readout for changing set points and monitoring unit operation.
.2 Provided with required sensors and programming.
.3 Factory programmed, mounted, and tested.
.4 Integral USB and Ethernet ports for updating programs and retrieving log files.

.2 POWER UP:
.1 When the unit main disconnect is closed a delay of 10 seconds (adjustable) occurs for the controller to come online.

.3 ERV UNIT START COMMAND:

.4 An input signal is required to enable the unit operation. The unit will be commanded on by:
.1 Internal time clock
.2 Enable via controller display

.5 All types of input that are enabled must be true before the unit will start.
.1 The exhaust fan starts after a 3 second delay (adjustable). The exhaust fan will not start until the damper actuator end switch closes.
.2 The supply fan starts after a 6 second delay (adjustable). The supply fan will not start until the damper actuator end switch closes.
.3 The supply fan, exhaust fan, heating are controlled based on the chosen unit operating modes and air conditions.

.6 ERV UNIT STOP COMMAND (OR DE-ENERGIZED):
.1 The unit can then be commanded off by:
.2 Internal time clock

.7 Disable via controller display
.1 Supply fan and exhaust fan are de-energized.
.2 All dampers are unpowered and spring return to their default position after a 10 second delay (adjustable).

.8 SUPPLY FAN OPERATION:
.1 The supply fan speed will be controlled for:
.2 Maintain CO2 setpoint from minimum to maximum.
.3 The unit will attempt to start the supply fan when the supply fan delay timer expires. When the supply fan starts the supply fan adjustable current switch should close and remain closed until the fan is turned off.

.9 SUPPLY FAN STATUS:
.1 Once the supply fan current switch closes heating operation is allowed. After a delay of 90 seconds (adjustable) from supply fan start signal, if the supply fan current switch is still open the supply fan alarm should be set to true and heating operation shall be prohibited. The supply fan status shall be set to true only when the supply fan output is on and supply fan current switch is closed. The supply fan status shall be false in all other circumstances.

.10 CO2 FLOW CONTROL OPTION:

.1 The controller will adjust the supply fan ECM command based on the return air CO2 level. The supply air flow set point is derived from the user entered minimum and maximum CO2 levels and minimum and maximum desired air flow rates. When the CO2 level is at or below the minimum CO2 level the air flow set point is at the minimum and when the CO2 level is at or above the maximum CO2 level the air flow set point is at the maximum. Between the minimum and maximum CO2 levels the air flow set point is linearly scaled. If the measured CO2 level exceeds 1000 ppm (adjustable) for more than 60 seconds (adjustable) a CO2 alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the CO2 level is at or below the CO2 set point.

.11 EXHAUST FAN OPERATION:

.1 The exhaust fan speed will be controlled for:

.1 Supply fan flow rate tracking

.2 The unit will attempt to start the exhaust fan when the exhaust fan delay timer expires. When the exhaust fan starts the exhaust fan adjustable current switch should close and remain closed until the fan is turned off.

.12 EXHAUST FAN STATUS:

.1 After a delay of 90 seconds (adjustable) from exhaust fan start signal, if exhaust fan current switch is still open the exhaust fan alarm should be set to true. The exhaust fan status shall be set to true only when the exhaust fan output is on and exhaust fan current switch is closed. The exhaust fan status shall be false in all other circumstances.

.13 HEATING OPERATION:

.1 Heating will be locked out if the outdoor air temperature is above 50 degrees (adjustable). The temperature set point can be configured as constant (adjustable) or can be reset by the outside air temperature. Heating will be controlled using the supply air temperature or return air temperature.

.14 CONSTANT TEMPERATURE OPTION:

.1 The controller will stage the heaters or adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is entered and adjusted from the unit controller display. The minimum and maximum values for the air temperature set point are unit dependent and are adjustable. An adjustable PI (proportional & integral) loop will compare the measured air temperature to the air temperature set point and adjust the analog output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump.

2.06 FILTER SECTION

.1 ERV shall have 2" thick MERV 8 disposable pleated filters located in the outdoor air and exhaust airstreams. All filters shall be accessible from the exterior of the unit.

2.07 ROOF CURB

.1 Each unit shall be provided with a prefabricated galvanized steel mounting curb designed and manufactured by the unit manufacturer for field assembly on the roof decking prior to unit shipment. The roof curb shall be a perimeter type with complete perimeter support of the air handling section and rail support of the condensing unit section. The curb shall be a minimum of 350 mm (14 in.) high. Gasketing shall be provided for field mounting between the unit base and roof curb. The roof curb shall be approved by the Canadian Roofing Contractors Association.

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 on roof curbs as indicated.

.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 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 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 the Consultant

.2 Verification requirements in accordance with Division 01 and 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 Verify accessibility, serviceability and cleanability of components including motorized dampers, filters, fans, motors, operators, sensors, and electrical disconnects.

.4 Performance Verification:

.1 Rooftop Energy Recovery Ventilators:
.1 Check for smooth, vibration less correct rotation of supply fan impeller.
.2 Measure supply fan capacity.
.3 Adjust impeller speed as necessary and repeat measurement of fan capacity.
.4 Measure pressure drop each component of air handling unit.
.5 Verify operating control strategies, including:
.1 Heat wheel operating and high limit.
.2 Early morning warm-up cycle.
.3 Freeze protection.
.4 Alarms.
.5 Voltage drop across thermostat wiring.
.6 Operation of remote panel including pilot lights, failure modes.

.6 Measure exhaust fan capacity.

.7 Adjust impeller speed as necessary and repeat measurement of exhaust fan capacity.

.8 Refer to other sections of these specifications for PV procedures for other components.

.5 Commissioning Reports:

.1 In accordance with Division and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified herein. Include:

.1 Report Forms and Schematics.

3.04 DEMONSTRATION

.1 Training: Provide training in accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified.

3.05 CLEANING

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

END OF SECTION 23 74 20

MCW Consultants Ltd.

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ELECTRICAL SPECIFICATIONS

FOR

VPCH OFFICE EXPANSION

155 QUEEN STREET NORTH

HAMILTON, ONTARIO

TO

DPAI ARCHITECTURE INTERIOR

URBAN DESIGN

DATED

SEPTEMBER 08, 2023

ISSUED FOR TENDER

Contact Person: Canh Le
Phone: 416-598-2920 Ext. 224
Email: cle@mcw.com

MCW Project No. 21424

CONTENTS

END OF SECTION

CONTENTS

PART 1 - GENERAL

1.01 SUMMARY

.1 Section Includes:

.1 Through Penetration Firestopping.
.2 Fire Resistive Joint Systems.

.2 Related Sections

.1 Division 1 – General Requirements.
.2 Division 3 – Concrete.
.3 Division 4 – Masonry.
.4 Division 7 – Thermal and Moisture Protection.
.5 Division 9 – Finishes.
.6 Division 22 – Plumbing.
.7 Division 23 – Heating Ventilating and Air Conditioning.
.8 Division 26 – Electrical.
.9 Division 27 – Communication.

1.02 REFERENCES

.1 American National Standards Institute (ANSI):

.1 ANSI/UL 263 - Fire Tests of Building Construction and Materials.
.2 ANSI/UL 723 - Surface Burning Characteristics of Building Materials.
.3 ANSI/UL 1479 - Standard for Fire Tests of Through-Penetration Firestops.
.4 ANSI/UL 2079 - Tests for Fire Resistance of Building Joint Systems.

.2 American Society for Testing and Materials(ASTM):

.1 ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
.2 ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
.3 ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
.4 ASTM E 1399 - Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
.5 ASTM E 1966 - Standard Test Method for Fire Resistive Joint Systems.
.6 ASTM E 2174 - Standard Practice for On-Site Inspection of Installed Firestops.
.7 ASTM E 2307 - Fire Tests of Perimeter Fire Barrier Systems Using Intermediate Scale, Multi-Story Test Apparatus.
.8 ASTM E 2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.3 Factory Mutual (FM) - FM4991 - Standard for Approval of Firestop Contractors.

.4 International Code Congress (ICC):

.1 International Building Code (IBC).
.2 International Residential Code (IRC).
.3 International Mechanical Code (IMC)
.4 International Fire Code (IFC)
.5 International Code Congress Evaluation Service (ICC ES)

.5 National Fire Protection Association (NFPA):

.1 NFPA 70 - National Electrical Code.
.2 NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
.3 NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
.4 NFPA 101 - Life Safety Code.
.5 NFPA 5000 - Building Construction and Safety Code.

.6 Underwriters Laboratories (UL) - UL Building Materials Directory:

.1 Through-Penetration Firestops Systems (XHEZ).
.2 Joint Systems (XHBN).
.3 Firestop Devices (XHJI).
.4 Forming Materials (XHKU).
.5 Wall Opening Protective Materials (CLIV).
.6 Fill, Void or Cavity Materials (XHHW).

.7 American Society of Sanitary Engineering (ASSE):

.1 ASSE Series 9000 – Professional Qualification Standard for Firestop Systems and Device Installers, Inspectors and Surveyors.

.8 International Association of Plumbing and Mechanical Officials (IAPMO):

.1 Uniform Plumbing Code (UPC).
.2 Uniform Mechanical Code (UMC).

.9 International Standards Organization (ISO):

.1 ISO 6944
.2 ISO 10295-1: 2007.
.3 ISO 10295-2: 2009.
.4 ISO 10295-3:

1.03 PERFORMANCE REQUIREMENTS

.1 Provide systems that are listed by at least one the following:

.1 Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory".
.2 Intertek Testing Service (Formerly known as Omega Point Laboratories), in "Directory of Listed Products".
.3 Factory Mutual (FM), in FMRC Approval Guide.
.4 Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections and is acceptable to authorities having jurisdiction.

.2 Provide firestop products that are flexible enough to allow for pipe vibration in a through penetration application.

.3 Provide fire resistive sealants and sprays for construction joint applications that are flexible enough to satisfy the movement criteria per the test standards ASTM E 1399, ASTM E 1966 or ANSI/UL 2079.

.4 Provide products with the appropriate flame spread index and smoke develop index, when tested in accordance with ASTM E 84.

.5 Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.

.6 Provide products identical to those tested and listed for classification by UL, Intertek or any other qualified independent testing agency.

.7 Provide products that bear classification marking of qualified independent testing agency.

.8 Where firestop systems not listed by any listing agency are required due to project conditions, submit a substitution proposal with evidence specified.

.9 Use only products specifically listed for use in listed systems.

.10 Provide products that are compatible with each other, with the substrates forming openings, and with the items, if any, penetrating the firestopping, under the conditions represented by this project, based on testing and field performance demonstrated by manufacturer.

.11 Firestopping materials must meet and be acceptable for use by all building codes and NFPA codes cited in this section.

.12 Provide products that meet the intent of the state or local guidelines on volatile organic compounds (VOC).

.13 Where applicable provide products that meet the intent of the F rating classification for passage of flame per ANSI/UL 1479 for through penetrations.

.14 Where applicable provide products that meet the intent of the T rating classification for the transfer of temperature per ANSI/UL 1479 for through penetrations.

.15 Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.

.16 Where applicable provide products that meet the intent of the W rating classification for passage of water per ANSI/UL 1479 for through penetrations.

1.04 SUBMITTALS

.1 Submit under provisions of the Contract and Division 01 – General Requirements.

.2 Shop Drawings: For each firestopping system, provide the following:

.1 Listing agency's detailed drawing showing opening, penetrating item(s), and firestopping materials, identified with listing agency's name and number or designation and fire rating achieved.
.2 For proposed systems that do not conform strictly to the listing, submit written instructions showing modifications and approved by firestop system manufacturer.
.3 Submit under provisions of the International Building Code (IBC) section 107 and 703 requiring a submittal package for fire-resistance ratings and fire tests.

.3 Product Certificates: Submit certificates of conformance signed by firestop system manufacturer certifying that materials furnished comply with requirements.

.4 Product Data: Furnish manufacturer's product data sheets on each material to be used in firestop systems. Information on manufacturer's product data sheet should include:

.1 Product characteristics including compliance with appropriate ASTM/UL/ANSI test standards.

.2 Storage and handling requirements and recommendations.

.5 Installation Instruction: Furnish manufacturer's installation instructions.

.6 Sustainable or LEED Submittals:

.1 VOC Content: For sealants and sealant primers, furnish documentation of VOC content.

1.05 QUALITY ASSURANCE

.1 General: All through-penetration firestop systems and construction gap fire resistive systems shall be installed with approved methods using materials that have been tested and classified to produce an approved assembly.

.2 Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of twenty five (25) years experience.

.1 Products shall be manufactured in a facility that follows ISO 9001 best practices.

.3 Installer Qualifications: Firm must be qualified by having experience, staff, and be properly trained to install the specified products, and meets the following criteria:

.1 Contractor is a **3M** Master Contractor.
.2 Contractor is a Certified **3M** Trained contractor.
.3 Contractor is acceptable to manufacturer.
.4 Contractor is acceptable to Authority Having Jurisdiction (AHJ).
.5 Contractor has completed the manufacturer's certified product installation training.
.6 Contractor must provide a list of completed projects as evidence of experience; include project name and address, owner's name and address, and architect's name and phone number.
.7 Certificate: Contractor should provide certificate of qualification.

.4 Codes: Where manufacturer's application procedures are in conflict with those of the local Authority Having Jurisdiction, the more strict guidelines will prevail.

.5 Pre-installation Meetings: Meetings to agree on firestop requirements, conditions, manufacturer's instructions.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store products until ready for installation in manufacturer's original unopened packaging, legibly marked with manufacturer's name and product identification, date of manufacture, lot number, listing agency's classification marking, curing/dry time, mixing instructions (if applicable) and MSDS reference number.

.2 Store and handle in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants, and other causes; follow manufacturer's instructions.

.3 Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local Authority Having Jurisdiction.

1.07 PROJECT CONDITIONS

.1 Coordinate construction and cutting of openings so that each particular firestop system may be installed in accordance with its listing, including assembly rating, L rating, sizing, sleeves, manufacturer’s published STC rating and penetrating items.

.2 Coordinate firestopping of dynamic and static construction joints (top-of-wall, bottom-of-wall, floor-to-floor, floor-to-wall), wall-to-wall, perimeter so that each particular system may be installed in accordance with its listing, including assembly rating, sizing, movement capabilities and manufacturer's published STC rating.

.3 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install firestopping under environmental conditions outside manufacturer's absolute limits.

.4 Provide ventilation as required by firestopping manufacturer, including mechanical ventilation if required.

1.08 WARRANTY

.1 At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

.1 Acceptable Manufacturer: **3M** Fire Protection Products, which is located at: **3M** Center Bldg. 223-2N-21 ; St. Paul, MN 55144-1000; Toll Free Tel: 800-328-1687; Email: request info (firetech1@mmm.com); Web: www.**3M**.com/firestop

.2 Requests for substitutions will be considered in accordance with provisions of Division 1- General Requirements.

.3 Single Source: To maintain control and integrity of the firestop applications a single manufacturer should be used. Specific UL or approved listing agencies systems applicable to each type of firestop condition should be supplied by one manufacturer.

2.02 SCOPE/APPLICATION

.1 Provide installed firestop products that limit the spread of fire, heat, smoke, and gasses through otherwise unprotected openings in rated assemblies, including walls, partitions, floors, roof/ceilings, and similar locations, restoring the integrity of the fire rated construction to its original fire rating.

.2 Provide firestop systems listed for the specific combination of fire-rated construction, type of penetrating item, annular space requirements, and fire rating, and the following criteria:

.1 F-Rating: Equal to or greater than the fire-resistance rating of the assembly in which the firestopping will be installed.
.2 T-Rating: In habitable areas where penetrating items are exposed to potential contact with materials on fire side(s) of rated assembly, T-rating must equal its F-rating.
.3 L-Rating: L-rating of 1 cfm per linear foot (5.5 cu m/h/m) maximum at ambient temperatures.
.4 W-Rating: meets UL Water Leakage Test, W Rating – Class 1 requirements for systems tested and listed in accordance with ANSI/UL 1479.
.5 Wall Penetrations: Through penetration systems must be symmetrical, with the same rating from both sides of the wall. Membrane penetrations may be asymmetrical.
.6 Testing: Determine ratings in accordance with ASTM E 814 or UL 1479.

.3 Provide fire-resistive systems listed for construction gaps per the specific combination of fire-rated construction type, configuration, gap dimensions, and fire rating, and the following criteria:

.1 Fire resistance rating must be equal to or greater than that of the assembly in which it is to be installed.
.2 Movement capability must be appropriate to the potential movement of the gap, demonstrated by testing in accordance with ASTM E 1399/ASTM E 1966/UL 2079 for minimum of 500 cycles at 10 cycles per minute.
.3 L-Rating: L-rating of 1 cfm per linear foot (5.5 cu m/h/m) maximum.
.4 Determine ratings in accordance with ASTM E 1966/UL 2079.

2.03 THROUGH PENETRATION FIRESTOP PRODUCTS

.1 **3M** Fire Barrier Cast-in-Place Devices: Firestopping device for use prior to a concrete pour. Adjustable height with pull tabs, straight edge design for close placement to walls and adjacent devices.

.1 Fire Resistance: For use in 1, 2, or 3 hour fire-rated systems.
.2 Locations: Horizontal assemblies only.

.2 **3M** Fire Barrier Ultra RC Pack: One piece metal collar assembly encasing intumescent material for firestopping of pipes and cables through rated walls and floors.

.1 Fire Resistance: For use in 1 or 2 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.3 **3M** Fire Barrier Ultra Plastic Pipe Device: Intumescent device for firestopping of plastic pipe and cables through rated walls and floors.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Configuration: One-piece metal collar, with locking latch and bendable tabs to secure; equipped also for conventional anchoring.
.3 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.4 **3M** Fire Barrier RC-1 Restricting Collar with either FS 195+ Wrap Strip or **3M** Interam Ultra GS Wrap Strip . (See product descriptions below): For firestopping of plastic pipes from 4 inches (102 mm) to 10 inches (254mm) in diameter.

.1 Fire Resistance: For use in 1or 2 hour fire-rated systems.
.2 Material: 28 gauge steel.
.3 Size: 25 foot (7.6 m) roll.
.4 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.5 **3M** Fire Barrier CP25WB+ Sealant: High-performance, intumescent, water-based sealant. No-sag, fast drying, paintable, red in color. Versatile firestop sealant for pipes (not for use with CPVC), cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
.3 STC rating of 54 when tested in STC 54-rated wall assembly.

.6 **3M** Fire Barrier IC 15WB+ Sealant: General-purpose, intumescent, water-based sealant. No-sag, fast drying, paintable, yellow in color. Economical firestop sealant for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
.3 STC rating of 54 when tested in STC 54-rated wall assembly.

.7 **3M** Fire Barrier Sealant FD 150+: Single-part, water-based, acrylic latex sealant. No-sag, low-shrinkage, low VOC. Blue, red or limestone color. Used to firestop for pipe penetrations (not for use with CPVC).

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
.3 STC rating of 54 when tested in STC 54-rated wall assembly.

.8 **3M** Fire Barrier Water Tight Sealant 3000 WT: Single-part, water-tight, intumescent silicone firestop sealant for filling voids in concrete gypsum, metal, plastic, wood and insulation. Light gray color with black flecks. Meets UL Water Leakage Test, W Rating – Class 1 requirements.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
.3 STC rating of 53 when tested in STC 54-rated wall assembly.

.9 **3M** Fire Barrier Water Tight 1000 NS Sealant: Single-part, non-slump firestopping silicone sealant for floor and wall openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
.3 STC rating of 56 when tested in STC 56-rated wall assembly.

.10 **3M** Fire Barrier Water Tight Sealant 1003 SL: Single-part, self-leveling firestopping silicone sealant for floor openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
.2 Locations: For horizontal assemblies only.
.3 STC rating of 56 when tested in STC 56-rated wall assembly.

.11 **3M** Fire Barrier Sealant 2000 NS: Single-part, non-slump elastomeric silicone firestop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to firestop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit, power and communication cable and telephone or electrical wiring.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.2 Locations: Vertical and horizontal assemblies.
.3 STC-Rating of 56 when tested in STC 56-rated wall assembly.

.12 **3M** Fire Barrier Sealant 2000+: Single-part, elastomeric silicone firestop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to firestop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit, power and communication cable and telephone or electrical wiring.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.2 Locations: Vertical and horizontal assemblies.
.3 STC-Rating of 56 when tested in STC 56-rated wall assembly.

.13 **3M** Fire Barrier Moldable Putty+: One-part, 100 percent solids intumescent firestop. Remains pliable, flexible and easily re-enterable. Non-toxic synthetic formula. Versatile putty for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.

.1 Type: Stick or Pad
.2 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.3 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.14 **3M** Fire Barrier 2001 Silicone RTV Foam: Two-part, liquid-silicone elastomer, foams in place when mixed. For use sealing large or complex openings such as cable bundles, cable trays and conduit banks.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.15 **3M** Fire Barrier Mortar: For sealing openings in concrete and masonry walls and floors. Self Leveling, non-sag, low VOC.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.16 **3M** Fire Barrier Self-Locking Pillow: Self-contained, intumescent firestop pillow with interlocking strips. Meets fire rating without the use of wire mesh. For use in firestopping larger openings

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.17 **3M** Fire Barrier Pillow: Self-contained, intumescent firestop product. Meets fire rating without the use of wire mesh. For use in firestopping larger openings

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.18 **3M** Fire Barrier CS-195+ Composite Sheet: Organic/inorganic intumescent elastomeric sheet, bonded on one side to a layer of 28 gauge galvanized steel. Other side reinforced with steel-wire mesh and covered with aluminum foil. Re-enterable. For use in firestopping larger openings

.1 Thickness: Nominal 0.3 inch (7.6 mm).
.2 Thermal Expansion: 8 - 10 times original size.
.3 Tensile Strength (ASTM D412): 93.6 psi (645 kPa)/489 percent.
.4 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.5 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.19 **3M** Interam Ultra GS Wrap Strip: Graphite based, flexible, largely inorganic, intumescent mat. For use around non-metallic piping with or with RC-1 collar.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.20 **3M** Fire Barrier FS-195+ Wrap/Strip: One-part, organic/inorganic intumescent strip with foil on one side. May be cut to fit irregular shapes. For use around non-metallic piping with or with RC-1 collar.

.1 Length: 24 inch (610 mm).
.2 Width: 1 or 2 inches.
.3 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.4 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.21 **3M** Fire Barrier Pass-Through Devices: One-Piece device for firestopping of cable penetrations through rated walls and floors.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.

.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.22 **3M** Fire Barrier Tuck-In: Graphite-based, flexible, intumescent wrap strip for use around non-metallic piping. Adhesive closure tab.

.1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

.23 **3M** Fire Barrier Putty Sleeve Kit: Device used for firestopping of cable penetrations through fire rated walls and floors.

.1 Fire Resistance: For use in 1, 2 3 or 4 hour fire-rated systems.
.2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

2.04 FIRE RESISTIVE JOINT PRODUCTS

.1 **3M** Fire Barrier Sealant FD 150+: Single-part, water-based sealant. Sag-resistant, low-shrinkage, low VOC.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
.2 Location: For use at top-of-wall, bottom-of-wall, wall-to-wall and floor-to-floor.
.3 Compression/Extension Recovery: +/- 19 percent of original joint width.
.4 Meets optional L rating requirements.
.5 STC rating of 56 when tested in STC 56-rated wall assembly.

.2 **3M** Fire Barrier Water Tight Sealant 1000 NS: Single-part, non-slump elastomeric silicone sealant. Sag-resistant, low VOC.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
.2 Meets UL Water Leakage Test, W Rating – Class 1 requirements.
.3 Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-floor, floor-to-wall and perimeter joints.
.4 Compression/Extension Recovery: +/- 15 percent of original joint width.
.5 STC-Rating of 56 when tested in STC-56-rated wall assembly.

.3 **3M** Fire Barrier Water Tight Sealant 1003 SL: Single-part, self-leveling elastomeric silicone sealant. Sag-resistant, low VOC.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
.2 Meets UL Water Leakage Test, W Rating – Class 1 requirements.
.3 Location: For use at top-of-wall, bottom-of-wall, floor-to-wall and floor-to-floor joints.
.4 Compression/Extension Recovery: +/- 15 percent of original joint width.
.5 STC-Rating of 56 when tested in STC-56-rated wall assembly.

.4 **3M** Fire Barrier Sealant 2000 NS: Single-part, non-slump elastomeric silicone sealant. Sag-resistant, low VOC.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
.2 Service Flexibility: Accommodate vibration from normal building movement.
.3 Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-wall, floor-to-floor and perimeter joints.
.4 Compression/Extension Recovery: +/- 31 percent of original joint width.
.5 STC-Rating of 56 when tested in STC 56-rated wall assembly.

.5 **3M** Fire Barrier Sealant 2000+: Silicone Sealant: Single-part, elastomeric silicone sealant. Sag-resistant, low VOC.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
.2 Compression/Extension Recovery: +/- 13 percent of original joint width.
.3 Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-wall and floor-to-floor joints.

.6 **3M** FireDam Spray 200: Water-based, paintable, low VOC, freeze/thaw resistant spray applied fire resistive product. Applied with conventional airless spray equipment.

.1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
.2 Compression/Extension Recovery: +/- 50 percent of joint width.
.3 Location: For use at head-of-wall, wall-to-wall, floor-to-floor, bottom-of-wall, floor-to-wall and perimeter joints.
.4 STC-Rating of 56 when tested in STC 56-rated wall assembly.

2.05 FIRESTOPPING FOR SINGLE MEMBRANE PENETRATIONS

.1 **3M** Fire Barrier Moldable Putty+: One-part, 100 percent solids intumescent firestop. Remains pliable, flexible and easily re-enterable. Non-toxic synthetic formula.

.1 Type: Pad.
.2 Fire Resistance: For use in 1, 2 or 3 hour fire rated systems.

.2 **3M** Endothermic Mat E-5A-4: Endothermic heat absorbing mat.

.1 Type: Mat.
.2 Fire Resistance: For use in 1 or 2 hour fire rated systems.

PART 3 - EXECUTION

3.01 EXAMINATION

.1 Do not begin installation until substrates have been properly prepared.

.2 Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestopping.

.3 Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.

.4 Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of firestopping, including ducts, piping, equipment, and other suspended construction.

.5 Verify that environmental conditions are safe and suitable for installation of firestopping.

.6 If substrate preparation is the responsibility of another installer, notify Architect or Engineer of Record of unsatisfactory preparation before proceeding.

3.02 PREPARATION

.1 Prepare substrates in accordance with manufacturer's instructions and recommendations.

.2 Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to firestopping installation.

3.03 INSTALLATION

.1 Install in strict accordance with manufacturer's detailed installation instructions and procedures.

.2 Install so that openings are completely filled and material is securely adhered.

.3 Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.

.4 After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.

.5 Repair or replace defective installations in accordance with manufacturer’s recommendations, listed systems details and applicable code requirements.

.6 At each through penetration or fire-resistive joint system, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.

.7 Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.

.8 Notify Authority Having Jurisdiction when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.

.9 Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

3.04 FIELD QUALITY CONTROL

.1 Owner will engage an independent testing agency to inspect installed firestopping and to prepare reports indicating whether the installed work complies with the contract documents.

.2 Notify testing agency at least 7 days prior to date when firestopping installation will be ready for inspection; obtain advance approval of general schedule and phasing, if any, required to allow subsequent construction to proceed.

3.05 CLEANING AND PROTECTION

.1 Remove left over material and debris from Work area. Use necessary means to protect fire protection product(s) before, during, and after installation.

.2 Touch-up, repair or replace damaged products before Substantial Completion.

.3 Install identification Labels for Through Penetration and Construction Joint Systems: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:

.1 The applicable words "Warning - Through Penetration Firestop System - Do not Disturb. Notify Building Management of Any Damage." or "Warning – Construction Gap Fire Resistive System - Do not Disturb. Notify Building Management of Any Damage."
.2 Listing agency's system number or designation.
.3 System manufacturer's name, address, and phone number.
.4 Installer's name, address, and phone number.
.5 General contractor's name, address, and phone number (if applicable).
.6 Date of installation.

END OF SECTION 07 84 00

CONTENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

.1 Comply with the requirements of Division 1 and all documents referred to therein.

1.02 APPLICATION

.1 This Section applies to and is a part of all Sections of Division 26.

1.03 DEFINITIONS

.1 Wherever the term "This Sub-Contractor" is used in the Division 26 Drawings and Specifications, it means the firm having a subcontract with the "Contractor" to perform, supervise and co-ordinate all work of this Division.

.2 Wherever the term "install" (and tenses of "install") is used in the Division 26 Drawings and Specifications, it means install and connect complete.

.3 Wherever the term "supply" is used in the Division 26 Drawings and Specifications, it means supply only.

.4 Wherever the term "Provide" or “Provision of” are used in relationship to equipment and other materials specified for the Work of Division 26 it means “Supply, Install and Connect”. Wherever the terms “Provide” or “Provision of” are used in connection with services such as testing, start-up and commissioning for any part of the Work of Division 26, it means procure, supervise, take responsibility and pay for these services.

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

.6 Wherever the terms “Authorities” or “Authorities having jurisdiction” are used in the Division 26, Drawings and Specifications, it shall mean any and all current laws and/or by-laws of any Federal, Provincial or local authorized agencies having jurisdiction over the sum total or parts of the work including, but not restricted to the Municipal Planning and Building Department, Municipal Fire Department, the Construction Safety Act, Municipal Public Works Department, Federal and/or Provincial Fire Marshall, the Gasoline Handling Act, the Ontario Electrical Safety Code and other codes in effect at the time of construction.

.7 Wherever the term "Work" is used in the Division 26 Drawings and Specifications, it means all equipment, permits, materials and labour to provide a complete electrical installation as required and detailed in the Drawings and Specifications.

.8 Wherever the term “Acceptable” is used in the Division 26 Drawings and Specifications it means acceptable to the Consultant.

1.04 WORK INCLUDED

.1 Sections of Division 26 are not intended to delegate functions nor to delegate work and supply to any specific trade and the Work shall include all labour, materials, equipment and tools required for a complete and working installation as described, but not necessarily limited to items in the following Sections:

Section 07 84 00	Firestopping
Section 26 05 00	Electrical General Requirements

Section 26 05 01	Shop Drawings, Product Data and Samples
Section 26 05 03	Testing and Commissioning
Section 26 05 05	Basic Materials and Methods
Section 26 05 10	Electrical Identification
Section 26 05 14	Work in Existing Building
Section 26 05 21	Wire and Cable up to 1000 Volts
Section 26 05 27	Grounding and Bonding
Section 26 05 29	Hangers and Supports
Section 26 05 33	Raceways and Boxes
Section 26 12 16	Low Voltage Dry Type Transformers
Section 26 24 16	Panelboards
Section 26 28 23	Safety Switches
Section 26 50 00	Lighting Luminaires
Section 26 60 01	Security System
Section 26 70 01	Fire Alarm System
Section 26 80 01	Communication Services

1.05 PERMITS, FEES AND INSPECTIONS

.1 Apply for, obtain, and pay for all permits, licenses, inspections, examinations and fees required for Work of Division 26. 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 26 contractor has no financial obligation for permit application except for permits not covered in the "single permit".

.2 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 approval of the inspecting Authorities.

.3 Comply with the requirements of the latest edition of the applicable CSA standards, the requirements of the Authorities, Federal, Provincial and Municipal Codes, the applicable standards of the Underwriters' Association and all other Authorities having jurisdiction. These codes and regulations constitute an integral part of these specifications.

.4 In case of conflict, the codes 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.

.5 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 furnish any additional drawings, details or information as may be required.

1.06 CONTRACT DRAWINGS

.1 The Drawings for Electrical work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and conduit 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 (conduits around beams, columns, etc.)

.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 components (e.g., light fixtures, speakers, heat or smoke detectors) in accordance with reflected ceiling drawings.

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

1.07 EXAMINATION OF SITE AND DOCUMENTATIONS

.1 Prior to submitting tender, carefully examine conditions at the site which could affect the Work. Refer to and examine all contract documents.

.2 Be responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.

.3 Refer to room finish schedules to determine finished, partially finished and unfinished areas of the building.

.4 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. Be responsible for any cutting and patching involved in getting assemblies into place.

1.08 CO-ORDINATION DRAWINGS

.1 Prepare drawings in conjunction with all trades concerned, showing sleeves and openings for passage through structure, and all inserts, equipment bases, and supports, and relate these to suitable grid lines and elevation datum.

.2 When requested, provide weights of major items of equipment.

.3 Prepare interference and co-ordination drawings for all areas where the work of this Division could conflict with and/or obstruct the work of other trades and/or other Sections of this Division. Submit drawings for review by the Consultant.

1.09 RECORD DRAWINGS

.1 Obtain a set of white prints ad as the job progresses, mark this set to accurately indicate installed work. Show location by dimension from walls or columns for all buried services as well as invert depths. Have these white prints available for inspection at the site at all times, and present for scrutiny at each job meeting.

.2 At completion of the project, Contractor will supply marked up hard copy “Red Line” drawings to the Consultant will transfer into the CAD as-built.

1.10 PRODUCT STANDARDS AND ALTERNATIVES

.1 Provide new material and equipment as specified and to the acceptance of the Consultant.

.2 Manufacturer’s names are listed as the “Basis of Design” and to set a standard of quality, performance, capacity, appearance and serviceability. Other acceptable manufacturers where listed may be used in the submission of the Electrical bid, however it is the bidders responsibility to ensure the equipment will perform and fit the available space used in the design.

.3 Where no other acceptable manufacturers are indicated, provide the exact make specified. Requests for acceptance of manufacturers not listed must be submitted not less than seven working days prior to closing date of the tender, and submissions must bear proof of acceptance by the Consultant if used in the tender.

.4 Assume full responsibility for ensuring that when providing other acceptable manufacturers all space, weight, connections, power and wiring requirements, etc., are considered, and costs therefore included in the tender. Equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.

.5 All electrical equipment, material, wiring and devices to conform to the Ontario Electrical Safety Code for the purpose for which they are to be used and bear the approval of CSA or other acceptable testing agency, alternately the equipment must bear special approval of the inspection authority.

1.11 PATENTS

.1 Pay all royalties and licence 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.

1.12 RIGHTS RESERVED

.1 Rights are reserved to furnish 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 this contract.

1.13 EQUIPMENT NAMEPLATES

.1 Provide apparatus with proper nameplates affixed thereto, showing the size, name of equipment, serial number and all information usually provided, which also includes voltage, cycle, phase, horsepower of motors and the name and address of the manufacturer.

1.14 EXPEDITING AND DELIVERY

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

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

.3 Immediately inform the Consultant in case information is required from him.

.4 Provide delivery records updated monthly.

1.15 SUPERINTENDENCE

.1 Maintain at the 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.

.2 The supervising personnel and their qualifications are subject to the approval of the Consultant.

1.16 WORKMANSHIP

.1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to function properly to the satisfaction of the Consultant. Install runs parallel and perpendicular to building lines, in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed install neatly and group to present a tidy appearance.

.2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore.

.3 Include in the work all requirements of manufacturers shown on the shop drawings or manufacturers installation instructions.

.4 Replace work unsatisfactory to the Consultant without extra cost.

.5 Make provision to accommodate future plant and equipment indicated on drawings.

.6 Protect from damage all equipment delivered to the site and during installation. Any damage or marking of finished surfaces shall be made good to the satisfaction of the Consultant.

1.17 TRIAL USAGE AND TESTS

.1 The Owner has the privilege of the trial usage of Electrical Systems or parts thereof for the purpose of testing and learning the operational procedures.

.2 Assist in trial usage over a length of time as deemed reasonable by the Consultant at no extra cost and do not waive any responsibility because of trial usage.

.3 Trial usage shall not be construed as Substantial Completion of the Work, or acceptance by the Owner.

.4 Provide and pay for all testing required on the system components where, in the opinion of the Consultant, manufacturers ratings or specified performance is not being achieved.

1.18 CLEANING

.1 Before energizing any systems, inspect and clean the inside of panel boards, switchgear and cabinets to ensure that they are completely free from dust and debris.

.2 Clean all polished, painted and plated work bright. Clean all lighting fixtures.

.3 Remove all debris, surplus material and all tools.

.4 Carry out additional cleaning operating of systems as specified in other sections of the specification.

1.19 COMPLETION

.1 Leave electrical work in specified working order.

1.20 WARRANTIES

.1 Provide warranty certificates, wherever given or required, in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.

1.21 INSTRUCTION TO OWNERS

.1 Instruct the Owner's representatives in all aspects of the operation of systems and equipment.

.2 Arrange for and pay for services of service engineers and other manufacturers' representatives required for instruction on specialized portions of the installation.

.3 Submit to the Consultant at the time of final inspection a complete list of systems stating for each system:

.1 Date instructions were given to the Owner's staff.
.2 Duration of instruction.
.3 Name of persons instructed.
.4 Other parties present (manufacturer's representative, consultants, etc.).

.4 Signatures of the Owner's staff stating that they properly understood the system installation, operation and maintenance requirements.

1.22 DOCUMENTATION AND SYSTEMS ACCEPTANCE

.1 Assemble three (3) copies of operating and instruction manuals in three ring binders with index tabs each containing this subcontractor's and suppliers names and telephone numbers.

.2 Each manual shall contain the following data:

.1 A set of as-built prints.
.2 Letters of Owner’s Instructions
.3 Final ESA Certificate.
.4 A copy of each "reviewed" shop drawing.
.5 Complete explanation of operation principles and sequences.
.6 Complete part lists with numbers.
.7 Recommended maintenance practices and precautions.
.8 Complete wiring and connections diagrams.
.9 Certificate of warranty.
.10 Representative certificates for:
.1 Fire Alarm System

.3 Ensure that operating and maintenance instructions are specific and apply to the models and types of equipment provided.

1.23 OWNER'S RIGHT TO RELOCATE ELECTRICAL ITEMS

.1 The Owner reserves the right to relocate electrical outlets at a later date, but prior to installation, without cost, assuming that the relocation per outlet does not exceed 3000 mm from the original location. No credits shall be anticipated where relocation per outlet of up to and including 3000 mm reduces materials, products and labour.

.2 Should relocations per outlet exceed 3000 mm from the original location the Contract Price will be adjusted accordingly.

.3 Necessary changes, due to lack of co-ordination, and as required and when approved, shall be made at no additional cost, to accommodate structural and building conditions. The location of conduits and other equipment shall be altered without charge to the Owner, if approved, provided the change is made before installation.

1.24 ELECTRICAL LIST OF MANUFACTURERS, SUBTRADES AND PRICES

.1 At the time of tender closing, list the names of manufacturers or subtrades carried (one per item), the total cost of the Electrical Works, any separate, unit and alternative prices where indicated.

.2 If this Subcontractor neglects to list the specified or acceptable manufacturers or lists more than one manufacturer per item, or lists manufacturers not specified, the Consultant will have the option of making the selection of the manufacturer.

.3 There will be no substitutions of named manufacturers or subtrades after tender close except as approved by the Consultant.

1.25 PHASING AND SCHEDULING OF WORK

.1 Refer to Scope of work for a detailed description of the phasing and scheduling of the work. Execute work in accordance with the phasing and construction schedule. Provide all necessary temporary connections and equipment to provide functional, operational systems during construction period when part of the building will be occupied and construction is still continuing in other portions.

1.26 MATERIALS FURNISHED BY OTHERS

.1 Where materials are furnished by others for installation under this Division, the Sub-Contractor shall notify the supplier of dates he will be ready for delivery as specified in the General Conditions. The Sub-Contractor shall receive, unload, handle, store, protect and insure the material until ready for actual installation. Upon receipt of material furnished by others, the Sub-Contractor shall spot-check or check the entire shipment and promptly advise the Consultant in writing of any damage and/or missing components. Any material which is subsequently lost or damaged due to negligence on the part of the Sub-Contractor shall be promptly replaced (or repaired to the satisfaction of the Owner) at the Sub-Contractor's expense.

1.27 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS.

.1 Where the Drawings indicated equipment to be furnished by others, provide Electrical rough-in for each unit pursuant to its shop drawings, and make final connections, disconnect switches and other electrical facilities for a complete installation.

1.28 ELECTRICAL LEGEND & SCHEDULES

.1 Refer to Electrical Drawings for Legend and Schedules

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 26 05 00

CONTENTS

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 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.

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

.5 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.

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

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 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 Minimum sheet size and larger sheets to be multiples of 8½" x 11".
.3 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 co-ordinated. Indicate cross references to design drawings and specification.
.4 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.
.5 Make changes in shop drawings as directed by the Consultant. Resubmit and note any revisions other than those requested.
.6 If only minor adjustments are made, shop drawings to be returned and fabrication and installation of work to proceed.

.3 Determine and verify:

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

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

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

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

.6 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.

.7 Products not specified by MCW 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.

.8 Shop drawings shall be accompanied by a complete copy of the attached “Shop Drawing Submittal Sheet” Section 26 05 01, Appendix ‘A’.

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

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 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 kick off 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.

1.06 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”.

1.07 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 26 05 01

SHOP DRAWING SUBMITTAL SHEET

Project:	Centre Wellington District High School Mechanical and Electrical Upgrades	Date:	
Project No.	21404B	Submittal No.	
Section:			
Equipment Description			
Contractor:			
Sub-Contractor:			
Suppliers Name:			
Manufacturer:			
Catalogue No.:			
Variations From Tender Documents			

Engineer: MCW Consultants Ltd.
207 Queen's Quay West, Suite 615
Toronto, Ontario
M5J 1A7

ELECTRICAL GENERAL REQUIREMENTS SECTION 26 05 01 – APPENDIX 'B' PROJECT: CWDHS – Mechanical and Electrical Upgrades PROJECT No: 21404B	**SHOP DRAWING SUBMITTAL SCHEDULE** DIVISION 26	Page 1 Date: _____

SECTION	DESCRIPTION (List Equipment Example only Edit to Suit)	MANUFACTURER	SHOP DRAWING				DELIVERY		COMMENTS
			SUBMITTED		RETURNED				
			SCHED	ACTUAL	SCHED	ACTUAL	SCHED	ACTUAL	
26 05 14	Work in Existing Building								
26 12 16	Low Voltage Dry Type Transformers								
26 24 16	Panelboards								
26 28 23	Safety Switches								
26 33 54	Photovoltaic System								
26 50 00	Lighting Luminaires								
26 70 01	Fire Alarm System								

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

.2 Include in Work of this Section the testing and commissioning of all new electrical and component systems.

1.02 SCOPE

.1 All electrical systems and equipment shall be totally commissioned and operating before date of “Substantial Completion”.

1.03 TEST REPORTS

.1 Submit certified test reports and certificates to Consultant from approved independent testing laboratories.

.1 Indicate compliance with specifications for specified performance characteristics and physical properties.
.2 Manufacturer’s field services: Submit copies of Manufacturer’s field inspection reports.

1.04 MANUFACTURER’S SERVICES

.1 Engage Manufacturer’s representative to review Work, installation or application of products, protection required, and final product cleaning.

.1 Submit written reports to Consultant to verify compliance with Project requirements.

.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 Manufacturer site visits to review Work, at following stages as a minimum:

.1 After delivery and storage of products, when preparation is complete, but prior to installation.
.2 Twice during equipment installation.
.3 Upon completion of Work after cleaning is complete.
.4 Obtain Manufacturer’s review reports within five (5) days of review and submit to Consultant.
.5 Provide field-testing of anti-islanding routine by opening the main breaker in a controlled after hours setting.
.6 Provide field-testing of interconnection with existing backup generator showing that emergency operation of the generator inhibits the operation of the inverters.

PART 2 - PRODUCTS

2.01 NOT USED

PART 3 - EXECUTION

3.01 GENERAL

.1 Perform site testing and commissioning only after all equipment is installed and operational.

.2 Furnish Manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to Manufacturer's instructions.

.3 Provide four (4) copies of certificates of all factory and site testing in complete detail bearing in each case, the seal of the Engineer responsible for the tests.

.4 Submit all test results for Consultant's review.

3.02 FIELD TESTS

.1 Provide advance notice to Consultant of proposed testing schedule.

.2 Perform tests at time of acceptance of Work.

.3 Perform tests in presence of Consultant.

.4 Provide field-testing of anti-islanding routine by opening the main breaker in a controlled after hours setting.

.5 Provide field-testing of interconnection with existing backup generator showing that emergency operation of the generator inhibits the operation of the inverters.

3.03 SEALING

.1 Ensure and verify that all penetrations of electrical equipment have been properly sealed with appropriate material and to the Manufacturers' requirements.

3.04 TRAINING

.1 Train operating personnel in operation, care and maintenance of electrical equipment.

.2 Arrange and pay for Manufacturer's factory service Engineer to provide training. Ensure operating personnel are conversant with its care and operation.

.3 Obtain and submit written confirmation from operating personnel that satisfactory training has been received.

END OF SECTION 26 05 03

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements, and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide materials as specified herein to complete the work as required by the contract documents.

1.03 SUBMITTALS

.1 Submit Shop drawings as required.

PART 2 - PRODUCTS

2.01 SLEEVES

.1 In concrete slabs, except as noted below, sleeves shall be #24 gauge galvanized steel or factory fabricated plastic sleeves, each with an integral flange to secure the sleeve to form work construction.

.2 In waterproof concrete slabs and in other slabs where waterproof sleeves are required, provide Schedule 40 mild galvanized steel.

.3 40 mild galvanized steel or suitable rigid, factory fabricated plastic sleeves.

2.02 ESCUTCHEON PLATES

.1 One-piece chrome plated steel sized to completely cover sleeves and complete with set screws to secure the plates to the conduit. Split plates will not be acceptable.

2.03 INSERTS AND BEAM CLAMPS

.1 Inserts for concrete form work shall be Crane Canada Ltd., #4-M Unistrut Ltd., or approved equal cast iron inserts, multiple type where required.

.2 Inserts for precast concrete and existing concrete shall be lead cinch anchors of "WEJ-IT" or self-drilling "STARR" or "PHILLIPS" anchors.

.3 Beam clamps for hanging and support to structural steel shall be Crane Canada Ltd., or equal.

2.04 ACCESS DOORS

.1 Minimum #12 gauge prime coat painted bonderized steel flush access doors, each complete with a heavy frame and anchor, heavy duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing provisions to suit the particular construction in which it is installed. Access door sizes shall suit the concealed work for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc., shall be ULC listed and labelled and of a rating to maintain the fire separation integrity.

.2 Where access doors are located in surfaces where special finishes are required, they shall be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout.

PART 3 - EXECUTION

3.01 INSTALLATION OF SLEEVES

.1 Where conduits, raceways and conductors pass through structural poured concrete, supply sleeves, unless otherwise noted.

.2 Size sleeves, unless otherwise noted, to leave 12mm clearance around the conduit, raceway, etc. Pack and seal the void between the sleeves and the conduit, raceway, conductor etc. for the length of the sleeves.

.3 Pack all sleeves with a ULC and CSA approved one part intumescent elastomer as manufactured by 3M. The installation shall be formed for each specific application using the manufacturers recommended combination of the following:

.4 P25 caulk, Puty 303, penetration sealing system 7902 or 7904, composite sheet CS195 or wrap strip FS-195.

.5 In poured concrete construction, accurately locate sleeves, and turn these sleeves over to the Division performing the concrete work for placement in the concrete form work. Sleeves shall be sufficiently rigid to prevent sleeve deformation when the concrete is poured, and shall be suitably plugged to prevent concrete from entering the sleeve.

.6 Submit to the concrete reinforcement detailer at the proper times, drawings, indicating all required sleeves, recesses and formed openings in poured concrete work. Such drawings shall be completely and accurately dimensioned and shall relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.

.7 Supply sleeves of a water protecting type for installation in the following locations:

.1 In Mechanical and Fan Room floor slabs except where on grade;
.2 In slabs over Mechanical, Fan, Electrical and Telephone equipment rooms or closets;
.3 In all floors equipped with waterproof membranes;
.4 In the roof.

.8 "Gang" type sleeving will be permitted only with the Consultant’s approval.

.9 Terminate sleeves for work which will be exposed so that the sleeve is flush at both ends with the wall, partition or slab surface so that the sleeves may be completely covered by escutcheon plates.

.10 Openings for multiple conduit or conductor runs, etc., will be provided by the Division responsible for the particular construction in which the opening is required. Carefully co-ordinate the opening locations with the particular Division and ensure that openings are suitably sized and located. Seal the space between the opening and the conduit, conductors, etc., for the length of the opening as for sleeves above.

.11 Where a round or formed opening is required, where placement of a sleeve has been missed, or where provision of an opening has not been properly co-ordinated with the Concrete Division, neatly cut a suitably sized hole or opening using proper tools to the approval of the Consultant. Prior to cutting any such holes or openings, determine whether or not any reinforcing steel or services, are concealed behind the surface where the hole or opening is to be cut and be responsible for all costs incurred for correcting any damage caused to the structure or services due to cutting holes or openings without prior study and approval.

3.02 INSTALLATION OF ESCUTCHEON PLATES

.1 Provide escutcheon plates over all exposed conduit passing through walls, floors, ceilings, partitions, furrings, etc., in finished areas.

3.03 INSTALLATION OF INSERTS AND BEAM CLAMPS

.1 Provide all inserts, beam clamps, fasteners, and similar hardware required for conduit, duct, raceway, conductor, etc., and equipment hanger and/or support materials unless otherwise noted.

.2 Accurately and properly set concrete inserts in the concrete framework.

.3 For runs of three (3) or more conduits, raceways, or conductors in concrete form work, use multiple type inserts used for the smallest conduit in the group.

.4 Where inserts are required in pre-cast concrete and in concrete work where concrete inserts have not been installed, drill a neat hole of the proper diameter and depth in the concrete and insert an anchor to accept the hanger rod, bolt, etc. or where concrete mass permits, use self-drilling concrete anchors.

.5 Fasten hangers and support provisions to brick or masonry with expansion shields and machine bolts, or for light loads, use plugs and screws.

.6 In cavity walls and/or ceilings, use two (2) wing toggles and for heavy loads, provide steel anchor plates with two (2) or more toggles to spread the load.

.7 Provide beam clamps for attaching, hanging and/or support provisions to structural steel, or where approved by the Consultant, weld the hanging and support provisions to the structural steel.

.8 Explosive power actuated fasteners will not be permitted unless specific approval for their use has been obtained from the Consultant.

.9 Use fibre or lead screw anchors for anchoring screws.

3.04 SUPPLY OF ACCESS DOORS

.1 Supply access doors to give access to all junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair but which is concealed in inaccessible construction except as otherwise specified herein or on the drawings.

.2 Before commencing installation of electrical work, prepare on a set of reflected ceiling plans with complete layouts of all ceiling access door which will be required. Submit these layouts to the Architect for approval and show the exact sizes and locations of such ceiling access doors. Locate access doors in walls and partitions to the Consultant's approval, and arrange electrical work to suit.

.3 Supply the respective trade with panels, doors or the frames therefore complete with all pertinent information and pay their trade for installation.

.4 Access doors shall be, wherever possible, of a standard size, for all applications. Confirm exact dimensions with the Consultant, prior to ordering.

.5 Submit a sample of each proposed type of access door to the Consultant for approval.

3.05 PLYWOOD

.1 Provide all plywood indicated on the drawings required for the work of Division 26. The backboards shall be 19mm thick, good both sides and shall be impregnated with white fire retardant paint on both sides.

3.06 EQUIPMENT CURBS, BASES AND SUPPORTS

.1 Set all floor mounted equipment on 100mm high concrete housekeeping pads 100mm wider and longer than the equipment base dimensions.

.2 Furnish dimensioned drawings, templates and anchor bolts for proper setting of equipment on bases and pads. Provide all structural steel frames, brackets, etc., for equipment bases and supports unless otherwise noted, and be responsible for all required levelling, alignment and grouting of the equipment.

.3 Provide structural steel stands for equipment where indicated or specified. Flange bolt stands to housekeeping pads.

.4 Where equipment is suspended above floor level it shall be, unless otherwise noted, supported on a suitable structural steel angles or channels bracketed to the wall or secured by hanger rods to slab construction, or where loading is excessive, from separate structural steel members carried to either the floor or ceiling, or both as required.

3.07 EXCAVATION AND BACKFILL

.1 Do all excavating bedding backfill and related work for the work of Division 26 as specified therein.

.2 For all electrical excavation, excavate to 150mm below and a minimum of 200mm to either side of the cable or duct run. Fill back with a bedding of granular ‘A’ gravel or sand. Minimum coverage shall be 750mm.

.3 Refer to details on the drawings and to utility company requirements for concrete encased duct installation.

.4 Where excavation is necessary in proximity to and below the level of any footings, bed with concrete to the level of the highest adjacent footing. Concrete strength shall be as directed by the Consultant.

.5 Carry out pavement cutting and repair of the Owners and Public Property as may be required for excavation and backfill work.

3.08 CONCRETE

.1 Do all concrete or related work required for the work of Division 26 as specified herein.

.2 Division 26 shall be responsible for all co-ordination to meet authority having jurisdiction requirements for ducts, provision of ducts and fittings as specified.

3.09 CUTTING AND PATCHING

.1 Inform other trades in time concerning required openings. In work already finished, cutting and patching shall be done by the trades installing the affected work, at the expense of Division 26. Obtain the approval of the Consultant, before doing any cutting.

3.10 PROVISION FOR SERVICES CROSSING BUILDING EXPANSION JOINTS

.1 Wherever services (conduit, cables etc.) cross building expansion joints, install the services in such a manner to permit free movement without imposing additional stress or loading upon the support system, and to prevent excessive movement at joints and connections.

3.11 SPRINKLER PROTECTION

.1 Weatherproof equipment where noted in the specifications and/or drawings shall have EEMAC Type 3 enclosure in accordance with the requirements of CSA C22.2 No. 94 Standard.

3.12 FLASHING

.1 Flash all electrical parts passing through or built into an outside wall, or a waterproof floor.

.2 Provide copper flashing for sleeves passing through exterior walls or water proof floors.

.3 Provide counter flashing on conduits passing through roofs to fit over flashing or curb. Supply flashing to appropriate division for installation.

3.13 METALS

.1 Steel construction required solely for the work of electrical trades and not shown on architectural or structural drawings shall be provided by Division 26 to the acceptance of the Consultant.

3.14 MOUNTING HEIGHTS

.1 Maximum mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated verify before proceeding with installation.

.3 Prior to rough-in, co-ordinate and have approved by the Consultant all mounting heights of devices.

.4 Mounting heights shall meet the requirements of the "Barrier Free" section of OBC.

.1	Local switches:	1050mm
.2	Local switches in suites:	1050mm
.3	Wall receptacles:	
.1	General:	400mm
.2	Above top of continuous baseboard heater:	200mm
.3	Above top of counters or splash back:	1100
.4	In mechanical room:	1050mm
.4	Panelboards (to top of panel trim):	1850mm
.5	Telephone and interphone outlets.	400mm
.6	Wall-mounted telephone and interphone outlets:	1050mm
.7	Wall-mounted A/V speakers:	2100mm or as noted
.8	Clocks:	2100mm
.9	Doorbell pushbuttons:	1050mm
.10	Pay Telephones:	1050mm
.11	Television outlets:	400mm

.12 All fire alarm devices shall be installed in accordance with CAN/ULC-S524-14 including:

.1	Manual stations:	1150mm
.2	Audible devices (not less then):	2300mm or 150mm below ceiling
.3	Visual devices: entire lens shall be not less than 2000mm and not more than 2400mm above finished floor.	
.4	Smoke detectors	100 – 300mm from ceiling to top edge of device.

END OF SECTION 26 05 05

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements, and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide lamacoid nameplates and other identification means for a complete installation.

1.03 SUBMITTALS

.1 Submit a list of proposed labels for review prior to manufacturing.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 STANDARD IDENTIFICATION

.1 Identify electrical work as specified herein:

.1 For each piece of electrical distribution equipment from the electrical source of supply up to and including panelboards and motor systems, for special control panels and cabinets, and for any other piece of equipment where specified in this Section, provide engraved lamacoid identification nameplates.

.2 Nameplates shall generally be black-white-black with bevelled edges, secured to apparatus with stainless steel screws. Generally lettering shall be 6mm high but equipment in the main electrical room shall be provided with lettering 13mm high.

.3 Warning signs, if and when required, shall be red with white lettering.

.4 Equip large multiple cell or component apparatus such as switchboards and distribution panels with main nameplates identifying the equipment, voltage characteristics and capacity and with sub-nameplates clearly identifying each cell or component and its service.

.5 Panelboard nameplates shall identify the panelboard numbers designated on the drawings, unless otherwise instructed. Nameplates for disconnect switches, control panels and cabinets shall outline their service.

.6 Motor starters, magnetic and manual, shall identify the piece of motorized equipment being serviced.

.7 Exact nameplate wording and sizes must be approved by and confirmed by the Consultant prior to manufacture.

.8 Directories for branch circuit panelboards shall be clearly and neatly typewritten, accurately identifying the type, location and wattage of the connected load for each circuit breaker. Directories shall be secured to the rear of the cabinet door under protective plastic. Incorporate copies of all panel board directories in each copy of operating and instruction manuals.

.9 Clearly identify each branch circuit breaker in a permanent manner to correspond with directories. Glued paper identification will not be acceptable.

.10 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting the outside of the covers. Paint colours shall be in accordance with the following schedule:

.1 Lighting - Yellow

.2	Power	-	Blue
.3	Emergency Power	-	Orange
.4	Fire Alarm	-	Red
.5	Telephone	-	Cream
.6	Miscellaneous Signals	-	Brown

.11 In addition to painting miscellaneous signal boxes clearly identify the specific system in which the box is installed.

.12 Colour code empty conduit capped and terminated for future use as specified above and clearly identify its intended use by means of securely attached tags.

.13 Colour code conductors throughout to identify phases, neutrals and grounds, by means of coloured conductor insulation. Colours shall be as follows:

.1	Phase A	-	Red
.2	Phase B	-	Black
.3	Phase C	-	Blue
.4	Ground	-	Green
.5	Neutral	-	White

.14 Control conductors, in addition, shall be numbered with Brady Ltd., or Electrovert Ltd., Z-type markers. Colour code conductors, for special component per manufacturer's recommendations.

.15 Use dymo tape to label each receptacle with its circuit number (e.g., UA-27).

3.02 PAINTING AND FINISHES

.1 Painting of exposed electrical work will be done as part of the work of Division 9. Equipment to be located in finished areas shall be provided to site prime coated.

.2 All exposed electrical fittings, supports, hangers, frames conduit, racks, boxes, raceways and similar material and apparatus shall be galvanized or finished with corrosion resistant primer ready to accept paint. Take special care when priming work exposed to the elements or in wet areas to prevent rust or corrosion from damaging adjacent surfaces.

.3 All large switchgear, transformers, distribution centres, panelboard, starters, disconnects or similar apparatus shall be factory finished in gloss air dry enamel over corrosion resistant sealer primer. Unless specified to the contrary, this finish shall be ASA #61 grey.

.4 Touch-up and/or repaint any factory finished equipment not scheduled to be painted by Division 9 that has been scratched or otherwise damaged during installation.

END OF SECTION 26 05 10

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

.1 Demolition and restoration of areas as identified on the contract documents.

1.03 WORK IN EXISTING BUILDING

.1 The building shall remain open and in operation during the construction period.

.2 Where existing services such as electrical power, fire alarm system, television system etc., are required to be disrupted and/or shut-down, co-ordinate the shut-downs with the Owner and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruption and/or shut-downs and ensure that the duration of same is kept to the absolute minimum. Submit for approval a written, concise schedule of each disruption at least 72 hours in advance of performing work and obtain Owner's written consent prior to implementing.

.3 Where disruption to life safety systems are required, comply with paragraph above and provide continuous monitoring during shut down period and ensure that all systems are reactivated prior to leaving site at the end of each working day.

.4 Should any temporary connections be required to maintain services during work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing system be damaged, make full repairs without extra cost, and to the satisfaction of the Consultant.

.5 Refer to Division 1 for phasing and staging of work and adhere to that program. Comply with instructions regarding working hours necessary to maintain the building in operation].

.6 The drawings indicating items of equipment to be deleted or relocated have been prepared as a guideline for this subcontractor, but shall not be construed as indicating every item of equipment or conduit. Be responsible for determining site conditions by personal examination.

.7 Where existing services (conduits, receptacles, switches, etc.) presently mounted on and/or concealed behind existing finishes become exposed during the renovation work and where these services will not be concealed behind or mounted on new finishes, include for relocating the service so as to be concealed behind or on new or existing finishes. Co-ordinate new locations with the Consultant.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 26 05 14

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements, and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide all wiring as specified herein for a complete installation, as required by the contract documents.

1.03 SUBMITTALS

.1 Submit shop drawings of building wire and cables.

.2 Submit a list of feeders used on the project, indicating cable type and size.

1.04 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers are; Canada Wire and Pirelli.

PART 2 - PRODUCTS

2.01 BRANCH CIRCUIT CONDUCTORS

.1 “RW90” single conductor to CSA C22.2 No. 38-95, colour coded 90ºC rated, with approved manufactured connectors at joints.

.2 1000 volts “RPV90” single conductor to CSA C22.2, colour coded 90°C rated, with approved manufactured connectors at joints.

.3 “RWU90” (-40ºC) single conductor to CSA C22.2 No. 38-95, colour coded, 90ºC rated, with joints soldered and taped to the Consultant’s approval.

.4 Flexible armoured cable, CSA type “AC-90” to CSA C22.2 No. 51-95.

.5 "TWH" single conductor to CSA C22.2 No. 75-M1983 (R1992), colour coded, 90ºC, rated with approved manufactured connectors at joints.

.6 Single conductor colour-coded, rubber insulated wire to CSA type "R90" 90ºC rated.

.7 Aluminum conductors where shown to be used, shall be provided with compression terminations, applied with corrosion preventing compound, and hydraulic or power activated tools shall be used for all connections.

.8 Branch circuit conductors up to and including #12 AWG shall be solid. Branch circuit conductors in sizes larger than #12 AWG shall be stranded. All branch circuit conductors shall be constructed of 98% conductive copper, unless otherwise noted, and shall be approved for 600 volts.

.9 Electric service, distribution and special conductors are specified in this Section and/or on the drawings.

.10 Lubricant shall be Ideal "Yellow 77" or approved equal.

2.02 LOW VOLTAGE (24 VOLT) CONDUCTORS

.1 Colour-coded #18 AWG TFF thermoplastic insulated wire for 600 volt service, complete with the number of copper conductors required.

2.03 MICC CABLE

.1 Pyrotenax of Canada Ltd. two hour rated mineral insulated cables and accessories to CSA standard C22.2 No. 124.

.2 Conductors shall be solid bare soft annealed copper.

.3 Insulation shall be compressed powdered magnesium oxide to form compact homogeneous mass throughout the entire length of the cable.

.4 The overall covering shall be an annealed seamless copper sheath type MI rated 600V, 250ºC.

.5 Terminations shall be factory pre-packaged kits.

PART 3 - EXECUTION

3.01 INSTALLATION OF BRANCH CIRCUIT CONDUCTORS

.1 Provide all required branch circuit conductors.

.2 Conductors for branch circuit work inside the building and above ground, except as noted below, shall be as specified in Article #2.01 Item .1 above.

.3 Conductors for branch circuit work underground as specified in Article #2.01, Item .2 above.

.4 Conductors for branch circuit lighting work (fixture tails) in accessible ceiling spaces, maximum length 1500mm, and branch circuit work in cavity wall construction from wiring devices to ceiling spaces, maximum length 6m, shall be as specified in Article #2.01, Item 3 above.

.5 Conductors for branch circuit work to electric heating coils and/or units shall be as specified in Article #2.01, Items .4 and .5 above.

.6 Branch circuit conductor sizes are scheduled and/or specified on the drawings. Such sizes are minimum requirements and must be increased, where required, to suit the length of run and voltage drop.

.7 Do not use conductors smaller than #12 AWG in systems over 30 volts, unless otherwise noted.

.8 Use lubricant when pulling wires into conduit. Ensure that wires are kept straight and are not twisted or abraded.

.9 Neatly secure exposed wire in apparatus enclosures with approved supports or ties.

.10 Splicing of all conductors shall be done with Ideal Wing nut #450 Series for conductors from #14 Awg to #8 Awg.

.11 For all conductors larger than #8 AWG, splicing shall be done with Burndy Serut connectors wrapped with 3 m #33 scotch tape.

.12 Provide a dedicated neutral for each branch circuit conductor unless noted otherwise.

.13 Joints in all conductors shall be kept to a minimum and all conductors shall be installed in continuous unbroken runs.

3.02 INSTALLATION OF LOW VOLTAGE (24) VOLT CONDUCTORS

.1 Install all low voltage wiring in conduit.

.2 Refer to manufacturer's shop drawings for special requirements pertaining to low voltage wiring.

.3 Refer to individual specification section and the drawings for additional wiring requirements.

3.03 INSTALLATION OF MICC CABLE

.1 For feeders and branch circuit conductors which are used in connection with fire alarm systems and all life safety systems connected to a standby generator power source, and where such feeders and conductors are not embedded in concrete, or utilize Pyrotenax MICC cables as specified.

.2 Cables shall be installed and terminations made as directed by the manufacturer.

.3 MICC cables shall be clipped and fastened on maximum 12" centres and shall be fastened within 6" of each bend.

.4 All MICC cables shall be meggered out using a 1000 volt megger upon completion of terminations.

END OF SECTION 26 05 21

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements, and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide a complete system of electric service grounding as outlined herein and as specified and detailed on the drawings. Grounding shall comply with the requirements of all grounding work, which is required but not specified herein or shown on the drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

.1 All grounding conductors shall be stranded copper, bare or insulated as indicated on Drawings or in Specifications.

.2 Use Cadweld or Burndy Thermoweld process for all weld connections. AMP of Canada Ltd. Wrench-Lok grounding connectors are an acceptable equivalent to welded connections.

.3 All ground connectors to be designed and approved for grounding purposes.

.4 Ground buses - 7mm x 50mm x 915mm (¼" x 2" x 36") solid copper. In the main electrical room, provide ground bus around the entire room.

.5 Ground electrodes - 3050mm x 20mm (120" x ¾") copper clad steel ground rods.

PART 3 - EXECUTION

3.01 INSTALLATION

.1 Bond the electrical system ground to the existing grounding system by extending 2 ground conductors in separated paths to the new electrical room. Ground conductors shall be a minimum ⅜ copper wire connected with approved fittings.

.2 Provide a perimeter ground bus supported on the wall in electrical rooms, containing medium voltage switchgear, power transformer and secondary switchboards. Connect all electrical systems and equipment ground wires back to ground bus in the electrical rooms. Make connections to ground bus with cable lugs, bolted through the copper with shake-proof lock washers and nuts. This ground bus to be the sole interconnection point for ground connections to:

.1 Main secondary switchboards.
.2 Transformers.
.3 All exposed metal work.

.3 Bond all interior non-electrical metallic piping systems to the electrical system ground including but not limited to water supply, waste water and gas systems.

.4 Ground the neutral point of each secondary wye connected transformer.

.5 Connect the ground bus inside each switchgear assembly to the grounding system.

.6 Inside main secondary switchboards, connect the neutral bus to the ground bus with conductor rated minimum 25% main bus rating.

.7 Final arrangement of grounding main secondary switchboards as approved by the ground fault system manufacturer.

.8 Connect the ground bus in each 600 volt emergency distribution panel to the grounding system.

.9 Ground all conduit, and all non-current carrying metal parts, equipment cases, frames, bases, brackets, frames of motors, duct systems, building steel, elevators, etc.

.10 Where conduit systems are used for grounds, provide all necessary bushings, studs and jumpers as may be required to maintain effective continuity of ground. Provide separate ground conductors in all non-metallic conduits, concrete encased conduit, conduit below grade and EMT conduit. Bond the ground wire to all boxes and luminaries.

.11 Ground each piece of fixed equipment back to the switchboard or panel feeding that equipment, by one of the following methods:

.1 Install a separate bare soft drawn copper ground inside each feeder conduit. At the switchboard or distribution panel, provide a grounding bushing, loop the ground conductor through the bushing, and connect to the switchboard ground bus. At the fixed equipment, connect to an internal ground bus, or connect to the inside of the metal enclosure utilizing approved screws and connectors (remove all paint).

.2 For branch circuits, the conduits may be used for grounding, provided seamless steel fittings are used on EMT and threaded fittings are used on rigid conduit. At each receptacle connect a stranded copper ground wire from the outlet box to the grounding terminal on the receptacle. Install a separate grounding conductor in all PVC conduits.

.3 Where equipment is fed by a multi-conductor power cable, provide a ground conductor in the cable. At the switchboard or panel, connect to the ground bus. Use a grounding connector on the cable for positive grounding of the metallic sheath. Loop the ground wire to the grounding connector.

.12 Where equipment is fed by single conductor flexible armoured cables, provide separate ground conductor and non-ferrous metallic plate and grounding connectors at the switchboard or panel for terminating cables. Run grounding conductor inside fixed equipment and terminate at the grounding connection. At the load end provide an insulating plate for terminating cables, the outer sheaths to be ungrounded.

.13 Run a separate ground wire in all flexible conduits. Connect each end to ground bus or lug or connector.

.14 Where mechanical protection is required for insulated grounding conductors install in rigid conduit. Use rigid PVC conduit in concrete or below grade slab and aluminium conduit in other locations.

.15 Provide weld connection or wrench type grounding connectors for:

.1 All connections between grounding conductors.

.2 All connections between grounding conductors and cable lugs.

.16 Arrange grounding to provide the minimum impedance paths for ground fault currents. Provide any additional grounding required for approval by the inspecting authorities.

.17 Ground uninsulated metallic materials, which are located below surfaces heated by electric heating cable.

3.02 TESTING

.1 Test the resistance of the grounding system. Add additional ground wires and ground rods if required as directed by the Consultant and retest. Repeat this process until ground resistance is 2 ohms or less. Conduct all tests using Megger Null Balance or Megger Universal ground resistance test equipment.

.2 Test all receptacles for proper connections with a neon lamp type polarity tester. Check that ground resistance is less than 0.2 ohms with an Edgecumbe Peebles Ltd., ground loop impedance tester.

END OF SECTION 26 05 27

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements, and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide all hangers and supports as required to provide a complete and operational system as required by the contract documents.

PART 2 - PRODUCTS

2.01 SUPPORT CHANNELS

.1 U-shape, size 41 x 41 x 2.5mm thick, surface mounted, suspended or set in poured concrete walls and ceilings, as required for the specific application.

PART 3 - EXECUTION

3.01 INSTALLATION

.1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole steel straps to secure surface conduits and cables 50mm and smaller.
.2 Two-hole steel straps for conduits and cables larger than 50mm.
.3 Beam clamps to secure conduit to exposed steel work.

.6 Suspended support systems

.1 Support individual cable or conduit runs with 6mm dia. threaded rods and spring clips.
.2 Support 2 or more cables or conduits on channels supported by 6mm dia. threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface-mounting of two of more conduits, use channels at 1.5m o.c. spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION 26 05 29

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide all conduits, fastenings, fittings and boxes for a complete installation, as required by the contract documents.

PART 2 - PRODUCTS

2.01 CONDUITS

.1 Rigid galvanized steel, CSA C22.2 No. 45, with exterior zinc and interior enamel coatings, galvanized threads where factory cut, red lead coated threads where site cut, factory made bends where site bending is not possible, factory made and threaded fittings and “tomic” joints and terminations made with rigid couplings, concrete tight where required.

.2 EMT (Thinwall), to CSA C22.2 No. 83, complete with factory made bends where site bending is not possible and joints and terminations made with set screw type connectors, concrete tight where required, maximum allowable size shall be 50mm diameter.

.3 Galvanized steel flexible liquid-tight metallic conduit, to CSA C22.2 No. 56, complete with proper and suitable liquid-tight flexible conduit connectors at terminations.

.4 Galvanized steel flexible metallic conduit to CSA C22.2 No. 56, complete with suitable type connectors at terminations.

.5 Rigid plastic (PVC) conduit to CSA C22.2 No. 211.1 complete with site made heat gun bends to 50mm diameter, factory made bends for conduit larger than 50mm, solvent weld joints with socket couplings and proper connectors and adaptors at terminations.

.6 Electrical non-metallic tubing to CSA C22.2 No 211.0 complete with suitable type connections and couplings.

.7 Conduit racks shall be Unistrut Ltd. Electrovert Ltd., “Cantruss”, Burndy Ltd., “Flexible” or equivalent.

2.02 STANDARD OUTLET BOXES

.1 Sheet Steel outlet boxes:

.1 Electro galvanized steel single and multi gang flush device boxes for flush installation.
.2 Electro galvanized steel utility boxes for outlets connected to surface mounted EMT conduit in interior application.
.3 102mm octagonal boxes for lighting fixture outlets
.4 102mm square outlet boxes with extension and plaster ring for flush mounting in finished plaster walls.

.2 Masonry boxes: Electro galvanized steel masonry single and multi gang boxes for devices flush-mounted in exposed block walls.

.3 Concrete boxes: Non-metallic concrete boxes with matching extension and plaster rings as required for flush-mounting in concrete.

.4 Conduit boxes: Type FS and FD ferralloy boxes with factory threaded hubs and mounting feet for exterior surface wiring of switches and receptacles.

.5 Each outlet box must be suitable in all respects for the application, and complete with securing lugs, knock-outs, and where necessary, suitable plaster rings, concrete rings, covers and any other required accessory.

.6 Outlet boxes for special wiring devices, for special equipment and for special applications, if and where required, are specified hereinafter in this Section or on the drawings.

.7 347 volt outlet boxes for 347 volt switching devices.

.8 Provide blank cover plates for all boxes without wiring devices.

2.03 PULLBOXES AND JUNCTION BOXES

.1 Pullboxes and junction boxes shall be constructed of galvanized or prime coated steel. Each shall be suitable in all respects for the applications, and complete with screw-on hinged covers as required.

.2 The physical size of pullboxes shall be as required by the "Ontario Electrical Safety Code" to suit the number and size of conduits and conductors.

PART 3 - EXECUTION

3.01 INSTALLATION OF CONDUITS

.1 Install conduit concealed in all finished areas, and concealed to the degree made possible by finishes in partially finished and unfinished areas. Conduit may be exposed in unfinished areas such as Electrical Rooms and Mechanical Rooms, unless otherwise noted on the drawings or specified herein. Refer to and examine the architectural drawings and on the drawings or specified herein. Refer to and examine the architectural drawings and room finish schedules to determine finished, partially finished and unfinished areas of the building.

.2 Where conduits are exposed, arrange same to avoid interference with other work and parallel to the building lines. Where horizontal conduits are exposed, install as high as possible. Do not install conduit within 150mm of “hot” pipes or equipment unless the conduit is associated with the equipment.

.3 Provide conduit for all electric service distribution and branch circuit conductors except armoured cable, and bus duct and except for applications where duct, cable tray and similar raceway material is provided.

.4 Conduit for branch circuit and distribution conductors, except as noted hereinafter, shall be as specified in Article #2.01, Item .1 above.

.5 From 1200mm above the ground floor slab.

.1 Conduit for branch circuit conductors concealed in masonry work in drywall, in shafts and furrings above ground and;

.2 For branch circuit conductors exposed inside the building shall be as specified in Article #2.01 Item .2 above.

.6 For distribution and branch circuit conductors concealed in poured concrete work above ground (not on grade); shall be as specified in Article #2.01 Item .6 above.

.7 Conduit for short branch circuit connections to motorized equipment (minimum length 450mm; maximum length 600mm with 180 degree loop where possible) shall be as specified in Article #2.01, Item .3 above.

.8 Conduit for short branch circuit connections to electric heating units where 90ºC rated conductors are required (minimum length 450mm - maximum length 600mm with 180 degree loop where possible) and at points where distribution and/or branch circuit conductors cross building expansion joints shall be as specified in Article #2.01, Item .4 above.

.9 Conduit for distribution and branch circuit conductors underground and for distribution and branch circuit conductors in special corrosive areas as defined herein shall be as specified in Article #2.01, Item .5 above.

.10 Conduit for branch circuit conductors where concealed in walls or encased in concrete shall be as specified in Article #2.01 Item 6 above.

.11 Conduits supplying equipment classified as explosion proof (i.e., fuel pumps and associated and adjacent equipment) shall be rigid galvanized steel for their entire length from their power source. Provide all required seals as specified in CEC Section 20.

.12 Provide a separate ground conductor in all plastic and EMT conduit.

.13 Secure conduit located in poured concrete work in place in a manner such that conduit will not float or move when concrete is poured. Protect conduit from concrete and water penetration during the concrete pour.

.14 Support and secure surface mounted and suspended single or double runs of metal conduit at support spacing in accordance with "Canadian Electrical Code" requirements by means of galvanized pipe straps, conduit clips, ring bolt type hangers, or by other manufactured devices. Support multiple mixed size metal conduit runs with conduit racks spaced to suit spacing requirements of the smallest conduit in the group.

.15 Install conduit parallel or perpendicular to building lines.

.16 Generally, conduit is sized on the drawings. Conduit not sized on the drawings shall be sized in accordance with the latest edition of the Canadian Electrical Code. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with the Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the scheduled or specified conduit size to suit.

.17 Increase conduit sizes for heavily insulated conductors (i.e., "TWU"), a minimum of one (1) conduit size, regardless of the size indicated or required.

.18 The maximum allowable size of conduit for installation in poured concrete work must be determined in consultation with the Consultant prior to installation. The placement of reinforcing steel in structural concrete work will take precedence over the placement of conduit. Multiple runs of conduit in poured concrete work must be adequately spaced as directed by the Consultant.

.19 Do not install horizontal runs of conduit in masonry walls.

.20 Ensure that all conduit systems which are left empty are clean, clear, capped and properly identified. Provide suitable fish wires in all such conduit.

.21 Provide a minimum of two (2) 25mm diameter conduits up to and into ceiling spaces from flush mounted panelboards located below and/or near a hung ceiling.

.22 Support and secure surface mounted and suspended rigid PVC plastic conduit with hangers and supports as specified above for metal conduit but at support spacing in accordance with the conduit manufacturer's published recommendations.

.23 Support all conduit installed underground on well tamped flat bed of earth, free from rocks or protrusions of any kind.

.24 Conduit fittings shall be, unless otherwise noted, constructed of the same material as the conduit and suitable in all respects for the application.

.25 Provide proper adaptors for joining conduits of different materials.

.26 Ends of all site cut conduit must be square and properly reamed.

.27 All conduits for high voltage cable installation shall be rigid galvanized steel.

.28 Electrical conductors supplying all equipment connected to a source of emergency supply shall use Pyrotenax Mineral Insulated copper sheathed cables (MI).

.29 As an alternate to the use of MI Cables, electrical conductors supplying equipment connected to a source of emergency supply may be installed in service spaces that do not contain other combustible material or shall be protected against exposure to fire as allowed by the Building Code. Provide fire rated enclosures or provide concrete enclosure as required to ensure continued operation for a minimum period of 2 hours from the source of power supply to the branch circuit supplying the equipment.

3.02 INSTALLATION OF OUTLET BOXES

.1 Provide an outlet box for each lighting fixture, wiring device, telephone outlet and any other outlet specified herein or shown or specified on the drawings, unless otherwise noted.

.2 Generally, mounting heights and locations for outlets are shown on the drawings and/or specified herein, however, confirm the exact location and arrangement of all outlets with the Consultant prior to roughing-in. Architectural drawings and the Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting heights and locations.

.3 Do not install outlet boxes "back-to-back" in walls and partitions. Such outlets must be staggered and sealed against noise transmission. "Thru-Wall" type outlet boxes will not be permitted for any application.

.4 Support and secure boxes independent of the conduit or cable connected thereto.

.5 All recessed outlet boxes for surface mounted devices or lighting fixtures must be totally concealed by the device or fixture.

3.03 INSTALLATION OF PULLBOXES AND JUNCTION BOXES

.1 Provide pullboxes in conduit systems wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30m in length, or with more than two (2) 90 degree bends shall be equipped with a pullbox installed at a convenient and suitable intermediate location.

.2 Provide a junction box wherever required and where shown and/or specified on the drawings.

.3 All pullboxes and junction boxes must be accessible after the building is completed.

.4 Accurately locate and identify all concealed pullboxes and junction boxes on "as-built" record drawings.

.5 Support and secure all boxes independent of the conduit or cable connected thereto.

.6 Install identification labels indicating system name on all pullboxes and junction boxes.

END OF SECTION 26 05 33

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 PRODUCT DATA

.1 Submit product data in accordance with Section 26 05 01 – Shop Drawings, Product Data and Samples.

1.03 REFERENCE STANDARDS

.1 Design, manufacture and test the dry type transformers in accordance with good industry practices and in accordance with the latest versions of the following Standards.

.1 CSA Std C22.2 No 0.12-M1985 Equipment Rated 750V or Less.
.2 CAN/CSA-C22.2 No 47-M90.
.3 UL 1561- 4 Ed.
.4 CSA C802.2-06 Minimum Efficiency Values for Dry-Type Transformers.
.5 NEMA ST-20 for sound level

1.04 STORAGE

.1 Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from potential damage from weather and construction operations.

.2 Store so condensation will not form on or in the transformer housing and if necessary, apply temporary heat where required to obtain suitable service conditions. Handle transformer using proper equipment for lifting and handling; use when necessary lifting eye and/or brackets provided for that purpose.

1.05 ACCEPTABLE MANUFACTURERS

.1 All transformers shall be of one manufacturer. Acceptable manufacturers are: STI, Rex Transformers, Cutler Hammer, Square D and Siemens.

PART 2 - PRODUCTS

2.01 TRANSFORMER TYPE

.1 Transformer shall be standard general purpose dry type unless otherwise indicated on drawings as K-Rated or Harmonic Mitigation type.

2.02 GENERAL PURPOSE TRANSFORMERS

.1 Transformers shall have the following characteristics:

.1 Type: AN/AA Ventilated self-cooled.
.2 KVA, primary voltage and secondary voltage and as indicated.
.3 Single or three phase as indicated.
.4 Delta connected primary for three phase transformers.
.5 Secondary winding shall be wye connected for three phase transformers unless Harmonic Mitigation type, or unless otherwise noted.

.6 Four full capacity 5% adjustment taps, 2 at 2.5% FCBN and 2 at 2.5% FCAN.
.7 Copper Windings.
.8 220°C Insulation Class.
.9 150°C Temperature rise.
.10 Standard Impedance.
.11 10kV BIL.
.12 Sound level per NEMA ST-20.
  .1 Ventilated Type 1 enclosure with Grey finish (Options Type 2 (drip-proof), Type 3R (weatherproof), Type 4 (totally enclosed), Sprinkler-proof]
.13 Anti-vibration pads shall be used between the core and the enclosure.
.14 The impregnation process for the core-and-coil assembly shall include a period under vacuum, followed by pressure impregnation (VPI).
.15 Transformer shall have embossed aluminum or stainless steel nameplate indicating, but not restricted to the following.
  .1 KVA rating
  .2 Voltage rating
  .3 Impedance
  .4 Type
  .5 Insulation class
  .6 Temperature rise
  .7 Connection diagram

2.03 K-RATED TRANSFORMERS

.1 In addition to all general purpose transformer characteristics in section 2.2, K-Rated transformers shall have the following features.

  .1 Transformers shall be K-13 rated for non-linear loads.
  .2 Transformers shall have 200% Rated Neutral.
  .3 Transformers shall have an electrostatic shield between primary and secondary windings.

2.04 HARMONIC MITIGATION TRANSFORMERS

.1 In addition to all general purpose transformer characteristics in section 2.2, Harmonic Mitigation transformers shall have the following features.

  .1 Transformers shall be compatible with load profile up to K20.
  .2 Transformers shall have 200% Rated Neutral.
  .3 Transformers shall have an electrostatic shield between primary and secondary windings.
  .4 3rd, 9th & 15th harmonics and other zero sequence currents shall be treated within the secondary windings through cancellation of the zero sequence fluxes. Simply trapping these currents in the delta primary winding is NOT acceptable.
  .5 For 5th, 7th, 17th & 19th harmonics provide the appropriate primary-secondary phase shift at 60 Hz as shown on drawings, in order to cancel these harmonic currents with those of other loads fed from the same primary supply.
  .6 Harmonic mitigation shall be by electromagnetic means only. No capacitors or electronics shall be used.
  .7 Positive & negative sequence impedance at 60Hz: 2.5% to 3.8% (up to 75 kVA), 3.0% to 4.8% (112.5 to 300 kVA)
  .8 Zero sequence impedance/reactance at 60Hz: Less than 0.95% and 0.3% respectively for sizes up to 300 Kva.

PART 3 - EXECUTION

3.01 MOUNTING

.1 Floor or wall-mount the dry type transformers up to 75 kVA as indicated.

.2 Mount transformers 75 kVA and above, on floor. Floor mounted transformer shall be installed on an isolated housekeeping concrete pad (100mm) poured on 3 layers of “Duracoustic” continuous cushion material as detailed on the drawings..

.3 Ensure adequate clearance around transformer for ventilation.

.4 Install transformers in level upright position.

.5 Remove shipping supports is any only after transformer is installed and just before putting into service.

.6 Loosen isolation pad bolts until no compression is visible.

.7 Supply and install anti-vibration dampers for wall or ceiling mounted transformers.

.8 Make primary and secondary connections with flexible conduit and in accordance with wiring diagram.

.9 Energize transformers as soon as possible after installation is completed.

END OF SECTION 26 12 16

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

.2 The panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of EEMAC and CSA.

1.02 WORK INCLUDED

.1 Provide all panelboards as specified and shown for a complete installation, as required by the contract documents.

1.03 SUBMITTALS

.1 Submit shop drawings showing the following information:

.1 Breaker layout drawing with dimensions indicated and nameplate designation.
.2 Component list.
.3 Conduit entry/exit locations.
.4 Assembly ratings including:
.1 Short circuit rating.
.2 Voltage
.3 Continuous current
.5 Cable terminal sizes.

.2 Where applicable, the following additional information shall be submitted:

.1 Key interlock scheme drawing and sequence of operations.

1.04 QUALIFICATIONS

.1 The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers and fusible switches.

.2 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.05 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers are: Schneider Canada, Eaton (Cutler Hammer) and Siemens.

PART 2 - PRODUCTS

2.01 RATINGS

.1 Panelboards shall have short circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.

.2 Panelboards shall be labelled with a CSA short circuit rating. When series ratings are applied with integral or remote upstream devices, a label shall be provided. Series ratings shall cover all trip ratings of installed frames. It shall state the conditions of the CSA series ratings including:

.1 Size and type of upstream device.
.2 Branch devices that can be used.
.3 CSA series short circuit rating.

2.02 CONSTRUCTION

.1 Interiors shall be completely factory assembled with bolt-on devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

.2 Trims for lighting and appliance panelboards shall have doors with concealed hinges over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi-flush cylinder lock and catch assembly. Trim fastening screws shall not be visible.

.3 Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

.4 Surface trims shall be same height and width as box. Flush trims shall overlap he box by one (1) inch on all sides.

.5 A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.

.6 All locks shall be keyed alike.

2.03 BUS

.1 Main bus bars shall be plated aluminum sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

.2 Full-size insulated neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

2.04 POWER DISTRIBUTION PANELBOARDS – CIRCUIT BREAKER TYPE

.1 Power distribution panelboards and the devices contained therein shall have series interrupting ratings as indicated on the drawings. Panelboards shall be Square D Type I-line. Panelboards shall have molded case circuit breakers as indicated below.

.2 Molded case circuit breakers shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics and shall be Square or approved equal. Ground fault protection shall be provided where indicated.

.3 Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-centre switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

.4 Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.

.5 Where indicated, circuit breakers shall be CSA listed for series rating.

.6 Where indicated, circuit breakers shall be current limiting.

.7 Circuit breakers 400 ampere frame and below shall be Square D with thermal-magnetic trip units and inverse time-current characteristics.

.8 Circuit breakers 600 ampere through 1200 ampere frame shall be Square D with microprocessor-based RMS sensing electronic trip units and the following features:

.1 Each molded case circuit breaker microprocessor-based tripping system shall consist of three current sensors, a trip unit, and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when pre-determined trip levels and time delay settings are reached.

.2 Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed or adjustable as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

.3 The microprocessor-based trip unit shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.

.4 When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override. Internal ground fault protection adjustable pick-up ratings shall not exceed 1200 amperes. Provide neutral ground fault current sensor for four wire loads.

.5 System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

.1 Adjustable long time pick-up and delay

.2 Adjustable short time pick-up and delay, with selective curve shaping

.3 Adjustable instantaneous pick-up

.4 Adjustable ground fault pick-up and delay, with selective curve shaping.

.6 Where indicated, provide circuit breakers CSA listed for application at 100% of their continuous ampere rating in their intended enclosure.

.7 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

2.05 POWER DISTRIBUTION PANELBOARDS – FUSIBLE SWITCH TYPE

.1 Power distribution panelboards shall have fusible switches as specified below and include fuses with ratings indicated on the drawings. Panelboard shall be Square D type QMQB or QMB.

.2 Fusible switch units shall be quick-make, quick-break design. Units 30 through 600A shall be rated not less than 200 kAIC with rejection-type clips for Class J type fuses. Units 800A and 1200A shall be rated for 200 kAIC with Class L fuse provisions. Fuses for these switches shall be supplied and field installed by the electrical contractor.

2.06 BRANCH CIRCUIT PANELBOARDS

.1 The Minimum Integrated Short Circuit Rating for branch circuit panelboards shall be indicated on the drawings. Panelboards shall be Square D type NF or NQOD. Panelboards shall have circuit breakers as indicated below.

.2 Bolt-in type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

.3 Circuit breakers shall be thermal magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100 ampere frame and through 100 ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be CSA listed as type SWD for lighting circuits.

.1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management and control system (EMCS) panels and fire alarm panels.

.4 Circuit breakers shall have a minimum interrupting rating of 10,000 amperes symmetrical at 240 volts and 14,000 amperes symmetrical at 600 volts.

2.07 SUITE PANELS

.1 Suite panels shall be Square D type QO load cent.

.2 Circuit breakers shall be Square D type QO (plug-on) thermal magnetic trip, with an integral crossbar to ensure simultaneous opening of all poles in multi-pole circuit breakers.

.3 Circuit breakers shall have an overcentre, trip-free, toggle-type operating mechanism with quick-make, quick-break action and possible handle indication.

.4 Handles shall have ON, OFF, and “Tripped” positions. In addition, trip indication shall include a VISI-TRIP indicator appearing in the window of the circuit breaker case (through 125 amperes).

.5 Circuit breakers shall have current ratings as noted on the plans. Interrupting ratings shall be selected to provide the required load centre short circuit current rating.

.6 Single-pole, 15 and 20 ampere circuit breakers intended to switch fluorescent lighting loads on a regular basis shall have the SWD marking.

.7 Provide Class A ground fault interrupter circuit breakers where scheduled on drawings.

.8 Provide arc fault circuit breakers as required to meet OESC requirements.

2.08 ENCLOSURE

.1 Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the Canadian Electric Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

.2 Enclosures shall be provided with one (1) blank end and one end with knock-outs.

.3 All enclosures shall be EEMAC 1 c/w drip shield for surface-mounted enclosure unless otherwise noted.

2.09 NAMEPLATES

.1 Provide an engraved nameplate for each panel section.

2.10 FINISH

.1 Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of grey ANSI 49 paint applied.

.2 Suite panel shall have WHITE finish.

PART 3 - EXECUTION

3.01 FACTORY TESTING

.1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of EEMAC and CSA standards.

3.02 INSTALLATION

.1 The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.03 FIELD SETTINGS

.1 The Contractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operation condition. The settings shall be in accordance with the approved protective device co-ordination study or as directed by the Consultant.

END OF SECTION 26 24 16

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide enclosed switches, fused and/or unfused, for a complete installation, as required by the contract documents.

1.03 SUBMITTALS

.1 Submit shop drawings of enclosed switches.

1.04 ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers are: Schneider Canada, Eaton (Cutler Hammer) and Siemens.

PART 2 - PRODUCTS

2.01 ENCLOSED SWITCHES (DISCONNECTS)

.1 Provide heavy duty, CSA approved enclosed switches.

.2 Each enclosed switch shall be front operated with a handle suitable for padlocking in the "OFF" position and arranged so that the enclosure cover cannot be opened while the handle is in the "ON" position. Operating mechanisms shall be quick-make, quick-break, positive acting with visible blades and a line terminal shield.

.3 Fusible units shall be complete with fuse clips suitable for HRC, Class "J" fuses unless otherwise noted. Each unit shall also be equipped with solderless lugs and a front cover nameplate identifying the catalogue number and electrical characteristics.

.4 Enclosures shall be, unless otherwise noted, NEMA 1 general purpose enclosures and NEMA 3 weatherproof enclosures.

.5 The ampere rating, number of poles and fuse requirements for enclosed switches shall be as specified on the documents.

.6 Where the enclosed switch is for use on a hydraulic elevator application, such switches shall be provided with auxiliary contacts. These contacts shall be Commander positive action switches or equivalent.

.7 Where the enclosed switch is for use on a variable frequency drive application, such switches shall be heavy duty type complete with auxiliary contacts, to wire remote stop to variable frequency drive.

PART 3 - EXECUTION

3.01 INSTALLATION OF ENCLOSED SWITCHES (DISCONNECTS)

.1 Provide disconnects:

.1 Wherever shown on the drawings and/or specified herein.
.2 Wherever required by starter schedule drawings:
.3 For motorized equipment which cannot be seen from the motor starter location or is more than 10m away from the starter location.
.4 For all "packaged" equipment supplied by other Divisions and fed from a motor starter panel.

.2 Enclosures mounted indoors and not exposed to the weather shall be NEMA 1 type.

.3 Enclosures mounted outdoors or in locations exposed to the weather shall be NEMA 3 type.

.4 Where the enclosed switch is for use on a variable frequency drive application, wire the normally closed contact on the switch to the stop circuit on the variable frequency drive.

END OF SECTION 26 28 23

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide all fixtures, poles and auxiliary equipment as required for a complete installation.

.2 This Contractor is responsible for releasing orders and coordinating deliveries of the light fixtures from the suppliers in order to adhere to the Construction schedule. This Contractor is responsible for receiving, handling and storing all light fixtures until ready for installation.

.3 Inspect deliveries to ensure they are complete.

.4 Install all electrical light fixtures as per architects reflected ceiling plans.

1.03 SUBMITTALS

.1 Submittals:

.1 Submit information in accordance with Section 26 05 01.
.2 Submit shop drawings for all products as follows:
.1 Provide complete, fully dimensioned detail drawings including all major components and details fabrication of each fixture type.
.2 Provide requisite schematics and plans indicating assembly and installation of components.

1.04 QUALITY ASSURANCE

.1 All components to be approved/listed and labelled by an approved agency.

1.05 SOURCE QUALITY CONTROL

.1 The Manufacturer of all products specified herein must have been engaged in the fabrication of the equipment for at least the past 5 years.

.2 The light fixtures listed in the light fixture schedule are pre-approved and are the standard of acceptance to be met through quality, performance, and architectural design.

1.06 DELIVERY AND STORAGE

.1 All lighting equipment shall be individually packaged with sufficient, protective padding for the selected method of transport. All handling and shipping shall be performed in accordance with the equipment manufacturer's recommendations. Unopened containers shall be stored in a protected location.

1.07 WARRANTY

.1 Provide Contractor warranties as well as factory warranties. All equipment and labor in this Contract shall be free from defects in products or workmanship for 24 months after substantial completion.

1.08 ACCEPTABLE MANUFACTURERS

.1 Acceptable fixture manufacturers are as listed in the fixture schedules.

PART 2 - PRODUCTS

2.01 GENERAL

.1 Provide new lighting fixtures complete with mounting accessories, junction boxes, trims, and lamps.

.2 All products of a specified type are to be from the same manufacturer.

.3 Fixture type catalogue numbers do not necessarily denote required mounting equipment or accessories. Provide complete mounting accessories appropriate for each mounting condition.

.4 All fixtures shall be installed with a frame or canopy that is compatible with the ceiling type specified by the Consultant.

.5 Provide appropriate accessories for proper mounting of all fixtures. Include plaster frames for plaster ceiling and firestop protection for fixtures in rated ceiling. For fixtures suspended from ceiling, provide pendants or aircraft cables complete with accessories to complete the installation as indicated on the drawings.

.6 Where light fixture or light fixture suspension apparatus penetrates metal pan or sheet metal ceiling or canopies, an approved copy of the shop drawings of those fixtures shall be provided to the ceiling manufacturer. Apertures in the ceiling or openings for suspension cables shall be pre-cut by the ceiling manufacturer to suit light fixtures. Instruct the manufacturer accordingly.

.7 If the words “equivalent” or “approved equal” are not indicated after light fixture manufacturer and catalog number in the fixture schedule, no other manufacturer will be acceptable for that particular type.

2.02 LAMPS

.1 All fixtures shall be provided with proper, new, and operable lamps. Provide lamps indicated on the Fixture Schedule, or, if not indicated, as recommended by the fixture manufacturer. Lamps shall be compatible with the respective fixture in all cases.

2.03 LAMP HOLDERS

.1 Lamp holders shall hold lamps securely to prevent damage caused by normal vibrations and maintenance handling.

2.04 FIXTURE CONSTRUCTION

.1 General:

.1 All fixtures shall be free of inappropriate light leaks.
.2 Fixtures in non-accessible ceilings and in the columns shall have accessible junction boxes, drivers, and transformers through fixture apertures.
.3 No metal clips, screws, angles, etc. shall be visible when the fixture is viewed from below.
.4 All mounting frames installed in damp locations or in plaster ceiling shall be galvanized.
.5 Extruded fixture housings shall have a minimum thickness of 2.3 ($\frac{3}{32}$") mm and be smooth and free of tooling lines. Die-cast end plates and joiner sections shall have a minimum thickness of 2 ($\frac{3}{32}$") mm thickness and concealed fasteners.
.6 Die-casts shall be smooth, free of pits, grooves, and imperfections.
.7 Spinning shall be smooth and clean with finished edges, and free of spinning lines.

.8 Sheet metal fixture housings shall be of welded construction with seams filled and ground smooth. Any exceptions shall be noted under individual fixture types.

.9 All adjustable fixtures shall have locking rotation and tilt devices.

.10 Pendant-mounted fixtures shall have stems with ball swivels or be cable-mounted to allow 45 degrees swing in any direction from vertical.

.11 Ball swivels and cables end hardware shall be concealed with sleeve.

.2 Fixture utilizing both 120 volt services and 347 volt services or utilizing more than one 120 volt service or more than one 347 volt service shall have wiring sections and separate wiring connections and labelling as necessary to satisfy all Code and local inspection requirements.

.3 Reflector Cones:

.1 Provide 45 Degrees lamp image cut-off when viewed from below unless indicated otherwise.

.2 Reflector cones shall have a minimum thickness of 0.8 (0.03125") mm and be manufactured of uniform gauge Alcoa 3002 alloy, free of spin marks, or other manufacturing defects. The use of plastic for cones or trim rings is not acceptable.

.3 Reflector finish shall be semi specular by means of an Alzak process. Reflector inner surface shall be free of water spotting and shall maintain a reflectivity ratio of no less than 80% on clear specular finish unless otherwise noted.

.4 Cone flange shall be formed as an integral part of cone and shall have identical appearance as inner cone unless otherwise indicated. Flange overlap shall have a perpendicular orientation to cone and shall have adequate width to cover ceiling opening with no visible light leaks.

.5 Fixtures with Alzak reflector cones shall all be furnished by the same manufacturer, unless otherwise indicated. All reflector cones shall have iridescent suppressant finish for linear and HID fixtures unless otherwise specified.

.4 Parabolic Louvre Assemblies:

.1 Louvre assemblies shall be shipped and stored in plastic bags and shall not be installed until construction has progressed to a suitably clean stage. Single piece peel-off seal on bottom of louvre is not acceptable. No construction dust or paint shall be allowed to accumulate on the louvres at any time. Louvres shall be constructed with minimum 0.6 (0.0235") mm Alcoa licensed process Coilzak semi-specular iridescent suppressant anodized aluminium. All louvre blades shall have parabolic designed curvature. All cell sizes shall be equal unless otherwise specified.

.5 Unless otherwise noted, lenses for use with linear fixtures shall be of minimum 3.175mm (0.125") thickness.

.1 Material shall be light-stable 100% virgin acrylic with minimum 98% transmittance unless otherwise indicated. Acrylic shall conform to minimum standards of IES-NEMA-SPI, and have a minimum thickness of 3mm. Material shall perform as applied for a period of 20 years with no greater than 5% transmission loss.

.6 Parabolic Baffles: All parabolic baffles shall be straight and paralleled with equal cell sizes. Baffles placed end to end shall have no visible break in appearance. Baffles shall be constructed with minimum 0.6mm (0.0235") Alcoa licensed process Coilzak semi-specualr iridescent suppressant anodized aluminium unless otherwise specified.

2.05 LINEAR FIXTURES

.1 The fixture housing pressure fit construction or utilizing rivets shall not be accepted and, when applicable, shall have lenses in hinged frame utilizing hidden release mechanisms of a heavy duty standard (i.e., visible frame releases will not be accepted). Lenses shall be securely retained in the frame assembly utilizing the equivalent of stainless steel spring clips.

.2 Fixture reflectors, unless specifically designed using specular metal, shall have a complete coverage of white alkyd reflecting enamel. Enamel shall have a minimum 85% reflectivity, applied by either an electrostatically charged spray or dip process then baked in a temperature controlled oven until paint is thoroughly cured. Prior to applying enamel, each metallic surface shall be prepared using a five stage hot zinc phosphatizing process.

.3 All fixtures shall have the following wording stencilled above each lamp and visible only when the lamp is removed: “RE-LAMP ONLY WITH (...TYPE) LAMPS”. Type shall include colour, temperature and lamp series.

.4 All painting to be done after cutting.

2.06 FIXTURE FINISHES

.1 Painted fixtures shall have synthetic enamel, with acrylic, alkyd, epoxy, polyester or polyurethane base applied after the fixture is completely constructed. Paint shall be light stabilized, baked on at minimum 180 Degrees C, and catalytically or photochemically polymerized after application.

.2 All metal parts shall be cleaned and treated with phosphate or chromate bonding process after fabrication for maximum paint adhesion.

.3 All polished decorative metals, (brass, chrome, etc.), shall have a clear protective finish, baked-on lacquer or air-cured urethane.

.4 All custom colour finishes are to be approved by the Consultant.

.5 All fixtures, lenses, diffusers and fittings to have a flame spread rating of less than 250.

2.07 LIGHTING FIXTURE SCHEDULE

.1 Catalogue numbers in the Lighting Fixture Schedule are shown to indicate approved manufacturer and fixture quality requirements. The numbers may or may not include variations or special light fixture features as specified in the associated fixtures carried in his bid include all features as specified in the Schedule.

2.08 EXTERIOR LIGHTING

.1 Supply and install exterior lighting as indicated in the FIXTURE SCHEDULE and as shown on the Drawings complete with poles, arms, light fixtures, lamps, anchor bolts and setting template, nut covers and other accessories necessary for proper installation. Finish all metal surfaces with zinc chromate primer, and finish paint as directed by the Consultant.

2.09 WIRE GUARDS

.1 Provide wire guards to all fixtures that are mounted so that any part of the fixture is less than 2400mm (8'-0") above adjacent floor, unless noted otherwise in the fixture schedules.

.2 All fixtures in storage rooms and services rooms shall have wire guards.

PART 3 - EXECUTION

3.01 VERIFICATION OF CONDITIONS

.1 Confirm all ceiling depths against final architectural ceiling plans and sections to ensure that recessed fixtures can be installed in all ceiling conditions and advice the Consultant immediately of any discrepancies prior to ordering of the fixtures or proceeding with the Work.

3.02 INSTALLATION – GENERAL

.1 Lighting fixtures shall be installed as indicated on architectural reflected ceiling plans, Electrical Drawings and per approved shop drawings.

.2 Lighting fixtures are indicated in the Lighting Fixture Schedule by means of type letters, which correspond to similar letters on the plans.

.3 Lighting fixtures shall be installed in accordance with fixture manufacturers written instructions, applicable requirements of the consultant, applicable authorities, and with recognized industry practices.

.4 Verify locations and spacings of lighting fixtures with reflected ceiling plans and notify Consultant of any variance or conflict between the plans and field conditions. Do not proceed until conflict has been resolved.

.5 Work shall be co-ordinated with other trades. Lighting fixture locations shall have priority over location of ducts, diffusers, sprinklers, smoke detectors and other non-structural obstructions.

.6 All fixtures shall be supported directly from the building structural members or from bridging attached to the structural members by rod hangers and inserts. Provide all necessary hardware and blocking to ensure that fixtures hang true, square, plumb, and in proper alignment.

.7 Fixtures installed in suspended T-bar ceiling shall be equipped with suspension chains, securely fastened to fixture and slab above. The light fixture shall be centred in the ceiling grid opening. Provide a minimum of two chains, one each on diagonal opposite corners, and provide more chains if required by local authority having jurisdiction.

.8 Provide every light outlet in the building with a lighting fixture as instructed complete with lamps and other accessories necessary for its proper installation and operation. If a fixture type is not designed for any particular outlet, obtain the necessary details from the Consultants prior to submission of tender. Alternatively, supply a suitable fixture for the outlet involved as directed by the Consultants.

.9 For exact location of ceiling mounted lighting fixtures, refer to Architectural reflected ceiling plan.

.10 Install lighting fixtures true to the surface in or to which they are mounted, and except where otherwise indicated on the Drawings, align correctly with building or room walls as the case directs. Mount wall fixtures at elevations specified or as shown on Architectural or Electrical Drawings. Where no elevation is shown, confirm mounting height with the Consultant prior to rough-in.

.11 Where lighting fixtures are stem hung from ‘ball and socket’ swivels at the ceiling, use stranded wire, #16 AWG (19 x 29) minimum size from outlet box to the fixture.

.12 Where lighting fixtures are chain-suspended, use solid conductor in armoured cable or flexible conduit and secure to chain with white or clear nylon cable ties.

.13 Provide lamicoid plate (white letters on blue background) with inscription “UPS" or “EMERG” and fasten to T-bar or fixture frame for all lighting fixtures connected to the UPS or emergency system.

.14 All parts of all linear and high intensity discharge lighting fixtures shall be securely fastened and if necessary fitted with neoprene spacers to minimize ballast noise amplification.

.15 All fixtures shall be installed with the bottom of the fixture housing aligned with the finished ceiling line unless otherwise noted in manufacturers installation instructions.

.16 Ceiling insulation shall be a minimum of 75 (3") mm away from fixture.

.17 Support recessed linear fixtures by four hangers per fixture minimum independent of ceiling structure or tee bars unless ceiling system is designed to carry the fixtures. In this case, provide seismic restraints only.

.18 Support recessed fixtures by one hanger per fixture minimum independent of ceiling structure or tee bars.

.19 Provide wiring channel for mounting fixtures and wiring in between fixtures, suspended below mechanical piping, ductwork, etc., as directed on 15mm (0.6") rigid conduit or 10mm (0.4") galvanized rod hangers, on 2440mm (8 ft.) centres.

.20 Nominal size of channels 70 x 70, 10mm (0.4") steel minimum, baked white enamel finish, complete with channel connectors, and closure pieces, coverpieces, mounting hickeys, fixture connectors, etc., with jointer pieces 300mm (12") in length minimum to form a rigid assembly.

3.03 INSTALLATION OF RECESSED FIXTURES

.1 Holes shall be cut to exact fixture size so that no gaps will be present when trims or cones are installed.

.2 Round holes in acoustical tile ceilings shall be cut using adjustable diameter cutter on slow speed drill press.

.3 Holes in metal pan and/or sheet metal ceiling and/or ceiling canopy shall be precut by ceiling manufacturer based on approved shop drawings of the light fixtures located in these areas. Electrical contractor shall be responsible for co-ordination between Division 26 and metal ceiling manufacturer(s) of light fixture installation in areas with metal ceilings.

.4 Provide plaster frames or plaster trim as required and turn same over to the ceiling section for installation.

.5 Installation of trims shall be tight with no gaps or light leaks. Reflector cones, baffles, aperture plates and decorative elements shall be installed after completion of plastering, ceiling tile work painting, and general clean-up in areas. Caulking or sealing fixture trim cones to ceiling to eliminate light leaks or gaps shall not be acceptable.

.6 Where fixtures are recessed into non-accessible ceiling and the fixtures specified are not pre-wired, wire to an outlet box adjacent to each fixture and visible only when the fixture is removed, connect to the fixture with suitable high-temperature wire in at least 1200mm (48") of flexible conduit. Install fixtures so that they may be readily removed to gain access to these outlet boxes.

.7 Provide insulated housings on all recessed lighting fixtures installed in ceilings where thermal insulation is installed.

3.04 INSTALLATION OF LINEAR FIXTURES

.1 Linear fixtures, surface mounted or suspended, shall not have more than 6mm (¼") variation in alignment for any 5 metre (17 feet) run.

.2 In spaces with metal pan or sheet metal ceiling installation of linear fixtures shall be co-ordinated with ceiling supplier and installer. Refer to mounting details on Electrical, Architectural, Interior Design drawings and manufacturer recommendation.

3.05 INSTALLATION OF TRACK LIGHTING

.1 In spaces with parallel rows of track, all track shall be installed such that neutral conductors and feeds have the same orientation.

3.06 INSTALLATION OF LAMPS AND AUXILIARY EQUIPMENT

.1 At the time of occupancy of any area, all lamps within that area shall be in proper place and working order.

.2 In the event the Contractor request and receive approval to use the new permanent lighting fixture system for construction purposes (i.e. temporary lighting) and the use of the permanent fixtures is in excess of sixty (60) days prior to occupancy or substantial completion (whichever is first), the Contractor shall supply replacement lamps as follows:

3.07 FIELD QUALITY CONTROL

.1 Operate each fixture after installation and connection. Each fixture shall be inspected for proper connection and operation.

.2 Perform testing of operation of temporary or emergency power systems.

.3 Verify that all lenses, louvres, baffles, fixture trim cones, diffusers and other parts are thoroughly cleaned in a manner recommended by the manufacturer.

3.08 LUMINAIRE WIRING

.1 Connect recessed luminaries to outlet boxes with 10mm (0.4") flexible conduit and 90 Degrees C wire.

3.09 CONTROL AND CIRCUITING

.1 Where no switching is shown, lighting shall be panel switched. Panel circuit breakers shall be suitable for switching duty marked “SWD”.

.2 Where circuiting is not specified, provide sufficient 15A - 1P breakers and wiring to limit loading to 1200 watts per circuit or to code whichever is the most restrictive.

3.10 FIXTURES IN SERVICE ROOMS

.1 Before mounting any fixture in mechanical, electrical or other service room obtain written approval of layout to be used. Layout must suit equipment limitations in the room and must be installed clear of mechanical equipment.

3.11 ADJUSTMENTS

.1 All adjustable fixtures shall be aimed as instructed by the Consultant. Personnel, lifts, and ladders shall be provided as required.

.2 Adjust exit sign directional arrows, if required.

3.12 CLEANING

.1 Remove all plastic bags from parabolic fixtures after construction is finished and prior to final acceptance.

.2 All unnecessary equipment, materials, wiring, and fixtures shall be removed from those areas affected by the construction. Materials that are not part of the lighting or electrical distribution system shall be removed from the Site.

.3 All lighting fixtures shall be cleaned in a manner approved by the manufacturer and shall be free of dirt and debris upon completion of installation.

3.13 DEMONSTRATION

.1 Building personnel shall be trained to operate lighting control system. Building personnel shall be advised on relamping procedures and be given a list of lamps required for the fixtures on the Project.

3.14 PROTECTION

.1 Lighting fixtures, once installed, shall be protected from damage during the remainder of construction period.

END OF SECTION 26 50 00

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

.1 Provide a system of empty conduits, backboxes and pull wire to allow the installation of a security system.

PART 2 - PRODUCTS

2.01 CONDUITS, PULL BOXES AND OUTLET BOXES

.1 Refer to appropriate sections.

2.02 CABLING REQUIREMENTS

.1 The cables will be provided by the Security Contractor.

PART 3 - EXECUTION

3.01 INSTALLATION OF CONDUIT SYSTEM

.1 Provide a system of conduit, cables and outlet boxes for the Security system.

.2 The security system will be supplied and installed under Division 28.

.3 Conduits shall be minimum 20mm complete with pull strings. There shall not be more than two (2) 90° bends in any run of conduit and pullboxes shall be provided in runs in excess of 100’ or where more than two (2) 90° bends are required.

.4 Conduit shall be left clear and free of all obstructions and shall be terminated as shown. Equip terminations with bushings and clearly identify each run.

.5 Co-ordinate the work with the Consultant and Division 28 and obtain the exact location of equipment, conduit sizes, outlet box requirements prior to roughing-in.

.6 Provide power outlets as shown on the drawings.

.7 Provide interface with the fire alarm system to release the mag locks as specified.

.8 Where security equipment requires special back-boxes to be mounted, they will be provided by the Security Contractor for installation by this Contractor.

.9 Provide one 110 volt GFI service at the common reader equipment location for power supply to the card access system, with separate permit to be provided to Division 28.

.10 Provide all fire alarm pull stations on mag lock doors with secondary contacts for mag lock release.

END OF SECTION 26 60 01

CONTENTS

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Electrical General Requirements Section 26 05 00 and all other documents referred to therein.

.2 This Section shall comply with applicable national and/or provincial codes recognized at the time of installation including:

.1 2006 Ontario Building Code including amendments
.2 Ontario Electrical Safety Code

.3 All work shall comply with relevant sections and versions of the following standards: Underwriter's Laboratories of Canada (ULC).

.1 CAN/ULC-S524, Installation of Fire Alarm Systems.
.2 CAN/ULC-S525, Audible Signal Devices for Fire Alarm Systems.
.3 CAN/ULC-S526, Visual Signal Devices for Fire Alarm Systems.
.4 CAN/ULC-S527, Control Units for Fire Alarm Systems.
.5 CAN/ULC-S528, Manual Pull Stations for Fire Alarm Systems.
.6 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
.7 CAN/ULC-S530, Heat Actuated Fire Detectors.
.8 CAN/ULC-S531, Smoke Alarms.
.9 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.
.10 CAN/ULC-S537, Verification of Fire Alarm Systems.
.11 CAN/ULC-S541, Speakers for Fire Alarm Systems.
.12 CAN/ULC-S548, Devices & Accessories for Water Type Extinguishing Systems.
.13 CAN/ULC-S552, Inspection & Testing of Smoke Alarms.
.14 CAN/ULC-S553, Installation of Smoke Alarms.
.15 CAN/ULC-S559, Equipment for Fire Signal Receiving Centres and Systems.
.16 CAN/ULC-S561, Installation and Services for Fire Signal Receiving Centres and Systems.

.4 All work shall comply with the requirements of the Local Authorities Having Jurisdiction.

1.02 SCOPE OF WORK

.1 The existing fire alarm system is conventional Notifier system. There is no spare zones in this existing panel.

.2 Contractor to provide new sub- control panel, Notifier NFS2-24 for adding new initiating zones as indicated and interconnect with existing control and annunciator panels.

.3 Provide all new fire alarm devices including horn and pull stations for system compatibility.

.4 Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on Class A Data Communication Link (DCLA).

2. Initiation Device Circuits (IDC) shall support Class A or Class B wiring as part of an addressable device connected by the DCLA Circuit

3. Notification Appliance Circuits (NAC) shall support Class A or Class B wiring as part of an addressable device connected by the DCLA Circuit.

4. On Class A configurations a single ground fault or open circuit on the system Signalling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

5. Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The System Alarm LED shall flash.

2. A local piezo electric signal in the control panel shall sound.

3. The 80 character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

4. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.

5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

.5 On completion of the installation, the manufacturer's representative shall check the system proper operation and issue an inspection certificate.

.6 The contractor shall retain an independent qualified contractor to verify the system on completion of the installation.

.7 The complete installation shall conform to the applicable sections of ULC S524-M01 and Local Code Requirements and Ontario Electrical Code Sprinkler system.

1.03 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 01 and as follows:

.1 A complete description of the system operation, including a detailed project-specific Sequence of Operations.
.2 An Input/Output Matrix, unless all outputs activate on any alarm input.
.3 A complete description of each system component including dimensions.

.2 Provide data to be incorporated into the maintenance manual specified herein and including the following:

.1 Operation and maintenance instructions for the complete Fire Alarm system to permit its effective operation and maintenance.
.2 Technical data and illustrated parts lists with part numbers.
.3 A copy of the final reviewed shop drawings.

1.04 ACCEPTABLE MANUFACTURERS

.1 The system specified herein is based on equipment and design of Notifier System.

1.05 VERIFICATION

.1 At the completion of the installation provide two letters of certification one from the electrical sub-contractor and one from the system manufacturer's representative. Each on company letterhead and signed by an authorized officer of the company. Each letter shall indicate the following:

.1 The name of the system.
.2 The name of the facility.
.3 The correct address of the facility.
.4 A statement that the system has been installed and that it operates in accordance with the drawings and specifications and that the system was found to be in proper operating conditions.

1.06 DEFINITIONS AND ABBREVIATIONS

.1 DCL - Data Communication Link

.2 SCP - Satellite Control Panel

.3 CPU - Central Processing Unit

.4 LED - Light Emitting Diode

.5 LCD - Liquid Crystal Display

.6 GUI - Graphical User Interface

.7 RAU - Remote Audio Unit

.8 APS - Auxiliary Power Supply

.9 AFF - Above Finished Floor

.10 AHJ - Authority Having Jurisdiction

1.07 SYSTEM DESCRIPTION

.1 This section of the specification includes the furnishing, installation, and connection of an intelligent reporting, microprocessor controlled, addressable and conventional and detection system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein.

.2 The fire alarm system shall comply with requirements of CAN/ULC Standards. The system shall be electrically supervised and monitor the integrity of all conductors.

.3 The system shall be an active/interrogative type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the main fire alarm control panel indicating that the device and its associated circuit wiring is functional. Loss of this signal at the main control panel shall result in a trouble indication as specified hereinafter for the particular input.

.4 Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

.5 The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

.6 All components shall be CSA and ULC listed and labeled, acceptable to the Ontario Fire Marshal and the local Fire Department and suitable for operation on service characteristics noted. System equipment and operation and installation shall comply with the National and Provincial Building Code; Canadian Underwriters Association Standards CUA 70 and CUA 72A, Canadian Electrical Code, and ULC Standard CAN4 S524 M91 and latest amendments.

.7 The installing company shall employ qualified Fire Alarm Technicians on site to guide the final checkout and to ensure the systems integrity.

.8 All new initiating devices shall be conventional type to match existing.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIAL, GENERAL

.1 All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

.2 All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.

.3 All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.02 POWER REQUIREMENTS

.1 The contractor shall confirm exact power requirements with fire alarm manufacturer prior to submitting bid, and include multiple circuits as required.

.2 The disconnect shall be painted red.

.3 The disconnect shall be locked in the ON position.

2.03 MAIN FIRE ALARM CONTROL PANEL

.1 The building has existing Notifer system and New Notifier NFS2-24 conventional control panel shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system.

2.04 SEQUENCE OF OPERATIONS

.1 In normal mode CACF's alpha-numeric display will indicate the date, time, and the "normal condition".

.2 ALARM Sequence-Single Stage Operation

.1 If an ALARM is initiated in any area of the building by one of the following:
- .1 operation of a manual station
- .2 operation of an automatic fire detector
- .3 operation of a sprinkler flow switch

.2 The Fire Alarm System shall initiate the following Alarm sequence of operations:
- .1 Indicate the point of alarm (zone/device description) on the alpha-numeric display of the CACF.
- .2 Indicate the alarm condition by lighting the "COMMON ALARM" red LED at the CACF.
- .3 The CACF shall indicate exact zone where alarm originated by illuminating a corresponding labelled red LED indicator.
- .4 Every audible signal appliance shall sound in "general alarm" mode at a temporal rate for 20 minutes, or until manually silenced. Manual silence inhibited during first minute of alarm.
- .5 If silenced, the "SIGNAL SILENCE" light on the control panel will illuminate.
- .6 If silenced, a subsequent alarm will re-activate the signals.
- .7 All alarm visual signals shall flash (i.e., strobes).
- .8 A trouble inhibit circuit shall be initiated to suppress any trouble signals during an alarm.
- .9 Type, location, time and date of alarm condition shall be recorded in the Fire Alarm System Event History.
- .10 Event shall be logged and displayed on the GUI, where applicable.
- .11 Event shall be printed on the system printer, where applicable.
- .12 All designated fans shall be automatically turned off.
- .13 All designated smoke control fans shall be automatically turned on.
- .14 Doors normally held open through magnetic door holders shall be released.
- .15 Doors normally locked by magnetic locking devices shall be released.
- .16 Initiate Emergency Elevator Recall.
  - .1 Elevator Recall shall not be initiated by a manual station.
  - .2 If alarm is initiated by an automatic detector on the floor of recall, activate Alternate Floor recall relay, where required by code.
- .17 Activate connection to monitoring system (by others) to transmit a signal to fire department or approved central station.

.3 An alarm in the Elevator Shaft or Elevator Machine Room shall activate a relay connected to the Elevator Controller.

.4 An alarm can be reset by pressing the "RESET" button on the CACF.

.3 ALARM Sequence-Single Stage Operation

.1 If an Alarm is initiated in any area of the building by one of the following:
- .1 operation of a manual station
- .2 operation of an automatic fire detector
- .3 operation of a sprinkler flow switch

.2 The Fire Alarm System shall initiate the following Alarm sequence of operations:
- .1 Indicate the point of alarm (zone/device description) on the alpha-numeric display of the CACF.
- .2 Indicate the alarm condition by lighting the "COMMON ALARM" red LED at the CACF.

.3 The CACF shall indicate exact zone where alarm originated by illuminating a corresponding labelled red LED indicator.
.4 Every audible signal appliance shall sound in “alarm” mode at a rate of 20 pulses per minute for 20 minutes, or until manually silenced. Manual silence inhibited during first minute of alarm.
.5 If silenced, the “SIGNAL SILENCE” light on the control panel will illuminate.
.6 If silenced, a subsequent alarm will re-activate the signals.
.7 All alarm visual signals shall flash (i.e., strobes).
.8 A trouble inhibit circuit shall be initiated to suppress any trouble signals during an alarm.
.9 Type, location, time and date of alarm condition shall be recorded in the Fire Alarm System Event History.
.10 Event shall be logged and displayed on the GUI, where applicable.
.11 Event shall be printed on the system printer, where applicable.
.12 All designated fans shall be automatically turned off.
.13 All designated smoke control fans shall be automatically turned on.
.14 Doors normally held open through magnetic door holders shall be released.
.15 Doors normally locked by magnetic locking devices shall be released.
.16 Initiate Emergency Elevator Recall.
.1 Elevator Recall shall not be initiated by a manual station.
.2 If alarm is initiated by an automatic detector on the floor of recall, activate Alternate Floor recall relay, where required by code.
.17 Activate connection to monitoring system (by others) to transmit a signal to fire department or approved central station.

.3 An alarm in the Elevator Shaft or Elevator Machine Room shall activate a relay connected to the Elevator Controller.
.4 An Alarm can be reset by pressing the “RESET” button on the CACF.
.5 If an ALARM is initiated in any area of the building by one of the following:
.1 Activation of the evacuation switch in a pull station
.2 Activation of a Manual Evacuation Button at the CACF
.3 Five minutes without the initial alarm being acknowledged
.6 Every audible signal appliance shall sound in “alarm” mode at a Temporal rate for 20 minutes, or until manually silenced.

.4 SUPERVISORY Sequence

.1 If a SUPERVISORY signal is initiated in any area of the building by one of the following:
.1 movement of a fire protection water supply valve or sprinkler valve
.2 loss of excess water pressure required to prevent false alarms in a wet pipe system
.3 loss of air pressure in a dry pipe system
.4 loss of air pressure in a pressure tank
.5 a significant change in water level in any water storage container used for fire fighting purposes
.6 loss of power to any automatically starting fire pump
.7 a temperature approaching the freezing point in any dry pipe valve enclosure or water storage container used for fire fighting purposes
.8 Emergency Generator fault
.9 Emergency Generator running
.2 The Fire Alarm System shall initiate the following Supervisory sequence of operations:
.1 Indicate the supervisory point (zone/device description) on the alpha-numeric display of the CACF.
.2 Indicate the supervisory condition by lighting the “COMMON SUPERVISORY” amber LED at the CACF.

.3 The CACF shall indicate exact zone where supervisory event originated by illuminating a corresponding labelled amber LED indicator
.4 Sound an audible buzzer at the CACF.
.5 Type, location, time and date of supervisory condition shall be recorded in the Fire Alarm System Event History.
.6 Event shall be logged and displayed on the GUI, where applicable.
.7 Event shall be printed on the system printer, where applicable.
.8 Activate connection to monitoring system (by others) to transmit a signal to fire department or approved central station.

.3 The CACF buzzer can be silenced by pressing the “ACKNOWLEDGE” at the CACF.

.5 TROUBLE Sequence

.1 If a TROUBLE signal is initiated in any area of the building by one of the following:
.1 Open circuit fault
.2 short circuit fault on signal circuit, or remote annunciator circuit
.3 failure of supervised indicator on remote annunciator
.4 disconnection or failure of the battery pack
.5 ground condition on field wire
.6 failure of 120VAC power
.7 removal or malfunction of control panel component
.8 loss of fire alarm network communications

.2 The Fire Alarm System shall initiate the following trouble sequence of operations:
.1 Indicate the type of trouble on the alpha-numeric display of the CACF and DGP.
.2 Indicate the trouble condition by lighting the “COMMON TROUBLE” amber LED at the CACF.
.3 Sound an audible buzzer at the CACF.
.4 Type, location, time and date of trouble condition shall be recorded in the Fire Alarm System Event History.
.5 Event shall be logged and displayed on the GUI, where applicable.
.6 Event shall be printed on the system printer, where applicable.
.7 Activate connection to monitoring system (by others) to transmit a signal to fire department or approved central station.

.3 The CACF buzzer can be silenced by pressing the “ACKNOWLEDGE” at the control panel.

2.05 SYSTEM CONVENTIONAL COMPONENTS

A. Programmable Electronic Sounders:

1. Shall be a System Sensor SpectrAlert Advance which is listed to CAN/ULC-S525, Audible Signal Appliances, Fire Alarm.
2. Shall operate on 24 VDC nominal.
3. Shall be field programmable with three audibility options and an option to switch between a temporal three-pattern and a non-temporal (continuous) pattern without the use of special tools.
4. Shall produce a sound level of at least 90 dBA measured at 10 feet from the device.
5. Shall be flush or surface mounted as shown on plans.

B. Strobe lights shall meet the requirements of CAN/ULC-524, Installation of Fire Alarm, and be fully synchronized, and shall meet the following criteria:

1. Shall be a System Sensor SpectrAlert Advance which consists of a xenon flash tube and

associated lens/reflector system, is listed to CAN/ULC-S526 and shall be approved for fire protective service.
2. Strobe intensity shall meet the requirements of CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.
3. The flash rate shall meet the requirements of CAN/ULC-S526, Visual Signal Appliances, Fire Alarm.
4. Shall have field-selectable candela settings including 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.

C. Manual Fire Alarm Stations

1. Manual fire alarm stations shall be non-coded, non-breakglass type, equipped with key lock so that they may be tested without operating the handle.
2. Stations must be designed such that after an actual activation, they cannot be restored to normal except by key reset.
3. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 100 feet (30.5 m) front or side.
4. Manual stations shall be constructed of high impact Lexan, with operating instructions provided on the cover. The word FIRE shall appear on the manual station in letters one half inch (12.7 mm) in size or larger.

D. Conventional Photoelectric Area Smoke Detectors

1. Photoelectric smoke detectors shall be a 24 VDC, two-wire, ceiling mounted, light scattering type using an LED light source.
2. Each detector shall contain a remote LED output and a built in test switch. 3. Detector shall be provided on a twist lock base.
4. It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.
5. A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall flash at least every 10 seconds, indicating that power is applied to the detector.
6. The detector shall not go into alarm when exposed to air velocities of up to 3000 feet (914.4 m) per minute.
7. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
8. All field wire connections shall be made to the base through the use of a clamping plate and screw.

E. Conventional Ionization Type Area Smoke Detectors

1. Ionization type smoke detectors shall be a two wire, 24 VDC type using a dual uni-polar chamber.
2. Each detector shall contain a remote LED output and a built in test switch. 3. Detector shall be provided on a twist lock base.
4. It shall be possible to perform a calibration sensitivity and performance test on the detector without the need for the generation of smoke.

5. A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs) over 360 degrees, on the detector, which may be seen from ground level. This LED shall flash every 10 seconds, indicating that power is applied to the detector.
6. The detector shall not alarm when exposed to air velocities of up to 1,200 feet (365.76 m) per minute. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
7. All field wire connections shall be made to the base through the use of a clamping plate and screw.

F. Duct Smoke Detectors

1. Duct smoke detectors shall be a 24 VDC type with visual alarm and power indicators, and a reset switch.
2. Each detector shall be installed upon the composite supply air ducts(s), with properly sized air sampling tubes.

G. Projected Beam Detectors

1. The projected beam type shall be a 24 VDC device.
2. The detector be ULC listed and shall consist of a separate transmitter and receiver capable of being powered separately or together.
3. The detector shall operate in either a short range (30' - 100') or long range (100' - 330') mode.
4. The temperature range of the device shall be 22 degrees F (-5.5 Celsius) to 131 degrees F (55 Celsius).
5. The detector shall feature a bank of four alignment LEDs on both the receiver and the transmitter that are used to ensure proper alignment of unit without special tools.
6. Beam detectors shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on lenses.
7. The unit shall be both ceiling and wall mountable.
8. The detector shall have the ability to be tested using calibrated test filters or magnet activated remote test station.

H. Automatic Conventional Heat Detectors

1. Automatic heat detectors shall have a combination rate of rise and fixed temperature rated at 135 degrees Fahrenheit (57.2 Celsius) for areas where ambient temperatures do not exceed 100 degrees (37.7 Celsius), and 200 degrees (93.33 Celsius) for areas where the temperature does not exceed 150 degrees (65.5 Celsius).
2. Automatic heat detectors shall be a low profile, ceiling mount type with positive indication of activation.
3. The rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory calibrated, moisture proof, trouble free vent, and shall operate when the rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.
4. The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft.
5. Automatic heat detectors shall have a smooth ceiling rating of 900 square feet (87 meters square).

2.06 BATTERIES AND EXTERNAL CHARGER

.1 Battery:

1. Shall be 12 volt, Gel Cell type.

2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

.2 External Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120/240volt 50/60 hertz source.

2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.

3. Shall have protection to prevent discharge through the charger.

4. Shall have protection for overloads and short circuits on both AC and DC sides.

PART 3 - EXECUTION

3.01 INSTALLATION – GENERAL

.1 Installation shall be in accordance with the CAN/ULC S-524 Installation of Fire Alarm standard, local and provincial codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

.2 All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

.3 All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

.4 Review with the system manufacturer and designated local fire inspector the requirements for wiring installation methods, sequence of operation of system, FACP annunciator requirements including nomenclature and any other pertinent requirements, and advise Consultant of any requirements that contradict or deviate from the Contract Documents. Review also the requirements for interconnections to other building systems, as applicable.

.5 The sequence of operation provided in this specification is an outline for tendering, with exact requirements to be confirmed and programmed to the requirements of the fire plan, authority having jurisdiction, and Consultant.

.6 The system shall be installed and wired by persons qualified and certified to perform the installation of fire alarm systems.

.7 Provide suitable raceway system and wiring for complete system.

.8 Provide outlet boxes of ample size for clearance to wiring connections; in particular, boxes for manual stations with plaster ring.

.9 Install all components per manufacturer's recommendations, and co-ordination with the installation schedule.

.10 Connect flow switches and supervisory switches for sprinkler, standpipe, and fire pump to fire alarm system (switches supplied by Fire Protection contractor).

.11 Connect duct smoke detectors (supplied by this division, installed by HVAC contractor).

.1 Where the duct smoke detector is not readily visible, mount duct smoke detector remote indicator in a visible and accessible location.

.2 Where a duct mounted smoke detector is located on the roof, provide a weatherproof enclosure, equipped with a heater c/w built-in thermostat and power connection from the nearest DGP. Enclosure shall be ULC listed.

.12 End-of-line devices shall have an identifying label attached to the front of the cover plate listing the zone or circuit served.

.13 Remote Indicator and Remote Test Stations shall have an identifying label attached to the front of the cover plate listing the device served.

.14 Where manual stations or automatic heat detectors are provided in an unheated area, they shall be installed to prevent the entry of moisture due to condensation.

.15 Where fire alarm devices are installed outdoors or in damp locations, they shall be protected from moisture and direct water spray, or designed for outdoor applications.

.16 All boxes and cabinets shall be listed for their intended purpose.

.17 Devices installed during construction will be protected from dust, dirt, and paint. Dust protection shall be removed upon completion of the verification.

3.02 WIRING

.1 Fire alarm wiring to be installed in EMT conduit throughout. Armoured cable is not acceptable, except where otherwise noted.

.2 Use solid copper conductors and size wiring to in accordance with manufacturer’s recommendations. Protect from mechanical injury or other conditions such as moisture, excessive heat or corrosive action to Class 1 requirements.

.3 Wiring for conventional detection circuits shall be no smaller than #18 AWG, wired in a Class B configuration, complete with end of line resistor.

.4 Wiring for addressable loop DCL circuits shall be no smaller than #18AWG, 2 conductor unshielded twisted pair, wired in a Class A (DCLA) configuration.

.5 Wiring for audio signal circuits shall be no smaller than #18AWG, 2 conductor unshielded twisted pair, wired in a Class B configuration, complete with end of line resistor.

.6 Wiring for DC signal circuits shall be no smaller than #14AWG, wired in a Class B configuration, complete with end of line resistor.

.1 Wire signal circuits alternately such that no two adjacent signal devices are on the same circuit.
.2 Ensure that in no case will the voltage drop to any signal exceed 10%.

.7 Wiring for remote annunciators shall be no smaller than #18AWG, 2 conductor unshielded twisted pair, plus two additional conductors for power, minimum #18AWG.

.8 Wiring for network data communication link(s) shall be no smaller than #18AWG, 2 conductor unshielded twisted pair, and:

.1 Network DCL conductors shall be located in two physically separated 1 h fire rated compartments, except at terminations to control units or transponders; or
.2 be one (1) hour fire-rated conductors in accordance with ULC-S139, Standard Method of Fire Test for Evaluation of Integrity of Electrical Cables.

.9 Use Shielded Twisted Pair wiring only where specifically noted.

.1 Capacitance of STP wiring shall not exceed manufacturer's specifications.
.2 Shield shall be made continuous and insulated from earth ground, except at the DGP
.3 Connect shield to earth ground only where at the DGP where specified by the manufacturer.
.4 The shield of a cable will be connected to earth ground at one point only, including the shield of cables between DGPs.

.10 Connect automatic detectors, smoke detectors, manual stations, audible signals, visual signals, and emergency telephones between red and black conductors at each outlet. Cut red and black conductors at each outlet and connect to terminal screws provided, red to red and black to black.

.11 Align alarm devices and signals, where grouped together, one above the other. If prescribed heights prohibit mounting devices one above another, mount devices one beside the other in an even and level centre to centre configuration.

.12 Entire installation shall be done under supervision of manufacturer. Upon completion of installation, check entire system and correct any malfunction immediately.

.13 Arrange routing of conduits and wireways as may be the Local authority during construction.

.14 In Class A conventional circuit wiring, DCL Style A wiring, and DCL Style C wiring, the primary wiring circuit and the alternate wiring circuit shall be installed in separate raceways or cable assemblies having a minimum separation of 300mm where the cables are installed vertically and 1200mm where the cables, are installed horizontally, except:

.1 For a distance not to exceed 3000mm where the primary and return conductors enter or exit the field devices, CACF or DGP enclosures.
.2 Single conduit or raceway drops to individual field devices.
.3 Single conduit/raceway drops to multiple field devices installed within a single room not exceeding 100 m².

.15 Fibre Optic Cable shall be installed according to Section 56 of the Electrical Safety Code. Fibre Optic Cable shall be installed in a continuous metallic raceway.

3.03 MOUNTING HEIGHTS

.1 All devices shall be mounted within the height requirements of applicable codes and standards.

.1 Manual stations shall be mounted at 1100mm AFF.

.2 Wall-mounted audible signal devices shall be mounted at no lower than 2300mm AFF to the top of the device and no less than 150mm from the ceiling to the top of the device.

.1 Audible signals incorporating a manual silencing means shall be clearly identified and located not less than 1200mm and not more than 1400 mm AFF measured from the centre of the silencing means.

.2 Separately installed manual silencing means shall be clearly identified and located not less than 1200mm and not more than 1400mm AFF measured from the centre of the silencing means.

.3 Wall mounted visual signal devices shall be mounted at no less than 2000mm AFF to the bottom of the lens and no higher than 2400mm AFF to the top of the lens.

.4 Combination wall mounted audible/visual signal devices shall be at no lower than 2300mm AFF to the top of the device, and no higher than 2400mm AFF to the top of the lens.

.5 Emergency telephones shall be installed between 1350mm and 1500mm AFF measured to the centreline of the enclosure.

.6 End of line devices shall be mounted at not lower than 1200mm AFF and no higher than 1800mm AFF.

.7 Central Alarm and Control Units and Data Gathering Panels shall be mounted at no more than 2400mm AFF to the top of the cabinet.

.1 Legend or operating controls shall be not more than 1800mm AFF.

.2 Clear space shall be maintained in front of control units equal to the width of the door, but not less than 1000mm.

.8 Remote Annunciators shall be mounted at no more than 2400mm AFF to the top of the cabinet. Legend or operating controls shall be not more than 1800 mm above the finished floor level.

.9 Special application devices such as Beam Smoke Detectors and Flame Detectors shall be mounted at heights as shown on the drawings, and in accordance with manufacturer's recommendations.

.10 Remote Indicator and Remote Test Stations for Duct Smoke Detectors and Beam Smoke Detectors shall be mounted between 1200mm and 1400mm AFF, unless otherwise noted.

3.04 TYPICAL OPERATION

Actuation of any manual station, smoke detector heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:

1. Activate all programmed NAC circuits.

2. Actuate all strobe units until the panel is reset.

3. Release all magnetic door holders to doors to adjacent zones on the floor from that the alarm was initiated.

4. Return all elevators to the primary or alternate floor of egress.

5. A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.

6. Smoke detectors in the elevator machine room or top of hoist way shall return all elevators in to the primary or alternate floor.

7. Duct type smoke detectors shall, in addition to the above functions shut down the ventilation system or close associated control dampers as appropriate.

8. Activation of any sprinkler system low pressure switch or valve tamper switch shall cause a system supervisory alarm indication.

3.05 TESTING, INSPECTION AND VERIFICATION

.1 Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. All testing and verification shall be in accordance with CAN/ULC S537.

.2 Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

.3 Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

.4 Verify activation of all flow switches.

.5 Open initiating device circuits and verify that the trouble signal actuates.

.6 Open Data Communication Link and verify that the trouble signal actuates.

.7 Open and short notification appliance circuits and verify that trouble signal actuates.

.8 Ground initiating device circuits and verify response of trouble signals.

.9 Ground Data Communication Link and verify response of trouble signals.

.10 Ground notification appliance circuits and verify response of trouble signals.

.11 Check presence and audibility of tone at all alarm notification devices.

.12 Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.

.13 Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

.14 When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

.15 The manufacturer of the fire alarm and voice communication system shall make a complete inspection of all components installed for system, such as manual stations, speakers, smoke detectors, annunciators, sprinkler and standpipe valves to ensure the following:

.1 That the system is complete in accordance with Specifications.
.2 That the system is connected in accordance with Manufacturer's recommendations.
.3 That the wiring conforms to local codes and standards.
.4 That where shielded wiring has been used, the shield is continuous and has tested free of grounds.
.5 That the regulations concerning the supervision of components have been adhered to (e.g., stations, detectors, supervised valves) and are properly wired and supervised.
.6 That all equipment as part of the system is inspected for visible damage or tampering which might interfere with its intended operation.
.7 That adjacent speakers have been connected to alternate circuits.

.8 That the following control functions have been tested for proper supervision, operation and annunciation;
  .1 elevator controls
  .2 fan shutdown
  .3 all speaker and emergency telephones control circuits

.9 That all speakers and emergency telephones are properly zoned.

.10 That all thermal detectors, smoke detectors, flame detectors, and manual stations have been operated and are in good working order.

.11 That all sprinkler system and standpipe system valves have been operated and are in good working order and display correctly on each annunciator.

.12 That all annunciators correctly pin-point the origin of any fire alarm.

.13 That actual smoke concentrations of sufficient density have been applied to each new smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set. The sensitivity of each detector shall be recorded on the Verification Report.

.14 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the Manufacturer.

.15 On completion of testing, a letter by the contractor shall be forwarded to the engineer stating that tests have been completed, and that the system is operating correctly.

.16 Verification records shall be maintained with the following minimum requirements:

  .1 Verification records shall list each device and show the date on which each device was verified.

  .2 Verification records shall show the date of all deficiencies encountered in the control equipment, wiring and field devices.

  .3 Verification records shall show the date when deficiencies were corrected and re-verified

.17 Provide any necessary equipment, test apparatus, ladders and scaffolding as required.

.18 Document sound pressure levels in each room.

.19 Adjust system and components as required to ensure complete system operation.

.20 Where partial occupancies occur, the fire alarm system for the area to be occupied (including control units, annunciators, etc.) shall be tested and meet the requirements noted above. Upon system completion and prior to final acceptance, those parts of the fire alarm system tested to this specification shall be retested in accordance with the requirements of CAN/ULC-S536, “Standard for the Inspection and Testing of Fire Alarm Systems”, and as required by Local Authorities.

3.06 FINAL INSPECTION

.1 After the testing and verification is completed, and all deficiencies rectified, notify the Engineers and representatives of the Fire Department and demonstrate the proper functioning of the system.

END OF SECTION 26 70 01

CONTENTS

PART 1 - GENERAL

1.01 REFERENCES

.1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

.2 Provide a complete system of conduits, pull boxes enclosures and outlet boxes to accommodate the installation of Communications System wiring by others.

.3 Conduit shall be of size as shown on the drawing and shall interconnect outlets and/or rooms as detailed and/or shown.

.4 Pull box sizes shall not be less than sixteen (16) times the entering conduit diameter.

PART 2 - PRODUCTS

2.01 CONDUITS, PULLBOXES, OUTLET BOXES, PLYWOOD, ETC.

.1 Refer to appropriate sections for details.

PART 3 - EXECUTION

3.01 PULL BOXES

.1 Pull box size and locations must be approved by the consultant prior to installation. Pull boxes must be located in an area, which will remain accessible over the life of the building.

.2 Pull boxes are to be free of electrical distribution cables and designated for communications use only.

.3 Conduits should enter ends of pull boxes.

3.02 SEPARATION FROM POWER

.1 Maintain a minimum separation of 300mm (12”) between telephone and electrical services.

3.03 SERVICE/ELECTRICAL ROOMS

.1 When a conduit enters a building up through the floor, they must terminate 50mm (2”) out from the finished wall where equipment is to be mounted.

3.04 GROUNDING

.1 The maximum ground resistance for the telephone equipment is 25 OHMS. Provide a 38mm (1.5”) PVC conduit with a minimum 2/0 cable must be provided to the telephone equipment room directly from the main building ground bar.

.2 Refer to the riser diagram for grounding riser requirements.

3.05 CONDUIT AND FITTINGS

.1 All conduits shall be connected using approved couplings and fittings and installed to conform to existing building codes.

.2 All conduits shall be installed complete with a 3mm (⅛") braided nylon waterproof pull cord.

.3 Bends in conduit that connect sections of a building or distribution locations shall be long sweep radius bends whenever it is possible and practical. However, in no instance shall the inside radius of bend be less than:

.1 Six (6) times the internal diameter for conduits 50mm (2") and smaller.
.2 Ten (10) times the internal diameter for conduits 64mm (2 ½") and larger.

.4 LB fittings are NOT acceptable.

.5 Conduits shall not exceed two (2) 90° sweep bends or the equivalent without the use of a pull box. Two offsets equal one (1) 90° bend.

.6 No conduit run shall be longer than 30.5m (100') between pullboxes or telephone terminating points.

.7 Leave conduits free and clear of all obstructions and terminate as shown. Equip terminations with bushings and clearly identify each run.

END OF SECTION 26 80 01