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MECHANICAL SPECIFICATION

PROJECT NAME:
NEW SAYERS FOOD STORE
BURLEIGH STREET, APSLEY, ON

OUR PROJECT NUMBER:
21376.000.M.001

DATE:
JULY 15, 2022

ISSUED / REVISION:
FOR CONSTRUCTION

20 00 00.00 Index

END OF SECTION

20 05 00.00 General Instructions for Mechanical Sections

1. General

1.1. WORK INCLUDED

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

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

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

1.2. INTENT

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

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

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

1.3. SECTIONS AFFECTED

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

1.4. REGULATIONS

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

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

.1 Ontario Water Resources Act.

.2 Ontario Plumbing Code.

1.4.3. Natural gas systems shall be in accordance with the:

.1 Gas Protection Act

.2 Installation Code of Natural Gas Burning Appliances and Equipment Code CAN/CSA B149.1 - Natural Gas and Propane Installation Code.

1.4.4. These Specifications are supplementary to the requirements above.

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

1.5. PERMITS, FEES INSPECTION

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

1.6. EXAMINATION OF SITE

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

1.7. DRAWINGS, CHANGES AND INSTALLATION

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

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

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

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

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

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

1.7.7. Vent pipes, exhaust hoods or other mechanical equipment mounted on the roof, or housing for such equipment, shall not be closer to the edge of the roof than a distance equal to the height of the pipe, hood or equipment, unless specifically reviewed and accepted by the Engineer's Representative.

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

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

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

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

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

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

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

1.8. INSTALLATION, INTERFERENCE AND SETTING DRAWINGS

1.8.1. Installation, interference and setting Drawings dimensioned and to scale, shall be submitted for review by the Engineer's Representative, as may be required or requested by the Engineer's Representative to make clear the work intended or to show its relation to adjacent work or to the work of other trades. When an alternative piece of equipment is to be substituted for equipment shown, Drawings of the area involved shall be prepared by this Division. Three copies of such Drawings shall be submitted for review, of which one will be retained by the Engineer's Representative.

1.8.2. Installation working Drawings to 1:50 scale (1/4 in. equal to 1 ft.) for mechanical rooms showing plan and sections of the plant, services, bases, curbs, drains, motor terminals, shall be prepared by this Division.

1.8.3. Interference Drawings are required for shafts, ceiling spaces, typical floors and wherever there is possible conflict with the positioning of mechanical equipment, piping or ductwork and architectural or structural features or the work of other trades.

1.8.4. The design of the structural framing of the mechanical rooms and pipe spaces and major pipe run supports has been based on assumed loadings supplied during the design phase. Well ahead of the construction of the affected areas, prepare and submit Drawings for review by the Engineer's Representative showing the layout and weights of all finally selected mechanical equipment including details of concrete pads, concentrated pipe loads and point reactions of the equipment onto the structure.

1.8.5. This Division shall prepare sleeving Drawings indicating the size and locations of openings required in concrete floor slabs, roof slabs/decks and walls for piping, ductwork and equipment. In case of failure to provide information in time (i.e. before the concrete is poured) any extras incurred shall be at the expense of this Division.

1.8.6. Work shall not proceed in areas involved until after final review of such Drawings has been obtained.

1.9. BID FORM AND SUBMISSIONS OF BIDS

1.9.1. Submit with the bid, all information called for on the Bid Form. Bids not completed in full may, at the discretion of the Owner may be rejected.

1.9.2. Show separate and unit prices for optional equipment or systems called for as additions to or deductions from the Bid amount.

1.9.3. Where only one name appears in the specification, the Bid shall include for the specified equipment.

1.9.4. Where two or more names are shown in the specifications as alternatives or equal to, this Division can select which manufacturer is to be carried, provided the choice is shown on the Bid Form. Where the choice is not indicated, the equipment described in the specification or first named on the Bid Form shall be supplied.

1.9.5. This Division is invited to list substitute equipment as a price deduction to the Bid price. Space has been provided to show manufacturers not specifically mentioned. Acceptance of substitute equipment shall be at the discretion of the Owner whose decision shall be final.

1.9.6. Materials and products specified by the name of the manufacturer, the brand or trade name, or catalogue reference, shall be the basis of the Bid price. These shall be provided under the Contract unless substitutions are proposed and accepted in accordance with the following procedures:

.1 Substitution may be proposed only when the clause or other approved manufacturer is used in the specification.

.2 The proposed substitution shall be listed under Substitute Equipment on the Bid Form.

.3 The proposed substitution shall indicate product name, a complete product description and what difference, if any, will be made in the amount of the Bid price for the substitution.

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

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

1.10. MATERIALS

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

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

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

1.11. CO-OPERATION WITH ENGINEER'S REPRESENTATIVE

1.11.1. To assist in the successful execution of the project, the Contractor will receive an initial job report that summarizes the expectations of the Engineer's Representative and the Contractor. This job report covers topics such as progress billings, shop drawing requirements, change order pricing, the commissioning process, installation drawings, the Specifications, as-built drawings and operations and maintenance manuals, along with a number of other items. This job report is intended to reiterate key items from the Contract Documents and is not intended to impose new requirements.

1.11.2. At the appropriate time during construction the Contractor shall submit the applicable documentation listed in the Mechanical/Electrical Unfinished Building Occupancy Checklist. The checklist shall be issued by the Engineer's Representative during the course of the project, however, a sample checklist can be provided at any time upon request. The checklist shall be completed by the Contractor when the information required for occupancy is submitted. The Engineer's Representative shall review the information and checklist and will identify when the information is complete. The Engineer's Representative's general review letter (required for building occupancy) will only be issued when the information requested in the checklist is submitted by the Contractor and deemed to be complete by the Engineer's Representative.

1.12. CO-OPERATION WITH OTHER DIVISIONS

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

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

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

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

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

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

1.13. TEMPORARY USE OF EQUIPMENT

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

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

1.14. STATEMENT OF PRICES

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

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

1.15. METRIC CONVERSIONS

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

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

1.16. ALTERNATIVE, SEPARATE AND IDENTIFIED PRICES

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

1.17. SCHEDULE, ACCESS, PROTECTION AND CLEAN-UP

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

1.18. HOUSEKEEPING PADS, CURBS AND SUPPORT PIERS

1.18.1. Provide dimensioned drawings for final sizes and locations for housekeeping pads, support piers, and curbs around all floor penetrations for pipes and ducts. Division 3 and the Engineer's Representative shall review the drawings. All housekeeping pads shall be minimum 100 mm (4 in.) high unless indicated otherwise. Refer to the Drawings and Details for additional information.

.1 Mechanical DivisionMechanical Division shall furnish and install curbs and housekeeping pads.

.2 Mechanical DivisionMechanical Division shall furnish and install equipment support piers.

1.19. ASHRAE 90.1

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

1.20. HOISTING FACILITIES

1.20.1. This Division shall provide its own hoisting facilities.

1.21. INTELLECTUAL PROPERTY

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

1.22. MATERIALS AND EQUIPMENT

1.22.1. Use new materials and equipment as specified or shown that are free from defects that impair strength, durability, or asthaetics.

1.22.2. Manufacture in Canada wherever possible.

1.22.3. Labelled and/or Listed as required by the Authority Having Jurisdiction or Code.

1.22.4. Mechanical systems are designed and coordinated based on the manufacturer and model number and/or parameters indicated on the Equipment Schedules. Accept all costs for differences in physical properties or performance between scheduled equipment and acceptable alternative equipment manufacturers or models identified in these specifications. Differences may include, but are not limited to, size, layout, arrangement of components, connection sizes, maintenance access, locations and/or quantity of service connections, and performance differences such as noise, power consumption, flow rates, etc.

2. Products

2.1. NOT USED

3. Execution

3.1. NOT USED

END OF SECTION

20 05 01.00 Abbreviations

1. General

1.1. ABBREVIATIONS

1.1.1. Generally, the following abbreviations are used in this Division:

AABC	-	Associated Air Balance Council
AAP	-	Alarm Annunciator Panel
ABC	-	Alberta Building Code
ABMA	-	American Boiler Manufacturers Association
ACO	-	Acid Resistant Cleanout
AD	-	Acid Resistant Drawings
AFD	-	Acid Resistant Floor Drain
AFF	-	Above Finished Floor
AGA	-	American Gas Association
AMCA	-	Air Moving and Conditioning Association
ANSI	-	American National Standards Institute
ARI	-	Air-Conditioning and Refrigeration Institute
AHRI	-	Air-Conditioning, Heating and Refrigeration Institute
ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AV	-	Acid Resistant Vent
AWG	-	American Wire Gauge
AWS	-	American Welding Society
AWWA	-	American Water Works Association
BHP	-	Boiler Horsepower or Brake Horsepower
Btu/hr	-	British Thermal Units per Hour
B.W.G.	-	British Wire Gauge
CAD	-	Computer Aided Drafting
CAFV	-	Controllable Air Flow Venturis
CAP	-	College of American Pathologists
CCA	-	Chromated Copper Arsenate
C.E.M.A.	-	Canadian Electrical Manufacturer’s Association
CEMS	-	Central Energy Management System
CCF	-	Central Computer Facility
cfm	-	Cubic Feet per Minute
CGA	-	Canadian Gas Association
CGSB	-	Canadian General Standards Board
CI	-	Cast Iron
CPU	-	Central Processing Unit
CRN.	-	Canadian Registration Number
CSA	-	Canadian Standards Association

cu.ft.	-	Cubic Feet
cu.m.	-	Cubic Meter
db	-	Dry Bulb
dB	-	Decibel
dBA	-	A-weighted Decibel
DDC	-	Direct Digital Control
DegC	-	Degrees Celsius
DegF	-	Degree Fahrenheit
dia.	-	Diameter
DPDT	-	Double Pull Double Throw
DPTX	-	Differential Pressure Transmitters
EAP	-	Excess Exhaust Alarm Panel
E.D.R.	-	Equivalent Direct Radiation
EF	-	Exhaust Fan
EEMCA	-	Electrical and Electronic Manufacturers Association of Canada
EEPROM	-	Electrically Erasable Programmable Read-Only Memory
EMT	-	Electrical Metallic Tubing
EP	-	Electric Pneumatic
EPDM	-	Ethylene Propylene Diene-Rubber
EPROM	-	Electrically Programmable Read Only Memory
ERW	-	Electric Resistance Welded
FACP	-	Fire Alarm Control Panel
FDA	-	Food and Drug Administration
FHC	-	Fume Hood Controller or Firehose Cabinet
F.L.A.	-	Full Load Amps
fpm	-	Feet per Minute
fps	-	Feet per Second
FM	-	Factory Mutual
ft.	-	Foot or Feet
ga	-	Gauge
gal	-	Gallons
GFD	-	Gallons per Square Feet per Day
GPD	-	Gallons per Day
GPH	-	Gallons per Hour
GPM	-	Gallons per Minute
GSS	-	Galvanized Sheet Steel
h-cu.ft.	-	Hour-cubic foot Doesn’t exist in this format
HCFCs	-	Hydrochlorofluorocarbons
HEPA	-	High Efficiency Particulate Air
HOA	-	Hand/off/Auto
HOT	-	Hand Held Operator Terminal
HSS	-	Hollow Steel Sections
HTK	-	Hood Termination Kit

hp	-	High Pressure or Motor Horsepower
Hz	-	Hertz
IAOC	-	Insurance Advisory Organization of Canada
ICU	-	Intensive Care Unit
(I.)G.P.H.	-	(Imperial) Gallons per Hour
(I.)G.P.M.	-	(Imperial) Gallons per Minute
in.	-	Inch or Inches
kg	-	Kilogram
kg/cu.m.	-	Kilogram per cubic meter
kPa	-	Kilopascals
kVa	-	Kilovolt-amps
kW	-	Kilowatts
lbs/cu.ft.	-	Pounds per cubic foot
lbs/hr.	-	Pounds per Hour
L	-	Litre
L/s	-	Litres per Second
LFC	-	Laminar Flow Cabinets
LEDS	-	Light Emitting Diode
LCP	-	Laboratory Control Panel
LTF	-	Linear foot
LM	-	Linear meter
mA	-	Milliamps
MAC	-	Make-up Air Controller
mADC	-	Milliamps Direct Circuit
MBH	-	1000 British Thermal Units per Hour
MCC	-	Motor Control Centre
mm	-	Millimetre
m	-	Metre
m/s	-	Metres per Second
mL	-	Millilitre
MCP	-	Motor Control Panel
MOV	-	Motor Overvoltage
mPa	-	Millipascals
MSC	-	Master Summing Controller
MSG	-	Manufacturers' Standard Gauge
NBS	-	National Bureau of Standards
NC	-	Noise Criterion as Defined by Graph in A.S.H.R.A.E.
NCCLS	-	National Committee for Clinical Laboratory Standard
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
NIM	-	Network Interface Module
NIST	-	National Institute of Standards and Technology
NIOSH	-	National Institute of Occupancy Safety and Health

NPS	-	American National Standard Straight Pipe Thread
NPSH	-	Net Positive Suction Head
NPT	-	American National Standard Taper Pipe Thread
No.	-	Number
OAT	-	Outside Air Temperature
OBC	-	Ontario Building Code
OC	-	On Centre
OCP	-	Operator Control Panel
OPSS	-	Ontario Provincial Standard Specification
OS&Y	-	Outside Screw and Yoke
OWRA	-	Ontario Water Resources Act
oz.	-	Ounce or Ounces
PCU	-	Personal Computer Unit
PE	-	Pneumatic Electric
PIT	-	Portable Interface Terminal
ph	-	Hydrogen Ion Concentration
ppm	-	Part per Million
psf	-	Pounds per Square Foot
psi	-	Pounds per Square Inch
psia	-	Pounds per Square Inch Absolute
psig	-	Pounds per Square Inch Gauge
PWM	-	Pulse Width Modulation
PVC	-	Polyvinyl Chloride
qt.	-	Quart
RAH	-	Return Air Humidity
RH	-	Relative Humidity
rpm	-	Revolutions per Minute
RPU	-	Remote Processing Unit
RPU-TU	-	Remote Processing Unit for Terminal Units
SCR	-	Silicone Controlled Rectifier
SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association
sp. in. wg.	-	Static Pressure, Inches Water Gauge
S.P.D.T.	-	Single Pull Double Throw
SPS	-	Sash Position Sensor
s.s	-	Stainless Steel
SF	-	Supply Fan
SPS	-	Sash Position Sensor
SPWM	-	Sine-Coded Pulse Width Modulated
SSPC	-	Steel Structures Painting Council (The Society of Protective Coatings)
sq.m.	-	Square Meter
STC	-	Supply/Exhaust Tracking Controller
SWS	-	Sidewall Velocity Sensors
TDS	-	Totally Dissolved Solids

TEFC	-	Totally Enclosed Fan Cooled
TIG	-	Tungsten Inert Gas
TKV-TWA	-	Threshold Limit Value - Time Weighted Average
UACU	-	Unitary Air Conditioning Units
UL	-	Underwriter’s Laboratories
ULC	-	Underwriter’s Laboratories of Canada
Ohm	-	Ohm
USP	-	United States Pharmacopoeial
USG	-	United States Gallons
USGPH	-	United States Gallons per Hour
USGPM	-	United States Gallons per Minute
VAC	-	Volts Alternating Current
VACFH	-	Closed Loop Variable Frequency Drive
VDC	-	Volts Direct Current
VFD	-	Variable Frequency Drive
VSC	-	Variable Speed Controllers
VSD	-	Variable Speed Drives
W	-	Watt
W/cu.m.	-	Watts per Cubic Meter
W/ft.	-	Watts per Foot
W/m	-	Watts per Meter
W/sq.in.	-	Watts per Square Inch
W/sq.m.	-	Watts per Square Meter
W	-	Water Closet
wb	-	Wet Bulb
wg	-	Water Gauge
WHMIS	-	Workplace Hazardous Material Information System
WSP	-	Working Steam Pressure
WOG	-	Water, Oil, Gas

2. Products

2.1. NOT USED

3. Execution

3.1. NOT USED

END OF SECTION

20 05 02.00 Record and As-built Drawings

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

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

1.3. RECORD OF REVISIONS ON SITE

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

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

2. Products

2.1. NOT USED

3. Execution

3.1. DOCUMENTATION REQUIREMENTS

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

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

.1 Underground piping invert elevations and pipe locations dimensioned to column lines after review and acceptance by the Authority Having Jurisdiction.

.2 Inverts of underground piping at building exit and entry, below floor slab at each branch connection, riser base, and change in direction as well as a least 3 points on long straight runs.

.3 Above ground piping revisions

.4 Duct revisions

.5 Equipment revisions

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

.7 Locations of valves

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

3.1.4. Final as-built documents shall not contain markings or corrections electronically or by hand (i.e. marker, pen, pencil, etc.). Drawings submitted that contain mark-ups will not be accepted.

3.2. SUBMISSION REQUIREMENTS

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

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

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

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

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

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

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

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

3.3. AUTOCAD SPECIFIC SUBMISSION REQUIREMENTS

3.3.1. Submit a complete list of layer names and brief description of each layer's use with all files.

3.3.2. Submit a complete list of symbol (block) names with a description of each symbol.

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

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

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

END OF SECTION

20 05 03.00 Shop Drawings

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Comply with Section 01 33 00.00 for Submittals except as amended below.

2. Products

2.1. SHOP DRAWINGS

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

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

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

.2 Attachments shall be limited to 20MB

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

.4 Shop Drawing Submission to the following email address:

.1 ContractAdmin.Toronto@smithandandersen.com

2.1.3. Shop drawings submitted directly Smith + andersen personnel (and not copied to the email address provided above) without advanced permission will not be processed nor considered as received.

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

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

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

3. Execution

3.1. SUBMISSIONS

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

3.1.2. Scanned PDF versions are not acceptable.

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

3.1.4. Provide all necessary copies required for the trades, suppliers or other Consultants.END OF SECTION

20 05 13.00 Electric Motors

1. General

1.1. WORK INCLUDED

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

1.1.2. Electric motors for all driven equipment supplied by this Division shall be provided and installed by this Division.

1.2. SUBMITTALS

1.2.1. Shop Drawings for all electrical motors shall be in accordance with the Section 20 05 03.00 - SHOP DRAWINGS and shall incorporate the following information.

.1 Horsepower
.2 Voltage
.3 Frequency
.4 Speed
.5 Starting current and torque characteristics
.6 Full load current
.7 Class of insulation
.8 Enclosure type
.9 Service factor
.10 Ambient temperature reference
.11 Type of bearings
.12 Locations of connection box
.13 Manufacturer

2. Products

2.1. MATERIALS

2.1.1. Unless otherwise specified motors shall be squirrel cage induction type with standard drip proof enclosure.

2.1.2. Motors unless otherwise specified shall meet all requirements of EEMAC and CSA standards for electrical motors and where possible shall be of Canadian manufacturer.

2.1.3. Generally, all motors shall have starting current-torque characteristics in accordance with EEMAC, Design B unless otherwise specified or unless load characteristics require a higher starting torque. Each motor shall have sufficient starting torque to start the driven equipment and to accelerate it to full speed within 10 seconds. Motor horsepowers shown are minimums. Submit starting times for review.

2.1.4. All motors shall be nominal 1750 rpm, unless otherwise specified.

2.1.5. Unless noted otherwise, all motors shall have Class B insulation and shall be designed for continuous operation at 40 deg. C. (104 deg. F.) Motors controlled from variable speed drives shall have Class H windings and Class F insulation.

2.1.6. Motors controlled from Variable Speed Drives shall be complete with a maintenance free, conductive microfiber, shaft grounding ring. AEGIS SGR for low voltage motors up to 500 hp or AEGIS Pro Series for medium and low voltage motors over 500 hp. Where explosion proof motors are required, shaft grounding rings to be installed within explosion proof enclosure in accordance with IEEE std 303 or inside the XP motor. Install in accordance with manufacturers reccomendations

2.1.7. Locate motor connection boxes on side of motor most easily accessible for maintenance and remote from belts, gears or driven equipment. If boxes are factory installed on wrong side of motor the manufacturer or contractor shall relocate as required.

2.1.8. Each multi-speed motor and associated switching device shall be circuited such that the overload device in the starter protects the motor on each step of the multi-speed switch. As an alternative to this requirement, the motor may have integral overload protection.
Multi-speed motors shall be single winding variable torque for 50% motor speed reduction and double winding, two speed for all other speed reductions.

2.1.9. Motors shall have the following electrical characteristics unless noted otherwise in equipment schedules

.1 For 0.375 kW (1/2 hp) and larger 208 volt, 3 phase, 60 cycle

.2 For 0.25 kW (1/3 hp) and smaller 115 volt, 1 phase, 60 cycle

2.1.10. Single phase motors 0.25 kW (1/3 hp) and smaller shall be capacitor start.

2.1.11. Provide motors 22.4 kW (30 hp) and larger with heat detector protection embedded in the windings for connection into the motor control circuit.

.1 Acceptable manufacturers:

.1 Siemens

2.1.12. All motors 74.6 kW (100 hp) and larger shall be suitable for reduced voltage starting, delta-wye.

2.1.13. Motor enclosures shall be as follows:

.1 If protected from the weather and entraining moisture, use open drip-proof, service factor 1.15.

.2 Motors located in air streams shall be selected to operate satisfactorily at maximum temperature and moisture levels of surrounding air.

.3 For all other locations, use totally-enclosed fan-cooled (TEFC), service factor 1.0.

.4 Use explosion proof motors where scheduled.

2.1.14. High efficiency motors shall be T frame, A.C., three phase, meet or exceed the CSA-390M-2010 Table 3 Premium Efficiency Levels and be approved under the Canadian Electrical Safety Code:

.1 High efficiency motors shall be used on all fans and pumps having motors 0.75 kW (1 hp) or larger.

2.1.15. Each electric motor shall be complete with a lamacoid nameplate securely fastened in a conspicuous place on the motor. The nameplate shall be a minimum of 2 mm (3/32 in.) thick laminated phenolic plastic 100 mm (4 in.) long x 50 mm (2 in.) wide with black face and white centre, 5 mm (7/32 in) high letters shall be engraved through to the white lamination with the following:

.1 Motor No.

.2 Mechanical Equipment Driven

.3 Circuit No.

.4 Panel No.

.5 Panel Location

2.1.16. Manufacturer nameplate shall include the nominal full load motor efficiency.

2.1.17. Electric motors shall be manufactured by:

.1 Canadian General Electric

.2 Westinghouse

.3 Lincoln

.4 U.S. Motors

.5 Weg

.6 Baldor

3. Execution

3.1. INSTALLATION

3.1.1. Drive between any motor and driven equipment shall be provided with a guard, except where casing acts as a guard. Guards for belt-driven equipment shall have a hole for tachometer reading on each shaft.

END OF SECTION

20 05 14.00 Wiring and Starters

1. General

1.1. WORK INCLUDED

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

1.1.2. All power and control wiring from starters, fused and non-fused switches, whether mounted in M.C.C.'s or individually, to all mechanical devices and equipment shall be provided by this Division except where shown and specified under the Electrical Division.

1.1.3. All starters for devices supplied by this Division shall be provided by this Division except where shown and specified under the Electrical Division.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. All power wiring and starters for devices supplied by this Division shall be provided by the Electrical Division except where shown and specified under this Division. All control wiring shall be provided by this Division.

1.2.2. Where starters for skid mounted, packaged equipment are provided by this division they shall meet the requirements of the Electrical Division.

2. Products

2.1. NOT USED

3. Execution

3.1. INSTALLATION

3.1.1. All wiring and starters provided by this Division shall comply with the requirements of the Electrical Division of the Specifications

3.1.2. This Division shall review the shop Drawings for the motor starters submitted by the Electrical Division to ensure that all field connections are shown, the motor horsepower are correct and that the motor control schematics reflect all requirements.

END OF SECTION

20 05 19.00 Indicating Instruments

1. General

1.1. WORK INCLUDED

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

1.2. SUBMITTALS

1.2.1. Shop Drawings: Further to requirements of Section 20 05 00.00 - GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS, submit working ranges of thermometers and gauges with Shop Drawings.

2. Products

2.1. MATERIALS

2.1.1. Pipeline thermometers shall be complete with:

.1 Dust-tight stainless case and stem with 127 mm (5 in.) dial.

.2 Bi-metal type.

.3 White face with black lettering

.4 Range normally 0 to 115 deg. C. (32 to 240 deg. F.) for hot water and -17 to 49 deg. C. (0 to 120 deg. F.) for chilled water but range shall suit maximum and minimum temperatures of location and be shown on shop drawings.

.5 Temperature marking in 1 deg. C. (2 deg. F.) increments in both imperial and metric scales.

.6 External recalibration adjustment.

.7 Separable socket with extension neck as required for insulated pipe.

.8 Universal adjustable hinge

.9 Wells shall be registered with the provincial Boiler and Pressure Vessel Safety Branch and have a C.R.N. registration number.

2.1.2. Pressure gauges shall be complete with:

.1 Dust-tight nominal 115 mm (4½ in.) dia. case, solid front complete with back blow-out to A.N.S.I. B40-1 Grade 2A Level Standards.

.2 Back-flanged where required.

.3 Black pointer

.4 White dial with black markings

.5 Dial range to cover twice the average working pressure of the equipment and shall be compound gauges on pump suction for all open systems.

.6 Clear lens

.7 Phosphor bronze bourdon tube, silver soldered.

.8 Brass or stainless steel movement, bronze or nylon brushed, scale and movement mounted independent of the case.

.9 Brass socket

.10 kPa and psi scales

.11 Provincial Boiler and Pressure Vessel Safety Branches registration number

.12 All wetted parts in contact with potable water systems shall be lead free

2.1.3. Pressure and temperature test port:

.1 Continous operating temperature range of -40 Deg. C. (-40 Deg. F.) to 65.6 Deg. C. (150 Deg. F.)

.2 Dueal self closing Nordel valves for 135 Deg. C (275 Deg. F.) intermittent maximum operating temperature

.3 2758 kPa (400 psig) maximum operating pressure

.4 Threaded brass or 316 stainless steel body to suit service material

.5 Screwed cap and gasket with retaining strap

.6 Temperature and pressure test kit in protective carrying case with 2 thermometers, 1 pressure guage and 2 adaptors for full range of service temperatures and pressures.

2.1.4. Pressure and temperature test ports shall be Pete's Plug II.

2.1.5. Thermometers shall be Trerice, Taylor, Weksler, Winters or Ashcroft.

2.1.6. Pressure gauges shall be Trerice, Ashcroft, Morrison, Winters or Weksler.

3. Execution

3.1. INSTALLATION

3.1.1. Locate all thermometers and pressure gauges so as to assure easy reading from the floor or platform.

3.1.2. Where direct reading instruments cannot be satisfactorily located use a remote instrument.

3.1.3. Locate remote instruments next to the point of the reading, on wall or structure.

3.1.4. Each remote or panel mounted instrument shall have an engraved lamacoid nameplate identifying the system and service.

3.1.5. Insert pipeline thermometer and/or pressure gauges into tanks, equipment tappings or in pipeline using screwed tees or forged steel couplings, welded into the pipe.

3.1.6. Provide thermometers in the following locations in pipelines:

.1 Each hot or cold water storage tank

.2 and where specifically shown

3.1.7. Provide test wells for thermometers where shown. Test wells shall be compatible with the thermometers used. Wells shall be registered with the applicable Provincial Authority Having Jurisdiction and have a CRN registration number.

3.1.8. Provide a ball valve on the inlet to each gauge. Install a pressure snubber on any gauge installed near a pump or in any location where damping is required to prevent rapid oscillation of the pointer. When the equipment is subject to vibration, mount the gauge on adjacent wall or on a mounting plate, supported from the floor.

3.1.9. Provide pressure gauges in the following areas (not permitted to be pressure and temperature test ports):

.1 Potable water line where it enters the building

.2 In and out of each pump

.3 In and out of all pressure reducing valves

.4 and where specifically shown

3.1.10. Provide pressure gauges or pressure and temperature test ports in the following areas:

.1 Air cushion tank or expansion tank

.2 Potable water make-up line

.3 and where specifically shown

END OF SECTION

20 05 29.00 Hangers and Supports

1. General

1.1. WORK INCLUDED

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

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

1.1.3. Hangers, supports, anchors, guides, and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. The Mechanical Division shall prepare detailed shop drawings showing all anchors and guides for all systems with the potential for thermal expansion/contraction and/or loads due to weight or thrust. The drawings shall bear the signed seal of a Professional Engineer licensed to practice in the appropriate discipline and place of work. The drawings shall include all details of construction, static and dynamic forces at points of attachment, etc. necessary for review and acceptance by the project Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division. No anchor points shall be permitted without reviewed shop drawings and, where installed prior to review, shall be removed and replaced to the satisfaction of the Engineer's Representative.

2. Products

2.1. MATERIALS

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

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

2.1.3. Pipe rolls shall have cast iron rollers, shaped to accept the outside diameter of the insulated pipe. Roll shall either rotate on a steel shaft mounted on a cast iron stand or shall roll on a cast iron bed plate.

2.1.4. Pipe slide assembly shall be manufactured to the latest requirements of MSS-SP-69. Assembly shall be complete with Carbon steel structural or fabricated tee, 100% virgin PTFE bonded slide plates and carbon steel base.

.1 For cold services such as domestic cold water, dual temperature, and chilled water to maintain the integrity of the insulation and vapour barrier and where slides cannot be directly welded to the pipe provide a plain carbon steel pipe clamp to be welded to the tee support. Clamp shall be full length of tee support and shall be minimum 150mm (6 in.) or as recommended by manufacturer for the specific pipe size.

.2 For hot services such as steam, heating water, etc. where the piping is 50mm (2 in.) and larger, use a standard catalogue protection saddle tack welded to the pipe, which provides a space between the pipe and tee equal to the thickness of the insulation. Weld the tee to the protection saddle.

.3 For longitudinal movement only provide hold down lugs.

.4 For free movement in all directions width of slide plate base shall be sufficient for full travel.

.5 As an alternative to the above, for compact installations, tees may be welded to the pipe directly provided that the temperature is suitable, extended structural or fabricated tees are used, and the tee is vapour sealed at the insulation and completely insulated to prevent condensation for cold services. Provide details and obtain approval from the Engineer's Representative prior to proceeding with this arrangement.

2.1.5. Roof supports for pipe or duct runs greater than 30 ft. shall be Thaler Roof Specialties.

2.1.6. Roof supports for pipe or duct runs less than 30 ft. shall be Thaler Roof Specialties, MIRO Industries (Unistrut), Advanced Support Products, Inc. or Portable Pipe Hangers Inc.

2.1.7. All hangers, supports, brackets and other devices installed exterior to the building shall be galvanized to prevent failure from environmental corrosion. If galvanized components cannot be used submit samples of proposed substitute for review prior to installation.

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

.1 As an alternative to the above field devised methods and materials, provide engineered pipe and fitting restraints designed and manufactured for the specific purpose of restraining no hub cast iron pipe and fittings against separation under thrust forces equivalent to 145 kPa (50 ft) head pressure. Equal to Holdrite #117.

3. Execution

3.1. INSTALLATION

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

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

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

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

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

3.1.6. Approved type expansion shields and bolts may be used for pipe up to 100mm (4 in.) diameter where the presetting of concrete inserts is not practical. Submit proposed hanger details for review and acceptance by the Structural Engineer's Representative. Make adjustments as necessary to satisfy the requirements of the Structural Division.

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

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

Pipe Size	Hanger Rod Diameter
50mm (2 in.) and under	9mm (3/8 in.)
65mm (2-1/2 in.) and 75mm (3 in.)	12mm (1/2 in.)
100mm (4 in.) and 125mm (5 in.)	16mm (5/8 in.)
150mm (6 in.) to 200mm (8 in.)	19mm (3/4 in.)
250mm (8 in.) to 300mm (12 in.)	22mm (7/8 in.)

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

Nominal Pipe Diameter	Maximum Span
Up to and including 38mm (1-1/2 in.)	2.1 m (7 ft.)
50mm (2 in.) to 125mm (5 in.)	3 m (10 ft.)
150mm (6 in.) and larger	4.6 m (15 ft.)

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

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

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

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

3.1.14. For hot water or steam piping 50mm (2 in.) and larger, use a standard catalogue protection saddle tack welded to the pipe, which provides a space between the pipe and hanger equal to the thickness of the insulation.

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

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

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

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

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

.2 250mm (10 in.) long and 12 US gauge for pipes 65mm (2-1/2 in.) to 300mm (12 in.) diameter

.3 300mm (12 in.) long and 10 US gauge for pipes 350mm (14 in.) to 400mm (16 in.) diameter

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

3.1.20. Unless otherwise specified or shown, all pipes supported from below shall be mounted on pipe rolls or pipe slides.

3.1.21. Unless otherwise specified or shown, vertical pipes shall be supported at least every fourth floor or every 12 m (40 ft.) maximum.

3.1.22. Pipe slides shall be pre-engineered type. Structural or fabricated tees shall be welded to the pipe or to the protection saddle.

3.1.23. Install resilient hangers in accordance with Section 20 05 48.00 - VIBRATION AND NOISE CONTROL.

3.1.24. Other means of support shall be as shown or as specified hereunder.

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

END OF SECTION

20 05 33.00 Electric Tracing

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 21 05 00.00 -GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.1.2. Conform to Section 26 05 00.00 - GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. Electric tracing cable shall be Raychem or Thermon, for 120 volt, 1 phase supply.

2.1.2. Tracing cable shall be self-regulating type to CSA Standard C22.2 No. 130.

2.1.3. Thermostat shall be minimum 20 amp rating with fixed control point set at 4.4 deg. C. (40 deg. F.).

2.1.4. Thermostat shall be minimum 20 amp rating with adjustable control from 0 deg. C. (32 deg. F.) to 49 deg. C. (120 deg. F.) with remote bulb, 3 m (10 ft.) of copper capillary. Where thermostat is mounted in conditioned areas enclosure shall be dust and moisture resistant and where mounted in non-conditioned areas enclosure shall be weather-proof. Thermostat shall have NEMA Type 4X enclosure.

2.1.5. Electronic controller with an alarm contact shall be provided for any fire protection or life safety systems to monitor cables and de-energize cables fully during periods when ambient temperatures exceed set point. Controllers for single circuit with features as follows:

.1 LED window digital display of measured temperature, set points, and alarm conditions;

.2 LED status indicators;

.3 integral 30mA ground fault protection;

.4 programmable temperature settings;

.5 current rating up to 30A;

.6 alarm contacts and LED indicator;

.7 NEMA 4X enclosure;

.8 thermister sensor;

2.1.6. Contactors, where required, shall be with 120 volt coil and pilot light in cover. Provide control transformer as required.

2.1.7. The following minimum watts/linear foot shall be maintained. The table below is based on a -29 Deg. C. (-20 Deg. F.) minimum ambient temperature.

Up to 75 mm (3 in.) pipe	=	5 watts/ft.
100 - 150 mm (4-6 in.) pipe	=	8 watts/ft.
200 mm (8 in.) and 250 mm (10 in.) pipe	=	12 watts/ft.
Larger than 250 mm (10 in.) pipe	=	watts/ft. to be individually sized

2.1.8. Provide thermal insulation as specified in Section 20 07 00.00 – MECHANICAL INSULATION. Insulation thicknesses are a minimum thickness. Provide thicker insulation as required by the heat tracing manufacturer's installation requirements.

2.1.9. On non-metallic (plastic) pipes the cable shall be installed using aluminum tape (AT180/AL-20L). The cable shall have an outer braid of tinned copper and an outer jacket of modified polyolefin.

2.1.10. Electric tracing cable for sprinkler systems shall be Listed for this use. Where electric tracing cable protects branch lines, it shall be specifically listed for use on branch lines.

2.1.11. Include the following accessories:

.1 power connection and end seal kits

.2 splice, and tee kits

.3 "Electric Traced" caution labels

.4 aluminum tape for plastic pipe (where required)

.5 glass cloth adhesive tape

.6 contactors, relays, power distribution components

3. Execution

3.1. INSTALLATION

3.1.1. Completely cover the pipe with cable for the full length shown, and without gaps. Ensure that valve body and bonnet are completely protected.

3.1.2. Install heating cables after pipe installation and testing is complete. Attach cable as recommended by the manufacturer with pipe straps, ensuring cables do not touch or cross.

3.1.3. Strap thermostat bulb to pipe clear of cable, and mount thermostat on wall or roof with brackets. Hang capillary on straps.

3.1.4. Retain the services of the manufacturer to inspect and approve the entire installation before the pipe is concealed and/or insulated. Check for breaks with a 2500 volt DC megger. Provide report for inclusion in the operating manuals. The cost of inspection shall be included in the Contract Price. This Contractor shall provide pre-commissioning and final commissioning.

3.1.5. The installation by this Section shall be complete requiring power supply only by the Electrical Division. Provide all wiring between the electric tracing and the electrical junction box and make final connections.

END OF SECTION

20 05 48.00 Vibration and Noise Control

1. General

1.1. WORK INCLUDED

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

1.2. SUBMITTALS

1.2.1. Shop Drawings: Supply Shop Drawings of the vibration and noise control equipment being supplied. Provide Shop Drawings showing completely the various acoustic assemblies.

1.3. PERFORMANCE REQUIREMENTS

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

1.3.2.

AREAS	N.C. LEVELS
General offices	35
Meeting Rooms	35
Corridor and Lobbies	35
Storage Rooms	40
Outdoors	45 dBA

2. Products

2.1. MATERIALS

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

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

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

2.2. VIBRATION ISOLATION

2.2.1. Type EP (Elastomeric Pad) - Vibro-Acoustics Model N, Kinetics Model NPD, Mason Industries Model W or Super W, or ISOTECH Model IR or ISOPAD.

.1 Type EP shall be 8mm thick ribbed or waffle neoprene pads. Isolator pads shall be selected for less than 80% maximum rated load.

.2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

2.2.2. Type MEP (Metal and Elastomeric Sandwich Pad) - Vibro-Acoustics Model NSN, Kinetics Model NGS, Mason Industries Model WSW, or ISOTECH Model IRMR or IPMP.

.1 Type MEP shall consist of two 8mm thick ribbed or waffle neoprene pads bonded to each side of a 16-gauge stainless or galvanized steel shim plate. Isolator pads shall be selected for less than 80% maximum rated load.

.2 If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved shall be installed under the bolt head between the steel washer and the base plate.

2.2.3. Type DDNM (Double Deflection Neoprene Mounts) - Vibro-Acoustics Model RDM, Kinetics Model RD, Mason Industries Model ND, or ISOTECH Model IDR.

.1 Type DDNM shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.

.2 DDNM mounts shall be selected for a static deflection of 9.5mm unless specified otherwise.

2.2.4. Type DDNH (Double Deflection Neoprene Hangers) - Vibro-Acoustics Model RHD, Kinetics Model RH, Mason Industries Model HD, or ISOTECH Model IHND.

.1 Type DDNH shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel. The diameter of the clear hole in the hanger box shall be at least 19mm larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed the hanger box shall be allowed to rotate through a full 360 degrees without encountering an obstructions.

.2 Unless otherwise specified the static deflection of DDNH hangers shall be 8mm.

2.2.5. Type SPNM (Spring and Neoprene Mounts) - Vibro-Acoustics Model FS, Kinetics Model FDS, Mason Industries Model SLFSW, or ISOTECH Model IOSB.

.1 Type SPNM shall have a free standing and laterally stable steel spring without any housing, and two type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator base plate. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall not be less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.

.2 Unless otherwise specified the minimum static deflection of SPNM isolators under actual load conditions for equipment mounted on grade slabs shall be 25 mm (1 in.), and 50 mm (2 in.) for equipment mounted elsewhere.

.3 Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 602/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

2.2.6. Type SPH (Spring Hangers) - Vibro-Acoustics Model SH, Kinetics Model SH, Mason Industries Model 30, or ISOTECH Model IHS, IHA or IHB.

.1 Type SPH shall consist of a steel spring and welded steel housing. Spring diameter and hanger box hole shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 19 mm (3/4 in.) larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.

.2 Unless otherwise specified, the static deflection of SPH hangers under actual load conditions shall be 50 mm (2 in.).

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

.1 Type SPNH shall consist of a steel spring and welded steel housing. Spring diameter and hanger box hole shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 19 mm (3/4 in.) larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions. .2 Type SPNH shall include the addition of a neoprene element in series with the spring. The neoprene element shall have a deflection of not less than 9mm with a strain not exceeding 15%. Unless otherwise specified, the static deflection of SPNH hangers under actual load conditions shall be 50 mm (2 in.).

2.2.8. Type CSNM (Constrained Spring and Neoprene Mounts) - Vibro-Acoustics Model CSR, Kinetics Model FLS, Mason Industries Model SLR, or ISOTECH Model ICSA.

.1 Type CSNM shall be a spring and neoprene mount that incorporates a housing which contains unrestrained stable springs with built-in leveling device and resilient vertical limit stops to prevent spring elongation when partial load is removed and limits the movement of equipment when it is subjected to wind loading.

.2 A minimum clearance of 25 mm (1 in.) shall be maintained around the restraining bolts and between the housing and the spring so as not to interfere with the spring operation. Limit stops shall provide minimum 6 mm (1/4 in.) clearance under normal operation, and a neoprene washer shall be installed beneath the bolt head/washer used to restrain the isolator.

.3 For Installations subject to wind load, provide tapped hole in top and bottom plates for bolting to equipment and the roof or supporting structure with a neoprene sleeve.

.4 Provide minimum 6mm thick neoprene acoustical base pad on the underside of the mount unless designated otherwise.

.5 Mount shall be capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.

.6 Unless specified otherwise, the minimum static deflection for Type CSNM mounts under actual load conditions shall be 50 mm (2 in.).

2.2.9. Type RTIC (Rooftop Isolation Curb) - Vibro-Acoustics Model RTR, Kinetics Model KSR, Mason Industries Model RSC, or ISOTECH Model ISVC.

.1 Type RTIC shall be curb type rail with integral isolators which is designed to fit over the roof curb and under the isolated equipment. The top and bottom members shall contain weather resistant springs having a minimum 25 mm (1 in.) deflection with 50% additional travel to solid. Spring diameter shall not be less than 80% of the compressed height of the spring.

.2 Wind resistance shall be provided by means of resilient snubbers with a minimum clearance or 6 mm (1/4 in.) so as not to interfere with the spring action except in high winds.

.3 The weather seal shall consist of continuous closed cell sponge materials both above and below the base and a waterproof, flexible neoprene connection joining the outside perimeter of the upper and lower members.

.4 The curb shall be manufactured as a single assembly.

2.2.10. All spring mounts shall be complete with levelling devices 6 mm (1/4 in.) thick ribbed neoprene sound pads and completely colour coded stable springs.

2.2.11. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 80% of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after spring installation.

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

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

2.2.14. All mounts installed outdoors or exposed to high humidity conditions shall have two coats of rust resisting paint and springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized.

2.2.15. Neoprene mounting sleeves for hold down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.

2.2.16. Grout: Non-shrink, self-levelling grout having ability to withstand thermal, vibratory and impact stresses.

2.2.17. Acoustic Sealant: Non-hardening, non-skinning permanently flexible, to CAN/CGSB-19.21. Tremco, CGC Acoustic Sealant or approved equivalent.

2.3. INTERNAL ACOUSTIC DUCT INSULATION

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

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

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

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

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

2.3.6. The following ductwork shall be internally insulated:

.1 All return air transfer ductwork.

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

.3 All supply and return air ductwork in the amenities, lobbies and common areas that serve that space.

3. Execution

3.1. INSTALLATION

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

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

3.1.3. All floor mounted equipment shall be erected on concrete housekeeping pads, with thickness as identified, over the complete floor area of the equipment, unless shown or specified otherwise. Wherever vibration eliminating devices and/or concrete inertia pads are specified, these items shall be mounted on concrete housekeeping pads.

3.1.4. Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.

3.1.5. All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 6mm maximum, under all operating conditions. Lateral restraining isolators shall have the same static deflection as equipment being isolated.

3.1.6. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 50 mm (2 in.) between the bottom of the equipment or inertia base (and height-saving bracket) and the concrete housekeeping pad (or bolt heads) beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short- circuit the vibration isolators. There shall be a minimum 100 mm (4 in.) clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

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

3.1.8. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping, and blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

3.1.9. All mechanical equipment not specifically identified in this Section that contains rotating or vibrating elements, and any associated electrical apparatus installed by this Division that contains transformers or inductors shall be installed on Type DDNM, MEP, or EP isolators as appropriate.

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

3.1.11. Elastomeric isolators that will be exposed to temperatures below 0 deg. C. (32 deg. F.) shall be fabricated from natural rubber instead of neoprene.

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

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

3.1.14. Fans and air handling units shall be levelled with fans operating before the flexible connectors are attached.

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

3.2. EQUIPMENT ISOLATION

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

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

3.2.2. Roof mounted air conditioning units shall be mounted on RTIC isolator.

.1 For roof mounted units that have openings through the structure directly below the unit provide a flexible neoprene coated canvas connection to provide an air tight/weather tight finish between the unit and the curb.

3.2.3. Vertical in-line pumps ceiling hung shall be supported by Type SPNH spring isolators. Refer to Mechanical Standard Details.

3.2.4. Fan coil units or heat pumps suspended from overhead structure shall be hung on Type SPNH spring isolators. Unless otherwise specified in the Vibration and Isolation Schedule, the static deflection of the isolators shall be 50 mm (2 in.).

3.2.5. Refrigeration machines and boilers shall be mounted on a Type SB base with CSNM isolators. Spring deflection shall be 50 mm (2 in.) minimum. If the equipment is suitable and an additional steel base is not required, the equipment can be mounted directly on the isolators.

3.2.6. Suspend all piping in Mechanical Rooms on Type SPH or SPNH isolators as required. Where piping is supported from the floor, weld brackets to the piping and support on Type SPNM isolators. Isolators do not replace constant support hangers or mounts.

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

3.2.8. Where a pipe connects to multiple pieces of equipment in the Mechanical Room the pipe isolators for the entire run shall be chosen to suit the connected equipment of the greatest static deflection.

3.2.9. Piping that is connected only to equipment installed on neoprene isolators shall be either supported from the floor by Type DDNM isolators or suspended from the structure on Type DDNH isolators within the Mechanical Equipment Rooms.

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

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

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

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

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

.1 Flexible connections are not permitted on NFPA 96 kitchen exhaust systems.

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

END OF SECTION

20 05 53.00 Pipe and Ductwork Identification

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

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

2. Products

2.1. MATERIALS

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

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

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

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

2.1.5. All reclaimed rainwater distribution systems shall be purple in colour and conform to requirements of NSF- RW and NSF/ANSI Standard 14. All other non-potable water piping shall conform to the requirements of CAN/CSA-B128.

2.1.6. Colour code shall conform to the requirements under the bylaws of the Authority Having Jurisdiction

3. Execution

3.1. INSTALLATION

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

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

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

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

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

3.1.6. Adhesive labels are not acceptable.

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

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

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

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

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

END OF SECTION

20 05 54.00 Nameplates

1. General

1.1. WORK INCLUDED

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

1.1.2. Nameplates for systems include the designated equipment name, model number and main design parameters.

1.1.3. Every piece of equipment shall have a nameplate.

1.2. SUBMITTALS

1.2.1. Submit samples of nameplates before installation.

2. Products

2.1. MATERIALS

2.1.1. The namplates must be a minimum 2mm (3/32 in.) thick microsurface impact acrylic suitable for a service temperature up to -29 Deg. C. through 80 Deg. C. (-20 Deb. F.. through 175 Deg. F.) Minimum size shall be 100 mm (4 in.) long x 50 mm (2 in.) wide with maximum size to suit nomenclature required. Nameplate shall be with black face and white centre and with 5 mm (7/32 in.) high lettering engraved through to the white lamination.

2.1.2. The nameplates shall have the equipment type and name as indicated in the Equipment Schedules.

2.1.3. The nameplates shall have the service and area of the building served (e.g. Chilled Water - South Zone).

3. Execution

3.1. INSTALLATION

3.1.1. Nameplates shall be securely fastened with screws or brass chains in a conspicuous place on the equipment.

END OF SECTION

20 05 55.00 Valve Tags and Charts

1. General

1.1. WORK INCLUDED

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

1.2. SUBMITTALS

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

2. Products

2.1. MATERIALS

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

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

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

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

3. Execution

3.1. INSTALLATION

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

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

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

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

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

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

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

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

END OF SECTION

20 05 63.00 Access Doors and Accessibility

1. General

1.1. WORK INCLUDED

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

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

2. Products

2.1. MATERIALS

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

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

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

2.1.4. Doors in drywall partitions or ceilings shall be 16 US gauge, prime painted steel flush door panel, concealed hinges, drywall bead frame, and screwdriver operated lock. Acudor model DW 5040 or Mifab Model MDW.

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

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

2.1.7. Minimum size of doors shall be 300 mm x 450 mm (12 in. x 18 in.). Wherever possible 600 mm x 600 mm (24 in. x 24 in.) doors shall be used.

3. Execution

3.1. INSTALLATION

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

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

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

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

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

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

END OF SECTION

20 05 73.00 Excavation and Backfill for Mechanical Work

1. General

1.1. WORK INCLUDED

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

1.1.2. This Section governs requirements for all Work required for the installation of underground storm drains, sanitary sewers, gas lines, pressurized water lines, and appurtenances associated with such services.

.1 Excavation and backfill work includes all work within the building footprint (plan), and extends to a point 1500 mm (5 ft.0in.) beyond face of building foundation line. Services underground within interior courtyards are included in this Section.

1.1.3. Assume that material to be excavated is earth. When rock is encountered during construction, payment will be made on unit price basis to the extent of net difference in cost between dry earth excavation and solid rock excavation, all as indicated in Contract Documents.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Removing subgrade materials for service trenches inside and outside building perimeter, for general grade adjustments, and backfilling of trenches from top of bedding up to bottom of slab-on-grade - under Division 31.

1.2.2. Dewatering of Site - under Division 31.

1.2.3. Rock excavating and spreading - under Division 31.

1.2.4. Finish grading and spreading of topsoil - under Division 31.

1.2.5. Weeping tile drainage lines and filter media - under Division 31.

1.3. SUBMITTALS

1.3.1. Provide Shop Drawings indicating proposed method of bedding and backfilling.

2. Products

2.1. SOILS

2.1.1. Provide Granulars “A”, “B” (Type 1), “M” and “Select Subgrade Material”;

.1 CAN/CSA A23.1 and CAN/CSA A23.2

.2 Ontario Provincial Standard Specifications (OPSS), Form No. 1010

2.1.2. Requirements for Pea Gravel: Granular, well-graded clean rounded pea gravel or stone with not more the 2% material that will pass 75 um (No. 200) sieve, maximum 6 mm (¼ in.), containing not other deleterious material, and subject to testing that specified density can be achieved without compaction.

2.1.3. Requirements for Sand Fill: Uniform quality and unwashed river sand or any clean sand containing less than 5% organic materials, clay or silt (passing 125 um sieve) is acceptable. It can contain a limited amount of small stones or rocks as it comes from the pit. Sharp, clean, coarse sand, water washed, free from clay, salts and organic matter, and in accordance with CAN/CSA A179 Mortar and Grout for Unit Masonry for masonry sand is also acceptable.

3. Execution

3.1. INSTALLATION

3.1.1. All excavation and backfilling for all services shall be in accordance with Division 31.

3.1.2. Refer to Division 31 for rough excavation, removal of excavated material and backfill.

3.1.3. Protection:

.1 Provide protection to existing structures and services. Be responsible for rectifying any damage to existing structures and services resulting from this operation.

3.1.4. Excavation in Soil:

.1 Where rough excavation is carried out by Division 31, perform all layout work for trenches required under this Division, including verification of trench depths and slopes. Work in close cooperation with excavating trades that remove subgrade to within 6 in. (150 mm) of the correct and final trench depth

.2 Perform the final excavation to the correct trench invert to permit proper bedding as detailed in the Standard Drawings. Excavation carried below the correct inverts shall be backfilled with 2000 psi (13.5 mPa) concrete to the underside of the pipe lines, unless otherwise directed in writing.

3.1.5. Excavation in Rock:

.1 All excavation in rock is included under a separate Section, and is taken to a minimum of 150 mm (6 in.) below the correct pipe invert. This Division shall use a bedding material as detailed in the Standard Details to the correct trench invert.

3.1.6. Backfilling

.1 Backfill with sand from the bottom of the trench or excavation up to a point 300 mm (12 in.) above the top of service line or appurtenance. The sand shall be thoroughly tamped around and over the pipes in 150 mm (6 in.) layers.

.2 Backfill the remainder of trench or excavation up to top of subgrade or bottom of floor slabs ongrade.

END OF SECTION

20 05 83.00 Sleeves and Escutcheons

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

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

2. Products

2.1. MATERIALS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

.8 Firestop products shall be mold and mildew resistant

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

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

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

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

3. Execution

3.1. INSTALLATION

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

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

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

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

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

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

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

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

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

END OF SECTION

20 05 88.00 Cutting and Patching

1. General

1.1. WORK INCLUDED

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

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

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

2. Products

2.1. MATERIALS

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

3. Execution

3.1. INSTALLATION

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

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

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

.1 Cut holes through slabs or walls only.

.2 Do not cut holes through beams.

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

.4 Maintain at least 100 mm (4 in.) clear from all beam faces. Space at least 3 hole diameters on Centre.

.5 For holes that are required closer than 25% of slab span from the supporting beam face, use cover meter above the slab to clear slab top bars.

.6 For holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars.

.7 X-rays shall be performed by a qualified technician, in a safe manner and in accordance with all applicable regulations governing this activity.

3.1.4. Obtain written approval from the Structural Engineer's Representative before cutting or core drilling openings or holes.

3.1.5. Patch all openings after services have been installed to match the surrounding finishes.

END OF SECTION

20 07 00.00 Mechanical Insulation

1. General

1.1. WORK INCLUDED

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

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

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

2. Products

2.1. MATERIALS

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

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

.2 Flexible duct insulation shall be 12 kg/cu.m. (3/4 lb.cu.ft.) type with vapour barrier.

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

2.1.2. Flexible elastomeric insulation for ducts exterior to the building shall be Armacell with Tuffcoat 25 surface or K-Flex with 374 protective coating.

2.1.3. Extruded polystyrene insulation for ducts exterior to the building shall be Dow Weathermate Styrofoam insulation board.

2.1.4. Mineral wool insulation board for ducts exterior to the building shall be Roxul RockBoard 80 125 kg/cu.m. (8 lbs/cu.ft.) density board insulation with factory applied reinforced foil vapour barrier.

2.1.5. Foamglass insulation shall be Pittsburgh-Corning.

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

2.1.7. Insulation jacket for services and ductwork exterior to the building, and for indoor components such as valves, pump, meters, etc. shall be Childers or Armacell field applied U.V. protected mesh reinforced mastic.

.1 Mastic shall be equal to Childers VI-CRYL CP-10/11 weather barrier coating. Finish shall be white.

.2 Sealant for areas where mastic meets adjoining insulated or uninsulated surfaces or dissimilar weather proofing materials shall be equal to Childers CP-76.

.3 Glass fibre reinforcing mesh for thickness control and strength at joint interfaces in field applied mastic on exterior ductwork insulation shall be equal to Childers CHIL-GLAS # 10.

2.1.8. Tie wire shall be 16 gauge (0.045mm) stainless steel with twisted ends on maximum 300mm (12 in.) centres.

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

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

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

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

2.1.13. P.V.C. fitted jackets and covers shall have a flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50 when tested in accordance with CAN/ULC-S102-M.

2.1.14. Aluminum Jacket shall be 0.51mm (24 B&S Gauge - 0.0201 in) thick sheet, embossed finish, with longitudinal slip joints and 50mm (2 in.) laps, die shaped fitting covers with factory applied moisture barrier.

2.1.15. Fire resistant duct insulation shall be 3M Fire Barrier Duct Wrap, CL4Fire, or Unifrax Corporation FyreWrap to meet the requirements of NFPA 96. Product shall meet flame spread rating of 25 and smoke developed rating of 50. Insulation product shall be complete with all manufacturers standard fastenings, including (where applicable) aluminum foil tape, filament tape, banding materials, pins, cup-head weld pins, and speed clips for a ULC listed installation.

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

3. Execution

3.1. INSTALLATION

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

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

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

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

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

3.1.6. Where approved by the Engineer’s Representative, as an alternative to the above, recover all piping insulation with a PVC jacket and preformed PVC elbows and fittings sealed with adhesive. PVC shall not be used on steam, medium and high temperature hot water piping or piping services that will be painted.

3.1.7. Cover all piping insulation external to the building and where specifically shown with field applied mesh reinforced mastic.

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

.1 Domestic cold water piping

.2 Chilled drinking water piping

.3 and exterior ductwork

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

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

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

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

3.1.13. Hot Services

.1 Hot fluid such as heating water services, heating glycol, low pressure steam and condensate piping, etc. shall have glass fibre preformed pipe insulation. Refer to Table 1 for required insulation thicknesses.

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

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

3.1.14. Cold Services

.1 Protect insulation by means of sheet steel shields at each hanger or support on the following:

.1 Domestic cold water piping 75 mm (3 in.) and larger

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

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

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

.5 Apply 12 mm (1/2 in.) thick, preformed glass fibre pipe insulation with vapour barrier jacket or 12 mm (1/2 in.) thick flexible elastomeric insulation to all domestic cold water and chilled drinking water piping.

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

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

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

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

3.1.15. Chilled water, spray coil and domestic pumps. Adhere 25 mm (1 in.) thick flexible elastomeric insulation.

3.1.16. Pipe serving chilled water pumps, spray water pumps and domestic water pumps located inside air handling or air conditioning units shall be covered with 25 mm (1 in.) thick flexible elastomeric insulation.

3.1.17. Drainage Piping

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

.2 Storm Drainage piping to be insulated:

.1 Roof drain sump

.2 All horizontal or sloping storm piping

.3 All elbows connecting the horizontal storm drainage piping to the vertical leaders

.4 Where the roof drain is less than 3000 mm (10 ft.) from the vertical leader, insulate the first 3000 mm (10 ft.) of pipe closest to the roof drain and the exposed portion of the roof drain.

.3 Sanitary drainage piping to be insulated:

.1 Sanitary drainage pipes from urinals

.2 Direct and indirect drains from drinking fountains

.3 Floor drains from air conditioning apparatus

.4 All horizontal drainage carrying chilled condensate.

.5 All piping passing through high humidity areas

.6 Sanitary drainage pipe from barrier free lavatories

3.1.18. Ductwork and Equipment

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

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

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

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

3.1.19. Insulate the following ductwork and equipment:

.1 Outside and mixed air plenums. Thickness to suit minimum RSI-2.12 (R-12) for all duct and plenums exposed to outside air.

.2 Outside and mixed air ductwork, including ducts to and from independent heat recovery units (ERW, HRV, etc.). Thickness to suit minimum RSI-2.12 (R-12).

.3 Heating and cooling coil sections of ductwork and plenums

.4 Casings of supply fans in equipment rooms

.5 Supply ductwork in equipment rooms.

.6 Exhaust and relief air ductwork, plenums and/or casings from 1500 mm (60 in.) upstream of shut-off dampers and from dampers to connection to exterior wall or roof. Thickness to suit minimum RSI-2.12 (R-12).

.7 Exhaust air ductwork from independent heat recovery units (ERW, HRV, etc.) up to connection to exterior wall or roof. Thickness to suit minimum RSI-2.12 (R-12).

.8 Exhaust, relief and supply and return air ductwork, plenums and/or casings through non-air conditioned or unheated internal space. Use 50 mm (2 in.) thickness.

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

3.1.20. Apply 2 layers of 50mm (2 in.) flexible elastomeric insulation on all ductwork which is external to the building. Exterior insulation shall be coated with factory applied coating. Provide sloped extruded polystyrene insulation support on top of ductwork to maintain slope at a minimum of 5%. All flanges shall be covered by a minimum of 12mm (1/2 in.).

3.1.21. Apply 2 layers of 50 mm (2 in.) thick rigid extruded polystyrene board insulation. Insulation on top of ductwork shall slope a minimum of 5% and all flanges shall be covered by a minimum of 12mm (1/2 in.). Install field applied mesh reinforced mastic jacket on all insulated ductwork which is external to the building in accordance with the manufacturers recommended installation. The mastic shall be trowelled, sprayed, or wet brushed to a smooth even finish. There shall be no voids or holidays.

3.1.22. Fire resistant duct insulation shall be applied directly onto the ductwork and plenums in strict accordance with the manufacturer's instructions and Listing. Tested to ULC Standard for Internal Grease Duct Testing and ISO standard 6944 as a gypsum shaft alternative per NFPA 96 guidelines.

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

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

.1 Heating Systems (Steam, Steam Condensate, Heating Glycol and Heating

Fluid Design Operating	Insulation Conductivity	Nominal Pipe Diameter - mm (in.)

Temp. range deg. C. (deg. F.)	Conductivity [W(m-K)] [h-cu.ft. - deg . F. (Btu-in.)]	Mean Rating Temp deg. C. (deg. F.)	Runouts [b] Up to 32 (1-1/4)	Less than 25 (1)	25-32 (1 to 1-1/4)	38-75 (1-1/2 to 3	100-150 (4-6)	200 (8) and up
Above 177	0.049	121	87	114	125	125	125	125
Above (350)	(0.34)	(250)	(3.5)	(4.5)	(5.0)	(5.0)	(5.0)	(5.0)
122-177	0.045	93	50	75	100	114	114	114
(251-350)	(0.32)	(200)	(2.0)	(3.0)	(4.0)	(4.5)	(4.5)	(4.5)
94-121	0.043	66	38	65	65	65	75	75
(201-250)	(0.30)	(150)	(1.5)	(2.5)	(2.5)	(2.5)	(3.0)	(3.0)
61-93	0.042	52	25	38	38	50	50	50
(141-200)	(0.29)	(125)	(1.0)	(1.5)	(1.5)	(2.0)	(2.0)	(2.0)
41-60	0.040	38	25	25	25	38	38	38
(105-140)	(0.28)	(100)	(1.0)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)

.2 Domestic and Service Hot Water Systems[c]

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

.3 Cooling Systems (Chilled Water, Chilled Glycol, Brine and Refrigerant)

Fluid Design Operating Temp. range deg. C. (deg. F.)	Insulation Conductivity		Nominal Pipe Diameter - mm (in.)					
	Conductivity [W(m-K)] [h-cu.ft. - deg. F. (Btu-in.)]	Mean Rating Temp deg. C. (deg. F.)	Runouts [b] Up to 32 (1-1/4)	Less than 25 (1)	25-32 (1 to 1-1/4)	38-75 (1-1/2 to 3	100-150 (4-6)	200 (8) and up
5-13	0.039	24	25	25	25	25	25	25
(40-60)	(0.27)	(75)	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)
Below 4.4	0.039	10	25	25	38	38	38	38
Below (40)	(0.27)	(50)	(1.0)	(1.0)	(1.5)	(1.5)	(1.5)	(1.5)

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

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

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

END OF SECTION

20 08 00.00 Commissioning

1. General

1.1. WORK INCLUDED

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

1.1.2. Conform to Section 20 05 02.00 - RECORD DRAWINGS.

1.1.3. Conform to Section 20 05 03.00 - SHOP DRAWINGS.

1.1.4. Conform to Section 20 08 03.00 - OPERATING AND MAINTENANCE INSTRUCTIONS.

1.1.5. Conform to Section 23 05 93.16 - TESTING AND BALANCING OF PIPING SYSTEMS.

1.1.6. Conform to Section 23 05 93.26 - TESTING AND BALANCING OF AIR SYSTEMS.

1.1.7. The commissioning process for the Mechanical Systems shall include:

.1 Verification that the installation meets the requirements of the contract documents.

.2 Verification that the systems performance meets the design intent.

.3 Provision of building operator training.

.4 Provision of as-built documentation, operating and maintenance manuals, and systems operating manuals.

1.1.8. The Contractor and Engineer's Representative shall provide the services to complete the process. The execution portion of this Section defines the areas of responsibility.

1.1.9. Provide labour, equipment and material to conduct the Contractor commissioning process as outlined in this Section.

1.1.10. A Testing and Balancing Contractor will provide the services identified in the Sections for "Testing and Balancing of Water and Air Systems".

2. Products

2.1. MATERIALS

2.1.1. The Contractor and manufacturers shall provide all instrumentation and equipment necessary to conduct the tests as specified in the Mechanical Sections. The Contractor shall advise the Engineer's Representatives of instrumentation to be used and the dates the instruments were calibrated.

3. Execution

3.1. INSTALLATION

3.1.1. This Section describes the commissioning process to be performed by the Contractor. The process shall provide a high level of quality control during the construction.

3.1.2. The commissioning process shall consist of:

.1 Shop Drawings/Record Drawings

.2 Installation review and equipment verification

.3 Plumbing and drainage system testing
.4 Testing of piping systems
.5 Balancing of water systems
.6 Testing of air systems
.7 Balancing of air systems
.8 Testing of equipment and systems
.9 Building Automation System Commissioning
.10 Operating and maintenance manuals
.11 Training
.12 Systems acceptance

3.2. INSTALLATION REVIEW AND EQUIPMENT VERIFICATION

3.2.1. The Contractor shall complete the equipment verification forms for each piece of equipment. The completed forms shall be forwarded to the Engineer's Representative for review and be included in the operating and maintenance manual.

3.3. TEST FORMS AND VERIFICATION FORMS

3.3.1. The Contractor shall prepare test forms for every test identified in this Specification. The Contractor shall complete each form as tests are completed and forward a copy to the Engineer's Representative for review on a monthly basis.

3.3.2. The forms shall be signed by either the Authorities having Jurisdiction or the Engineer's Representative where applicable.

3.4. PLUMBING AND DRAINAGE SYSTEM TESTING

3.4.1. The plumbing and drainage system shall be tested in accordance with Section 23 05 93.16 - TESTING AND BALANCING PIPING SYSTEMS.

3.4.2. The Contractor shall notify the Building Inspector when systems are available for testing. The Contractor shall document all tests performed and shall arrange for the Building Inspector to sign the forms for tests completed.

3.5. TESTING OF PIPING SYSTEMS

3.5.1. Test all piping systems in accordance with Section 23 05 93.16 - TESTING AND BALANCING PIPING SYSTEMS.

3.5.2. All tests for the systems shall be performed in the presence of the Engineer's Representative.

3.6. TESTING OF AIR SYSTEMS

3.6.1. Conform to Section 23 05 93.26 - TESTING AND BALANCING AIR SYSTEMS.

3.6.2. All tests shall be performed in the presence of the Engineer's Representative.

3.7. TESTING OF EQUIPMENT AND SYSTEMS

3.7.1. Conform to Section 20 08 03.00 - OPERATING AND MAINTENANCE INSTRUCTIONS

3.7.2. The Contractor shall hire the services of the manufacturer's technicians to test the equipment and associated systems. The technician shall record the results of the tests on the testing forms. The tests shall be witnessed by the Engineer's Representative or the Commissioning Agent. When the tests have been completed satisfactorily the technician and witnessing authority shall sign the forms.

3.7.3. Should equipment or systems fail a test, the test shall be repeated after repairs or adjustments have been made. The additional tests shall be witnessed by the Engineer's Representative or the Commissioning Agent.

3.7.4. Tests which have not been witnessed shall not be accepted and shall be repeated.

3.8. COMMISSIONING MEETINGS AND SCHEDULING

3.8.1. The Contractor shall include the schedule for all tests and equipment start-up tests in the construction schedule.

3.8.2. The commissioning meetings shall occur during the regular construction meetings. The testing schedules and results of all tests shall be reviewed.

3.9. OPERATING AND MAINTENANCE MANUALS

3.9.1. Conform to Section 20 08 03.00 - OPERATING AND MAINTENANCE INSTRUCTIONS.

3.9.2. Submit Operating and Maintenance Manuals for review.

3.10. OPERATOR TRAINING

3.10.1. Conform to Section 20 08 03.00 - OPERATING AND MAINTENANCE INSTRUCTIONS.

3.10.2. Submit Operating and Maintenance manuals for review.

3.10.3. The training shall be conducted at the equipment or system.

3.10.4. Training will begin when the operating and maintenance manuals have been delivered to the Owner and reviewed by the Engineer's Representative.

3.10.5. Each training session will be structured to cover:

.1 The operating and maintenance manual

.2 Operating procedures

.3 Maintenance procedures

.4 Trouble-shooting procedures

.5 Spare parts required

3.10.6. The training sessions will be scheduled and co-ordinated by the Contractor.

3.10.7. Training shall be provided for the following systems:

System	Minimum Training Times
Air handling units	2 hours
Life safety & fire protection systems	2 hours
Water treatment systems	2 hours
The mechanical system	8 hours
Controls System	4 hours

3.10.8.

3.10.9. The training requirement for the mechanical system shall include a walk-through of the building by the Contractor. During the walk through the Contractor shall:

.1 Identify equipment

.2 Identify starters associated with equipment

.3 Identify valves and balancing dampers

.4 Identify access doors

.5 Review general maintenance of equipment

.6 Review drain locations in pipework systems

.7 Identify maintenance items

3.10.10. When each training session has been completed with the Owners representative, theywill sign the associated form to verify completion.

3.11. PERFORMANCE TESTING

3.11.1. The Contractor shall conduct performance tests on all mechanical systems and document the results on the performance forms included with this Specification.

3.11.2. Performance testing will begin when all mechanical systems have been completed, tested by the Contractor reviewed by the Engineer's Representative and substantial completion has been achieved.

3.12. COMMISSIONING PROCESS ALLOCATION

3.12.1. The commissioning process shall be allocated a value equal to 8% of the contract. This value shall be itemized in the Statement of Prices which forms the basis for progress payment for the various portions of work. The Contractors may draw from this allocation as the commissioning process is completed.

.1 The Contractors shall submit all test and verification forms. The Engineer's Representative will use these forms to calculate a percentage complete.

.2 The Contractor may claim up to 2% of the contract, as per Schedule of Breakdown, on a monthly basis, from this allocation leading up to performance testing. The remaining 3% shall not be paid out until the performance testing, O&M manuals and training have been completed satisfactorily.

3.12.2. The commissioning process allocation shall be broken down as follows:

Shop Drawings	0.50%
Installation review and equipment verification	0.50%
Plumbing and drainage system testing and balancing	0.25%
Testing and balancing of air systems	0.25%
Testing of equipment and systems (system start-up)	0.50%
Operating and Maintenance Manuals	1.00%
Training	1.00%
Record Drawings	1.00%

END OF SECTION

20 08 02.00 Cleaning and Protection

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. NOT USED

3. Execution

3.1. INSTALLATION

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

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

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

3.1.4. Any unpainted steel surfaces, installed for longer than one year prior to the completion date, shall be prime coated under this Division.

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

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

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

END OF SECTION

20 08 03.00 Operating and Maintenance Instructions

1. General

1.1. WORK INCLUDED

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

1.1.2. Comply with all requirements of Section 20 05 02.00 - RECORD DRAWINGS.

1.1.3. Comply with all requirements of Section 20 05 03.00 - SHOP DRAWINGS.

1.1.4. Comply with all requirements of Section 20 08 00.00 - COMMISSIONING.

1.1.5. Comply with all requirements of Section 01 78 00 - CLOSEOUT SUBMITTALS.

2. Products

2.1. REQUIREMENTS FOR MANUALS

2.1.1. Three copies of complete and approved operating and maintenance instructions for all mechanical equipment and systems shall be supplied before substantial completion. Manuals shall be also submitted in electronic format. Electronic manuals shall be prepared in Adobe PDF format with all sections bookmarked for quick reference and submitted on a portable data storage device.

2.1.2. Binders shall be three-ring, hard-cover, loose-leaf type and identified on the binding edges as “Maintenance Instructions and Data Book”, for “Sayers Food Store”.

2.1.3. Terminology used in all the Sections shall be consistent.

2.1.4. Volume One shall contain the master index of all systems, the name of the Contractor, Mechanical Sub-Contractors and the date of substantial performance for the Contract.

2.1.5. Volume One shall contain a section with all necessary warranty information.

2.1.6. Each binder shall have a complete index for all volumes.

2.1.7. Each binder shall be no more than half filled.

2.1.8. There shall be a separate section for all materials used on the project which fall under the WHMIS legislation. There shall be a hazard data sheet for each of the materials.

2.1.9. There shall be a separate section for all Insurance Certificates, Test Certificates, Verification Forms and Test Forms.

2.1.10. All relevant information relating to a system or product shall be contained within one binder.

2.1.11. The manual sections shall follow the specification sections.

2.1.12. Any diagrams, installation drawings, flow charts, etc. shall be mechanically reduced while maintaining full legibility to standard page size. If this cannot be achieved they shall be carefully folded and contained within a clear plastic wallet within the manual.

2.2. DATA FOR MANUALS

2.2.1. Equipment data shall contain:

.1 Operating instructions

.2 Operating conditions such as temperature and pressure

.3 Location of equipment

.4 Maintenance instructions and schedules for one year routine

.5 Recommended list of spare parts

.6 Lubrication schedule

.7 A trouble shooting table showing where to look for problems under various conditions of malfunction

.8 All wiring diagrams

.9 Equipment operating curves

.10 Equipment nameplate data and serial numbers

2.2.2. System data shall contain:

.1 A listing of all systems

.2 A valve schedule and locations

.3 Equipment name tags

.4 Filter schedule

.5 An electric pipe tracing schedule including location and electrical service location

.6 Cleaning, maintaining and preserving instructions for all material, products and surfaces. Include warnings of harmful cleaning, maintaining and preserving practices.

2.2.3. Sub-Contractor manuals are required for:

.1 BAS

.2 Water treatment

.3 Water and air balancing

2.2.4. As-built documentation shall contain:

.1 Reviewed As-Built Shop Drawings

.2 As-Built Construction Drawings

.3 Originals of Test Forms

.4 Originals of Test Certificates

2.3. OPERATING INSTRUCTIONS

2.3.1. Instruct the Owner's representative in all aspects of the operation and maintenance of systems and equipment.

2.3.2. Comply with all requirements of Section 20 08 00.00 - COMMISSIONING, for duration of tests.

2.3.3. Instruct the Owner for a minimum of three (3) working days.

2.3.4. Arrange for and pay for the services of engineers and other manufacturers' representatives required for instruction on the systems and the equipment as requested by the Engineer's Representative and/or the Owner.

2.3.5. At the time of final review, provide a sheet for each system and piece of equipment showing the date instructions were given. Each sheet shall show the duration of instruction, name of persons receiving instruction, other persons present (manufacturer's representative, Engineer's Representative, etc.), system or equipment involved and signature of the Owner's staff stating that they understood the system installation, operating and maintenance requirements. This information shall be inserted in the manuals after all instructions have been completed.

2.3.6. Review information with the Owner's representative to ensure that all information required has been provided.

2.3.7. Mechanical equipment and systems included in the instruction requirements are:

.1 Heating water generators and associated equipment

.2 Automatic controls and instrumentation

.3 Water treatment and cleaning

.4 Life safety and fire protection

.5 Noise and vibration

.6 Air handling distribution and components

.7 Miscellaneous ventilation systems

.8 Storm, sanitary and domestic water pumping and distribution system

2.4. TRIAL USAGE

2.4.1. The Owner shall be permitted trial usage of systems or parts of systems for the purpose of testing and learning operational procedures. Trial usage shall not affect the warranties nor be construed as acceptance, and no claim for damage shall be made against the Owner for any injury or breakage to any part or parts due to the tests, where such injuries or breakage are caused by a weakness or inadequacy of parts, or by defective materials or workmanship of any kind.

3. Execution

3.1. NOT USED

END OF SECTION

21 25 00.00 Portable Fire Extinguishers

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

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

2. Products

2.1. MATERIALS

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

2.1.2. Provide 6A80BC rating, 4.53 kg (10 lbs.) multi-purpose dry chemical powder type and ULC labelled in Mechanical and Electrical Rooms.

2.1.3. Provide 1-A:K rating, 6 L (1.59 USgal.) wet chemical type, stainless steel, and ULC labelled in kitchens in addition to general coverage extinguishers.

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

2.1.5. Extinguishers in non-finished areas not accessible to the general public shall be mounted on wall brackets.

2.1.6. Portable fire extinguisher cabinets in finished kitchen areas shall be recessed type with 12mm (1/2 in.) return frame, 1.19 mm (0.0478 in. - 18 M.S.G.) thick steel tub with enamel interior and maximum inside dimensions of 254 mm x 762 mm x 203 mm (10 in. x 30 in. x 8 in.) deep. Front shall be adjustable, 2 mm (0.0747 in. - 14 M.S.G.) thick steel door. Glass shall be 5mm (3/16 in.) clear. Hinge shall be full length semi-concealed piano type. Door latch shall be flush stainless steel type with no visible mounting screws. All exterior metal shall be prime coated with the exception of the door latch. National Fire Equipment Model CE-950-2.

2.1.7. Portable fire extinguisher cabinets in all other finished areas shall be recessed type with 6mm (1/4 in.) return frame, 0.76 mm (0.0299 in. - 22 M.S.G.) thick steel tub with enamel interior and maximum inside dimensions of 229 mm x 610 mm x 152 mm (9 in. x 24 in. x 6 in.) deep. Front shall be adjustable, 1.57 mm (0.0618 in. - 16 M.S.G.) thick steel door. Glass shall be 5mm (3/16 in.) clear. Hinge shall be full length semi-concealed piano type. Door latch shall be flush stainless steel type with no visible mounting screws. All exterior metal shall be prime coated with the exception of the door latch. National Fire Equipment Model CE-950-3.

2.1.8. Extinguishers in non-finished areas accessible to the general public shall be surface mounted type with 1.19 mm (0.0478 in. - 18 M.S.G.) thick steel tub with enamel interior and maximum inside dimensions of 266 mm x 610 mm x 159 mm (10.5 in. x 24 in. x 6.25 in.) deep with cylinder locked door and breakable plexi-glass. All cabinets shall be keyed alike. National Fire Equipment Model ECS-999.

3. Execution

3.1. INSTALLATION

3.1.1. Spacing of extinguishers shall conform to the Authority Having Jurisdiction. Maximum spacing for Class B fires in ordinary hazard occupancies shall be 9 m (30 ft.) for 10 BC extinguisher and 15 m (50 ft.) for 20 BC extinguishers, but in no case shall there be less than one extinguisher in each electrical room, kitchen or mechanical room. Maximum spacing for Type A extinguishers in Class A fires shall be 25 m (75 ft.).

END OF SECTION

22 05 76.00 Cleanouts

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

2.2. FINISHED AREAS

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

2.2.2. Cleanouts with recess for terrazzo shall be similar to cleanouts in finished areas with membrane floors but shall have terrazzo recess. J.R. Smith 4180-F-C, Zurn ZN 1400-Z-KC, Mifab C1100C-UR-1-34, Watts CO-100-C-R-1-34G.

2.2.3. Cleanouts with recess for tile shall be similar to cleanouts in finished areas with membrane floors but shall have 3 mm (1/8 in.) tile recess. J.R. Smith 4140-F-C, Zurn ZN 1400-X-KC, Mifab C1100C-UR-1-34, Watts CO-100-C-R-1-34G.

2.2.4. Cleanouts for carpeted areas shall be similar to cleanouts in finished areas but shall have stamped stainless steel carpet marker. J.R. Smith 4020-Y, Zurn ZN 1400-CM, Mifab C1100-RC-1-34, Watts CO-100-C-R-1-34G.

2.3. NON-FINISHED AREAS

2.3.1. Cleanouts in non-finished areas shall be all coated cast iron body with heavy duty cast iron or ductile iron top. J.R. Smith 4220-F-C, Zurn Z-1400-KC, Mifab C1100-XR-4-34, Watts CO-100-C-R-1-34G.

2.3.2. Cleanouts at the base of each vertical stack and rain water leader shall be either Daisy or Barrett type.

3. Execution

3.1. INSTALLATION

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

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

END OF SECTION

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

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

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

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

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

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

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

.3 Grooved end copper fittings conforming to ASTM B75/B75M-11.

.4 Couplings to be designed with angle bolt pads to provide a rigid joint.

.1 Installation ready for direct stab installation without field disassembly, complete with grade EHP gasket, rated for -35 deg. C. to 121 deg. C. (-30 deg. F. to 250 deg. F. Victaulic 607.

.2 Copper tubing standard coupling complete with EPDM flush seal gaskets rated for -35 deg. C. to 110 deg. C. (-30 deg. F. to 230 deg. F.) Victaulic 606.

.5 Butterfly valves, bubble-tight service up to 2065 kPa (300 psi) with bronze body Victaulic 608.

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

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

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

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

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

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

.12 Hose bibs shall be for 860 kPa (125 psi) non-shock, bronze body with composition disc and 19 mm (3/4 in.) garden hose thread, complete with a ULC vacuum breaker.

2.1.4. All city and domestic water above ground 100 mm (4 in.) and larger, less than 1380 kPa (200 psi) working pressure.

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

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

.3 Grooved end copper fittings conforming to ASTM B75.

.4 Couplings to be designed with angle bolt pads to provide a rigid joint.

.1 Installation ready for direct stab installation without field disassembly, complete with grade EHP gasket, rated for -35 deg. C. to 121 deg. C. (-30 deg. F. to 250 deg. F. Victaulic 607.

.2 Copper tubing standard coupling complete with EPDM flush seal gaskets rated for -35 deg. C. to 110 deg. C. (-30 deg. F. to 230 deg. F.) Victaulic 606.

.5 Butterfly valves, bubble-tight service up to 2065 kPa (300 psi), with bronze body. Victaulic 608.

.6 Joint shall be Victaulic where exposed and screwed or flanged where concealed.

.7 Stainless steel pipe may be used as an alternative material on sizes 100 mm (4 in.) and over if acceptable to Local Authorities.

.8 Gate valves, 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with ANSI/AWWA C550 coated iron body, lead free bronze mounted, outside screw and yoke, and flanged ends.

.9 Globe valves, 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock ANSI/AWWA C550 coated iron body, lead free bronze mounted, outside screw and yoke, flanged ends and composition disc for water service.

.10 Check valves 860 kPa (125 psi) WSP or 1380 kPa (200 psi) non-shock WOG with ANSI/AWWA C550 coated iron body, lead free bronze mounted, swing check, flanged ends.

.11 Non-slam check valves downstream from pumps, 1032 kPa (150 psi) pressure rating, dual flapper design with 316 stainless steel body and stainless steel check, renewable disc and resilient seat for flanged installation. Non-slam check valves shall be Velan-ProQuip Model DDD11-1D1, Duo CHEK II H15CMF3-14, or Mueller Sure Check #72-HHH-3-H.

.12 Strainers shall be flanged ANSI/AWWA C550 coated cast iron Y body equal to Colton Industries Model 125YFI or Mueller #758.

.13 Drain valves and blow-off valves shall be 4137 kPa (600 psi) WG 19 mm (3/4 in.) ball valves with lead free, bronze or forged brass body, solid ball, virgin Teflon seat and packing, male threaded hose end, brass cap and chain equal to Watts B-6000, Toyo 5046, Kitz 58CC or Apollo 78-100.

2.1.5. All city and domestic water underground 50 mm (2 in.) and smaller:

.1 Soft copper Type K conforming to ASTM B88-83.

.2 Minimum number of joints brazed using BCuP-3 alloy with 5% silver, 89% copper, and 6% phosphorus.

.3 Gate valves, bronze body, non-rising stem, extension sleeve and box to grade, to local authorities approval.

2.1.6. All city and domestic water underground 65 mm (2-1/2 in.) and larger:

.1 Copper pipes Type L with wrought or cast couplings and fittings conforming to ASTM B88-83 etc.

.2 Joints brazed using BCuP-3 alloy with 5% silver, 89% copper, and 6% phosphorus.

.3 Alternate for underground pipe; cast or ductile iron coated to AWWA.

.4 Gate valves, AWWA iron body, non-rising stem, extension sleeve and box to grade, to local authorities approval.

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

2.1.8. Vent stack covers:

.1 1100-0T alloy aluminum with vandal proof removable cap

.2 EPDM base seal

.3 PVC coated deck flange or bituminous deck flange as required to suit roof membrane

.4 Insulated for inverted steel roof construction with insulation on top of deck

.5 Uninsulated for concrete roof construction

.6 Unisulated: Thaler Metal Industries SJ-24/SJ-25

.7 Insulated: Thaler Metal Industries SJ-26/SJ-27

2.1.9. Underground storm and sanitary inside the building shall be SDR 28 rigid for 100mm (4 in.) to 150mm (6 in.), SDR 35 for 200mm (8 in.) and larger, green PVC gasketed hub and spigot pattern sewer pipe and injection molded and fabricated gasketed fittings to meet the requirements of CAN/CSA B182.2 with assembled with PVC pipe lubricant.

2.1.10. Sump and sewage pump discharge shall be Type “L” copper, brazed.

2.1.11. Butterfly valves may be used in lieu of gate valves in size 65 mm (2-1/2 in.) and over in systems 1380 kPa (200 psi) and less. Where specifically shown on drawings, butterfly valves must be used. Install between 860 kPa (125 psi) flanges.

.1 Valves shall have NSF/AWWA coated iron body, one piece or split alloy steel shaft, top and bottom bearings, lead free bronze disc or coated iron disc with stainless steel trim and resilient elastomer replaceable seat with integral reinforcing ring or keyed to body.

.2 Body shall have threaded lugs.

.3 Valve shall have bubble tight shut-off to 1035 kPa (150 psi) pressure in either direction when the piping and connecting flange is removed from one side of the valve.

.4 Valves 100 mm (4 in.) and smaller shall have lever operator with lock.

.5 Valves larger than 100 mm (4 in.) shall have worm gear manual operator with indication of valve opening.

.6 Butterfly valves for grooved end systems shall be Victaulic 608.

2.1.12. Backflow preventers:

.1 Reduced pressure zone assemblies to prevent the reverse flow of polluted water from entering into the potable water supply due to backsiphonage and or backpressure

.2 Lead Free bronze body construction (1/4 to 2 in.)

.3 Lead Free epoxy coated ductile or cast iron (2 1/2 to 10 in.),

.4 Two, in-line independent check valves, replaceable check seats with an intermediate relief valve, and ball valve test cocks.

.5 Maximum Working Pressure: 1207 kPa (175psi)

.6 BEECO FRP, Zurn-Wilkins 975XL2/375A or Watts LF009/LF909 Series

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

2.1.14. Except where special feature are required or unless otherwise approved or noted, all valves shall be of one manufacturer with the manufacturer's name and the pressure rating clearly marked on the outside of the valve body.

2.1.15. Backwater valves for services larger than 100mm (4 in.) shall be by J.R. Smith. Valves shall be complete with cast iron body and bolted cover, plain end inlet and outlet, bronze flap and bronze valve seat. Valve shall be normally open.

.1 Unit up to 300 mm (12 in.) underground, shall be complete with access cover at grade and extension sleeve between cover and valve casing.

.2 Unit more than 300 mm (12 in.) underground, shall be complete with minimum 600 mm (24 in.) dia. galvanized steel, concrete or vitrified clay tile access pit with 600 mm (12 in.) dia. heavy duty scoriated manhole cover and frame.

2.1.16. Provide extendable backwater valve complete PVC extendable valve body and normally open cassette for services 100mm (4 in.) and smaller. Extend to grade with PVC DWV pipe and provide 19mm (3/4 in.) cassette pipe extension to grade for cassette retreival. Provide cleanout access suitable for floor finish in accordance with Section 22 05 76.00 - Cleanouts. Backwater Valve shall be Mainline Adapt-A-Valve Model ML-#XP to suit size of drain.

2.1.17. Water hammer arresters shall be stainless steel bellows type and shall bear the Plumbing and Drainage Institute seal of approval. JR Smith 5000 Series, Zurn Z-1700, Mifab WHB, Watts SS Series. Piston type are not permitted.

2.1.18. Thermostatic mixing valves

.1 Thermostatic mixing valves shall be Lawler Series High-Low Water Mixer 804 combination thermostatic and pressure balanced water controller, 38mm (1-1/2 in.) inlet and 50 mm (2 in.) outlet, liquid filled motor. The valve shall maintain output temperature for changes in inlet pressure and temperature. Valve construction shall be bronze body and stainless steel piston and liner. Mixing valve shall include a union end stop and check valve with removable strainer on each inlet. Complete with 0 - 200 deg. F. dial thermometer and shut off valve on tempered water outlet.

2.2. FLUSHING AND DISINFECTING:

2.2.1. Chlorine:

.1 Sodium hypochlorite to ANSI/AWWA B-300.

3. Execution

3.1. INSTALLATION

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

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

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

3.1.4. Blow-off valves shall be provided on each 65 mm (2-1/2 in.) strainer and larger.

3.1.5. Globe valves shall be installed as shown and in each bypass.

3.1.6. Install reduced pressure backflow preventers where recommended by CSA B64 and in the following locations:

.1 RO and other systems not used as potable water

.2 Upstream of all trap seal primer assemblies unless the trap seal primer assembly includes a 1" air gap, or other device suitable for Severe Hazard sources

.3 Where shown on the Drawings

.4 As requested by the Authority Having Jurisdiction

3.1.7. Check valves shall be installed as shown and where required to prevent backflow.

3.1.8. Underground piping shall be of a class and type and laid in a bedding as noted and/or as recommended by the manufacturer and any Authority Having Jurisdiction. Class of pipe and bedding shall take into consideration location, size of pipe, type, width and depth of trench and type of soil.

.1 Bedding types shall be Class A or Class B as detailed. Standard Drawings for concrete, vitrified clay or asbestos cement pipes or the manufacturer’s equivalent with minimum load bearing factors of 2.8 and 1.9 respectively.

3.1.9. The following publications shall be used to establish class of bedding and class of piping for installation other than the above. They shall also serve as guide for preparation of bedding, installation and testing.

.1 Installation manual of the Ontario Concrete Pipe Association.

.2 Design data of the American Concrete Pipe Association as distributed by the Ontario Concrete Pipe Association.

.3 Cast iron soil pipe and fittings handbook of the cast iron soil pipe institute.

.4 Sewer pipe manual of Canron.

.5 Sewer Design & Construction of the Water Pollution Control Federation.

.6 The Blue Brute and Ring Tite PVC gravity sewer pipe installation Guide by Manville.

3.1.10. Pipe passing under a driveway or parking lot with less than 1.5 m (5 ft.) of cover shall be encased in 150 mm (6 in.) of 13800 kPa (2000 psi) concrete on top, bottom and sides.

3.1.11. Provide thrust blocks of 20 mPa (3000 psi) concrete at each tee, elbow, valve and other fitting where thrust forces could occur. Thrust blocks shall be sized to suit the local authorities requirements, but in no case be smaller than 150 mm (6 in.) greater on all sides than the pipe served.

3.1.12. PC4 jointing material shall not be used on underground piping. PC4 or similar jointing material shall be used for caulking waste pipes from sinks or dishwashers and other waste pipes carrying hot discharge liquids.

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

3.1.14. All piping shall run parallel with closest wall.

3.1.15. Piping in walk-in pipe spaces shall be installed as close to one wall as possible.

3.1.16. Each water hammer arrester shall be accessible for service and replacement. They shall be installed in compliance with the recommendations of the Plumbing and Drainage Institute as found in Standard PDI-WH201. The water pressure at fixture level on the first floor is 550 kPa (80 psig).

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

3.1.18. Vent stack covers shall be properly sized for each vent penetrating the roof. Division 23 shall supply vent stack covers for installation and flashing by the roofing contractor.

3.1.19. Provide an isolation valve downstream of all flow balancing valves on the domestic water distribution.

3.1.20. Provide a thermostatic mixing valve on discharge of domestic hot water systems.

3.2. FLUSHING AND DISINFECTING

3.2.1. Flush and disinfect all new or reworked domestic water piping, ensure water flows through all fixtures, hose outlets, service connections and/or any other potable water outlet. Remove sediment from aerators as required.

3.2.2. Provide circulating pumps, connections and valves as required for complete flushing and disinfection of the system.

3.2.3. When flushing is complete, disinfect the piping with a solution of chlorine in accordance with ANSI/AWWA C601.

3.2.4. Test water samples from disinfected water system at a certified laboratory for purity and conformance with governing standards.

.1 Submit a copy of the test results prior to building occupancy.

END OF SECTION

22 11 23.29 Circulators

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

2.1.1. Circulators shall be Armstrong, Grundfos-Paco, Xylem Bell & Gossett, FloFab, Patterson Pump Company, or Taco Industries in the line type with flanged inlet and outlet, mechanical seal and suitable for 125 psig working pressure.

2.1.2. For domestic water systems (potable) pump body shall be lead free bronze or stainless steel with impeller meeting the low lead requirements of NSF/ANSI 372 for all wetted parts.

2.1.3. For all systems except domestic water pump shall be cast iron, steel impeller and stainless steel shaft.

2.1.4. Pump capacity shall be as shown in the Pump Schedule.

3. Execution

3.1. INSTALLATION

3.1.1. Support pump as shown on Standard Details.

END OF SECTION

22 13 19.13 Floor Drains

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

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

2.2. FINISHED AREAS

2.2.1. Floor drains in finished areas and stainless steel top shall be all coated cast iron body, flashing clamp with seepage openings and adjustable 127 mm (5") diameter stainless steel heavy duty strainer with No. 4 satin finish, secured with S.S. screws, 100 mm (4") throat on strainer. Drain shall be complete with trap primer connection. J.R. Smith 2005-A05SS-P050, Zurn ZXSS-415-5A, Mifab F1000C-5-3, Watts FD-1100-C-5-3.

2.2.2. Floor drains in quarry or mosaic tiled areas and stainless steel top shall be similar to floor drains in finished areas but with 127 mm x 127 mm (5" x 5") square stainless steel strainer with No. 4 satin finish. J.R. Smith 2005-B05SS-P050, Zurn ZS-415-Y5, Mifab F1000C-S5-3, Watts FD-1100- C-L5-3.

2.2.3. Funnel floor drains in finished areas shall be similar to floor drains in finished areas but with minimum nominal 127 mm (5") dia. strainer, full opening for funnel and nominal 75 mm x 225 mm (3 in. x 9 in.) oval funnel. J.R. Smith 2005-A05-NB-3591-OT-P050, Zurn ZN-415-BF, Mifab F1100C-EG-1, Watts FD-100-C-EG-1.

2.2.4. Floor drains in Safety Sheet Vinyl Flooring Areas shall be similar to floor drains in finished areas but with 2 piece flashing clamp collar. JR Smith 2051, Zurn ZN-415-R9, Mifab F1100C-FC9-1, Watts FD-100-C-FC9-1.

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

2.3. NON-FINISHED AREAS

2.3.1. Floor drains in non-finished areas shall be coated cast iron body, drainage flange, adjustable nominal 200 mm (8 in.) dia. heavy-duty strainer. Drain shall be complete with trap primer connection. J.R. Smith 2110, Zurn Z-536-8, Mifab F1320C-4, Watts FD320-4.

2.3.2. Funnel floor drains in non-finished area shall be similar to floor drains in non-finished areas but with nominal 75 mm x 225 mm (3 in. x 9 in.) oval funnel. J.R. Smith 2110-3591, Zurn Z-536-8-FO, Mifab 1320C-4-G-50, Watts FD320-4-G-50.

2.3.3. Pressure activated automatic trap seal primer serving 1 or 2 drains shall have 12 mm (1/2 in.) connections and shall have integral CSA B64 backflow prevention to the requirements of the Authority Having Jurisdiction. Provide manufacturer recommended distribution unit for trap primers serving more than one drain. Mifab M-500 series, Zurn 1022 series or PPP PR-500 series.

2.3.4. Electronic automatic trap seal primer system shall have 12 mm (1/2 in.) connection be complete with integral ball valve, CSA B64 backflow prevention to the requirements of the Authority Having Jurisdiction. The unit shall be pre-piped with a copper manifold and distribution system suitable for the number of drains served. Electrical components to require a single point power connection at 120V. Unit shall include a manual override switch and 24 hour timer with relay and adjustable delay. All components shall be factory assembled and installed into a coated steel box with access door for recessed mounted installation. Mifab MI 100-UA series, Zurn Z1020 series or PPP PT or MPB-500 series.

3. Execution

3.1. INSTALLATION

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

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

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

.3 It is permitted to use pressure activated trap seal primers for remotely located drains, no less than 30m (98 ft) from an adjacent trap primer assembly, provided that the manufacturer recommended pressure fluctuation is sufficient to activate the device.

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

3.1.2. Provide a backwater valve in accordance with Section 22 11 13 - Pipes, Valves and Fittings (Plumbing System) on floor drains within walk-in coolers before connecting to sanitary drainage system.

END OF SECTION

22 13 19.26 Interceptors

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

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

2.2. STANDARD GREASE INTERCEPTOR (STAINLESS STEEL)

2.2.1. Grease interceptors shall be fabricated entirely of stainless steel construction. Interceptor shall be at minimum rated for a 95 lpm (25 USGPM) flow rate and a 23 kg (50 lb) grease holding capacity unless shown otherwise. Interceptor extensions shall be provided as required to suit invert of drains.

2.2.2. Unit shall include: removable baffle assembly and cross bar, deep seal trap, cleanout, securing bolt(s) or lock and lift ring(s), internal flow control fitting, internal air relief bypass and stainless steel non skid, rectangular gasketed lid(s). Mifab MI-G-SS Series, J.R. Smith 8000E-SS Series, Zurn ZS-1170 Series, Watts GI-100-SS.

3. Execution

3.1. INSTALLATION

3.1.1. Provide auxiliary flow control for interceptors installed with a head of more than 1500mm (5ft).

END OF SECTION

22 14 26.13 Roof Drains

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

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

2.1.2. Roof drains in metal decks or poured concrete roofs shall be coated cast iron body, large sump, wide non-crimping flange, vandal proof aluminum or ductile iron mushroom dome strainer, extension frame to suit thickness of insulation, sump receiver, under-deck clamps and flashing clamp with integral gravel stop. J.R. Smith 1010-AD-E-R-C-U, Zurn ZA-100-E-C-R-VP, Mifab R1200-6-M-B-U-V, Watts RD-100-B-D-K80-L-V.

2.1.3. Roof drains for flooded roofs shall be as specified above but shall be complete with flooding dam to provide approximately 50 mm (2 in.) depth of flooding.

2.1.4. Roof drains in I.R.M.A. or upside-down roofs shall be similar to drains specified above but with cast extensions to suit full depth of gravel and/or pavers and insulation and cast slotted surround for full depth of gravel and insulation for all openings larger than 12 mm (1/2 in.). J.R. Smith 1012-AD-LR-C-U, Zurn ZA-100-SE-C-R-VP, Mifab R1200-HC-6-M-B-U-V, Watts RD-100-CH-B-D-K80-L-V.

2.1.5. Provide screens as required to prevent gravel from entering the drain pipes.

2.1.6. Expansion compensators shall be J.R. Smith 1710, Zurn Z-190, Mifab R1900, Watts RD-900.

3. Execution

3.1. INSTALLATION

3.1.1. Roof drains connected to vertical rain water leaders with less than 1200 mm (4 ft.) of horizontal offset shall be complete with expansion compensators.

3.1.2. Turn drain bodies over to roofing and waterproofing trades on site for priming and setting into bearing pads of waterproofing materials.

END OF SECTION

22 34 36.23 Domestic Gas Fired Hot Water Heater

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

2.1.1. Storage tank with forced draft propane gas fired heater shall be equal to P.V.I. Industries.

2.1.2. Heater section shall be pure copper combustion chamber and tubes.

2.1.3. Heater section shall be complete with the following items:

.1 Burner for 83% efficiency

.2 Solid state flame safeguard

.3 Thermal expansion control valve

.4 Upper and lower operating thermostats

.5 Temperature high limit control

.6 ASME temperature and pressure relief valve

.7 Drain valve

.8 Manway

.9 Heavy insulated jacket

.10 Prefinished outer casing

.11 Minimum 125 psi working pressure

.12 Power blower to operate on 120 volts

.13 38mm [1-1/2 in.] inlet and outlet

.14 Thermometer

.15 Low water cut-off

.16 Damper

.17 Burner assembly complete with all regulating devices and suitable for 1.74 to 3.48 kPa [7 to 14 in.W.C.] incoming propane gas pressure

.18 Gas reliefs piped to roof

2.1.4. Each heater shall be as shown in the Domestic Hot Water Heater Schedule.

3. Execution

3.1. INSTALLATION

3.1.1. All connecting piping shall be installed to allow removal of heater after disconnecting flanged pipe connections.

END OF SECTION

22 38 13.19 Kitchen Equipment

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Kitchen equipment supply and installation - under the Architectural Kitchen Equipment Section.

2. Products

2.1. MATERIALS

2.1.1. All exposed pipes and fittings shall be chrome plated brass.

3. Execution

3.1. INSTALLATION

3.1.1. Rough-in and connect to all kitchen equipment.

3.1.2. Co-ordinate with the kitchen equipment supplier to fix the location of all roughing in, pipe sizes and pipe runs, including plumbing vents. Holes in floor for roughing in shall be drilled through rough floor prior to finished floor being laid. Sleeves shall be set in these holes and tightly sealed.

3.1.3. Co-ordinate propane gas pressure requirements for all equipment with the kitchen equipment supplier. Propane gas is supplied to the kitchen at 7 - 11 inch W.G. This Division shall provide the necessary pressure reducing valve and appurtenances to ensure any piece of kitchen equipment that requires a lower natural gas pressure operates properly with the correct pressure. Submit letter to the kitchen equipment supplier (copied to the Engineer's Representative) confirming that this coordination has taken place.

3.1.4. Connect ductwork to exhaust hoods and seal watertight.

END OF SECTION

22 42 00.00 Fixtures and Trim

1. General

1.1. WORK INCLUDED

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

1.2. SUBMITTALS

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

2. Products

2.1. MATERIALS

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

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

.1 Part 7 of the Building Code

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

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

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

2.1.6. Provide Fixtures and Trim equal to product specification sheets

2.2. WATER CLOSETS AND URINALS

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

2.2.2. All flush valves shall have non-syphon by-pass and factory set rate of flow.

2.2.3. Water closets shown as type ‘W-1 – Floor mounted pressure-assist tank’ shall be a “Pressure-Assist Low Consumption” tank toilet, floor mounted, vitreous china, elongated siphon jet flush action bowl, fully glazed 50 mm (2 in.) internal trapway, 250 mm x 300 mm (10 in. x12 in.) large water surface, “Speed Connect” P.A. tank complete, 6 L (1.6 gal.) flush, with cast sanitary guard on bowl for china to china tank assembly, and bolt caps. Provide floor flange, flange bolts and gasket. American Standard Cadet Elongated 2333.100, Crane Economizer 3835, Eljer Aqua-Saver 091-7025, Kohler Wellworth Pressure-Assist K-3458.

.1 Seat for W unit above shall be elongated heavy-duty solid plastic toilet seat, less cover, with stainless steel check hinge and stainless steel posts, washers, and nuts. Bemis 1955-C, Centoco #500STSCC, Kohler Lustra K-4670-C, Olsonite 10CCSS.

.2 Supplies for W unit above shall be chrome plated, heavy pattern angle lavatory supplies, lockshield, screw driver slot, stuffing box cartridge, 3/8 in. IPS brass inlet supply nipple, flexible riser tubes, and stainless steel wall flange. Delta Commercial 47T1316SD, McGuire H166 LKN3.

2.2.4. Water closets shown as type 'W-2 – Floor mounted pressure-assist (Barrier free design)' shall be a "Low Consumption" tank toilet, floor mounted, vitreous china, elongated siphon jet flush action bowl, fully glazed 50 mm (2 in.) internal trapway, 250 mm x 300 mm (10 in. x 12 in.) large water surface, "Speed Connect" P.A. tank complete, 6 L (1.6 gal.) flush, with cast sanitary guard on bowl for china to china tank assembly, and bolt caps. Provide floor flange, flange bolts and gasket. American Standard Cadet Elongated 2333.100, Crane Economizer 3838, Eljer Aqua-Saver 091-7045, Kohler Highline Pressure Lite K-3544.

.1 Seat for W unit above shall be elongated heavy-duty solid plastic toilet seat, open front with cover, with stainless steel check hinge and stainless steel posts, washers, and nuts. Bemis 1950SS, Centoco 820STS, Kohler Lustra K-4650-EB, Olsonite 46SS.

.2 Supplies for W unit above shall be chrome plated, heavy pattern angle lavatory supplies, lockshield, screw driver slot, stuffing box cartridge, 3/8 in. IPS brass inlet supply nipple, flexible riser tubes, and stainless steel wall flange. Delta Commercial 47T1316SD, McGuire H166 LKN3, Zurn Z-8820-CR-LK-3.

2.3. LAVATORIES

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

.1 Faucet for lavatory unit above shall be 100 mm (4 in.) centreset, solid cast brass body with integral proximity sensor, with vandal-resistant 0.5 GPM (1.9 L) flow spray outlet, control module, solenoid, strainer, circuitry, tempered water supplied by mixing valve with back checks and stops housed in 250 mm (10 in.) Sq. recessed metal box with 300 mm (12 in.) Sq. V.P. face, located in wall under basin. Flexible conduit from control module to faucet and solenoid to be provided. Each unit shall be supplied with a 120/24 VAC 50VA Transformer (15VA power required for each unit). Delta Commercial 591T0258TR and ELAVT0008ARI and RP32508 transformer, Kohler K-13463/K-13478-A-CP escutcheon with K-13480-NA power supply, Sloan ETF-600-A-VPB-MIX60-A with EL-154 transformer or Zurn Z-6915-XL-CWB-F-MV-SH22-ALBOX with P6000-HW6 Power converter.

2.3.2. Drain for all lavatory units with concealed under counter installation shall be 32 mm (1¼ in.) size, polished chrome plated inline open grid and cast brass lavatory waste strainer, 17 gauge straight tubular tailpiece. Delta Commercial 33T260, Kohler K-7129-A, McGuire 155A, Zurn Z-8743-PC.

2.3.3. "P" trap for all lavatory units shall be polished chrome plated cast brass, adjustable body 32 mm (1¼ in.) size with cleanout plug, 17 gauge tubular wall bend. Safety covers are to be supplied as per local codes for exposed under counter installation. Delta Commercial 33T311, McGuire 8872C, Zurn Z-8700-D-PC, Kohler K8998.

2.3.4. Supplies for all lavatory units shall be a pair of chrome plated, heavy pattern angle lavatory supplies, lockshield, screw driver slot, stuffing box cartridge, 3/8 in. IPS brass inlet supply nipple, flexible braided stainless steel risers, and stainless steel wall flange. Delta Commercial 47T2512SD, McGuire H165LKN3RB, Zurn ZH-8820-LR-LK-PC-3.

2.4. GENERAL SINK UNITS

2.4.1. Sinks shown as 'CS-1 - Two Compartment Stainless Steel Sink (General use)' shall be stainless steel three hole bar sink, 200 mm (8 in.) centers, 520 mm x 780 mm x 203 mm (20½ in. x 31 in. x 8 in.) deep, counter mounted, back ledge, grade 18-8 type 302 stainless steel, double compartment, mirror finished rim, satin finished bowl with spillway, self-rimming with crumb cup strainers, and sound deadening. Aristaline LBD6408-1, Kindred QSL-2031-8, Kohler K-3369 with K-8813 sink strainer, Architectural Metal Industries 2009-B-I or Novanni 2007EI.

.1 Faucets for sink unit above shall be 200 mm (8 in.) centre, single control, brass body deckmount faucet, polished chrome plated finish, stainless steel rotating ball mechanism or ceramic disk cartridge, brass spout and trim, 200 mm (8 in.) swing spout, and 2.1 GPM (7.9 L) vandal resistant flow aerator and vandal resistant 150 mm (6 in.) handle. American Standard 2021.600.002, Delta Commercial 100LF-HDF, Kohler K-15171-F, Zurn Z-82300-XL-CP8-2M.

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

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

2.5. SHOWERS

.1 Shower valves for alcove shown as 'SH-1' shall be concealed in-wall, single lever pressure balancing control, polished chrome plated finish metal trim, integral stops and checks, 57 mm (2¼ in.) vandal resistant metal lever handle with shower unit only, brass adjustable spray shower head arm & flange, and flow of shower head not to exceed 1.5 GPM (5.7 L). American Standard 2000.501.002, Delta Commercial R10000-UNWS with T13H123, Kohler Coralais K-TS15611-4/K-8304-KS pressure-balancing valve with stops, Powers P902G-K1-0-0-0-0.Provide DreamLine QWALL-5 Shower Base and Backwalls with Threshold SlimLine Base. Size: 850 mm deep x 1,500 mm wide x 1,919 mm high [34in. deep x 60in. wide x 76-3/4in. high]. Drain Location: Right. Colour: White

3. Execution

3.1. INSTALLATION

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

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

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

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

END OF SECTION

22 42 46.00 Fixture Carriers

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

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

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

2.1.3. All fixture carriers with integral cast iron fittings shall be certified to CSA B70 as required by Authority Having Jurisdiction.

2.2. LAVATORY CARRIERS

2.2.1. Carriers for barrier free wall-hung lavatories shown as ‘L-1’ shall be all coated with rectangular steel uprights, welded block base feet support and extended concealed arms with locking device and levelling screws. J.R. Smith 700-27-M31, Zurn Z-1231-79, Mifab MC-42, Watts CA-411-W.

3. Execution

3.1. INSTALLATION

3.1.1. Rigidly secure all fixture carriers to the floor using approved anchor bolts and inserts.

3.1.2. Verify the finished wall location and type of wall construction and elevation of finished floor before installation of carriers.

END OF SECTION

22 42 49.00 Hydrants (Plumbing Systems)

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

2.1.1. Hydrants shall be J. R. Smith, Zurn, Mifab, or Watts, equal to the following series.

2.1.2. Wall hydrants shall be non-freeze, key operated with 19 mm (3/4 in.) hose connection, removable nylon or bronze seat, 19 mm (3/4 in.) ground joint union inlet, brass operating parts and nickel bronze access box with polished cover. Length of wall sleeve shall suit location. J.R. Smith 5509QTNB, Zurn Z-1300, Mifab MHY-20, Watts HY-725.

2.1.3. All hydrants shall be complete with vandal proof vacuum breaker, if backflow preventer is not provided.

3. Execution

3.1. NOT USED

END OF SECTION

22 67 19.00 Domestic Water Treatment

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. PRODUCTS

2.2. COMPLETE WATER TREATMENT SYSTEM

2.2.1. Supply and install a complete water system to produce a minimum of 756 L per day (200 US gallon per day). The system and all components shall be designed and manufactured by Culligan or BioLab.

2.2.2. The water quality shall meet or exceed the following water standards:

.1 College of American Pathologists: CAP Type I, II, III

.2 National Committee for Clinical Laboratory Standards: NCCLS Type I, II, III

.3 American Society for Testing Materials: Type I, II, III, IV

.4 United States Pharmacopoeial USP Version (most current version)

.5 Reduce the dissolved mineral content of the water by 98% overall.

.6 CSA Z314.0 Annex E or AAMI TIR34 for medical device reprocessing units.

2.2.3. The system shall consist of, but not be limited to, one or more of the following components as required to meet the specified water flow rates and water quality.

.1 Mixed media/carbon filter package

.2 Water softener package

.3 Reverse osmosis package

.4 Storage tanks

.5 Ultra violet sterilizer units

2.3. MIXED MEDIA/CARBON FILTER PACKAGE

2.3.1. Supply and install, where shown on Drawings or where required for a complete water treatment system, a carbon filter package complete with housing unit, filter media and automatic controls.

2.3.2. The package shall be as manufactured by Culligan or BioLab and shall be suitable for dechlorination and dissolved organic reduction.

2.3.3. The package shall be sized for a flow rate of 15.2 L/min (4 gpm) with a pressure drop less than 6.2 kPa (0.9 psi).

2.3.4. The package shall be sized to meet the requirements for the complete water treatment system described herein.

2.3.5. The tanks shall be 114 mm (4.5 in.) in diameter and 508 mm (20 in.) in height and supported by a steel ring skirt. The tank shall be tested at 1034 kPa (150 psi) for 860 kPa (125 psi) working pressure. It shall be equipped with an opening in the head for filter media filling purposes. The tank shall be constructed of high grade steel with a 20 mil vinyl liner and a molded plastic jacket for corrosion resistance. No steel shall be in contact with the water.

2.3.6. Filter media shall be provided to meet the above filtration requirements.

2.3.7. Filter operation shall be controlled by a motor driven, piston operated automatic control valve to permit three cycles of backwash, downflow rinse and service. The filter tank control shall be equipped with self-adjusting flow control to properly control the backwash and rinse rates. It shall be pressure compensating to prevent mineral loss and restrict waste water discharge when operating in the range of 207 to 690 kPa (30 to 100 psi). The automatic valve shall include a timeclock for initiating backwash on a calender clock basis. It shall be adjustable for any time of the night or day, any day of the week, length of backwash and rinse. Controls shall be capable of manual operation during a power failure.

2.4. WATER SOFTENER PACKAGE

2.4.1. Supply and install, where shown on Drawings or where required for a complete water treatment system, a water softening package complete with duplex resin tanks, distribution system, softening media, brine system and automatic controls.

2.4.2. The package shall be as manufactured by Culligan or BioLab.

2.4.3. The package shall be sized for 56.8 L/min (15 gpm) with a pressure drop of less than 31.7 kPa (4.6 psi) at the above flow rate. The package shall reduce the water hardness to less than 3 mg/L. The package shall have a softening capacity of not less than 60 Kgrains of softening capacity per regeneration when a salt dosage of 8.2 kg (18 lbs) per tank is used.

2.4.4. The package shall be sized to meet the requirements for the complete water treatment system described herein.

2.4.5. Resin tanks shall be 457 mm (18 in.) in diameter. The height shall be sufficient to allow adequate expansion of resin. The tank shall be tested at 1034 kPa (150 psi) for 860 kPa (125 psi) working pressure. The tank shall be constructed of high grade steel with a 20 mil vinyl liner and a molded plastic jacket for corrosion resistance. No steel shall be in contact with the water.

2.4.6. The distribution system shall ensure even distribution of water to ensure maximum water softening capacity.

2.4.7. Provide 0.14 cu.m (5 cu.ft.) of resin per tank having an exchange rate of 31,000 grains per cu.m. (cu.ft.) when regenerated with 6.8 kg (15 lbs) of salt. The resin shall be manufactured to comply with the FDA food additive regulations.

2.4.8. Brine tanks shall be 762 mm (30 in.) in diameter and 1270 mm (50 in.) in height. The tank shall be constructed of corrosion proof, high density polypropylene. The tank shall be equipped with an elevated plate for brine collection and a chamber to house a brine valve assembly. The brine valve shall open and close automatically to regulate flow of soft water to the brine tank. The brine tank control shall work with the timed feature of the softener control valve to admit the correct volume of water to the brine tank. The brine tank shall include a float operated safety shut-off valve as a backup to prevent brine tank overflow.

2.4.9. Softener operation shall be controlled by a motor driven, piston operated automatic brass control valve to permit six positions to accommodate the regeneration steps of backwash, brine draw-slow rinse, fast-rinse, refill and standby in addition to the service position. The control shall be fitted with a fixed orifice educator nozzle and a self adjusting backwash control. The automatic control shall include a meter located on the outside of the water softener. The meter shall be connected to the cycle timer by a cable.

2.4.10. An electrically operated timer shall be provided to control the regeneration and to alternate the tank in service. The timer shall activate a motor drive which shall shift the standby tank to the service position, perform the regeneration functions on the exhausted tank and leave it in the standby position. The timer shall allow individual adjustment for the length of time for each regeneration step.

2.4.11. Provide a test kit with the softener package.

2.5. REVERSE OSMOSIS PACKAGE

2.5.1. Supply and install, where shown on Drawings or where required for a complete water treatment system, a reverse osmosis package complete with prefilter, pump, module and automatic controls.

2.5.2. The package shall be as manufactured by Culligan, BioLab.

2.5.3. The package shall be sized for 756 L/day (200 gal./day). The package shall reduce the dissolved mineral content of the water by 98% overall.

2.5.4. The package shall be sized to meet the requirements for the complete water treatment system described herein.

2.5.5. Provide a 5 micron media prefilter of polypropylene construction to assure proper protection of the reverse osmosis modules.

2.5.6. Provide pressure booster pump and motor assembly securely fastened to the reverse osmosis assembly. Booster pump shall be rotary vane positive displacement pump with a stainless steel shaft and impeller and shall be sized to raise the incoming water to a pressure of 60psi operating pressure.

2.5.7. Pump shall be connected to a 120VAC - 24VAC plug-in type transformer.

2.5.8. The package shall use reverse osmosis elements in a spiral-wound modular configuration. The elements shall be polyamide thin film composite. The quantity of modulates shall be suitable to meet the flow and quality requirements for system with an average permeate flux of less than 20 GFD.

2.5.9. The reverse osmosis package controls shall be fully automatic. A normally closed brass shutoff valve on the inlet to the unit shall open when the unit is operating. A corrosion resistant, relief-type pressure regulator on the waste side of the module assembly shall control operation. The pressure regular to shall be adjustable for different operating pressures. Two liquid filled gauges shall indicate feed and module pressure. A stainless steel throttling valve shall permit adjustment of waste flow. An on/off switch shall start and stop the unit and shall light to indicate when the unit is on. A level control switch, mounted on the storage tank, shall shut down the unit when the level storage tank is full. A STORAGE FULL indicator light shall indicate at the control panel when the storage tank is full.

2.5.10. An elapsed time indicator shall be installed to record module and pump run times.

2.5.11. A low pressure switch shall be installed after the inlet solenoid to protect the pressure pump from cavitating. A LOW PRESSURE indicator light shall be located in the control panel.

2.5.12. Two pre-treatment relays shall be provided to interlock the reverse osmosis system to shut down when pre-treatment systems are regenerating.

2.5.13. An automatic waste water flushing system shall be provided including control valve, timers and controls.

2.6. REVERSE OSMOSIS STORAGE TANKS

2.6.1. Supply and install, where shown on Drawings or where required for a reverse osmosis system, a water storage tank with vent.

2.6.2. The unit shall be as manufactured by Flexcon Industries.

2.6.3. The tank shall be sized for 132.5 L (35 gal.) and shall be 419 mm (16.5 in.) in diameter and 1217 mm (48.9 in.) in height and supported by a steel stand. The tank shall be constructed of polypropylene.

2.7. ULTRA VIOLET STERILIZER PACKAGE

2.7.1. Supply and install, where shown on Drawings or where required for a complete water treatment system, UV sterilizer package on the supply and return of the system.

2.7.2. The package shall be as manufactured by Culligan, BioLab.

2.7.3. The package shall be sized for a flow rate of 75.7 L/min (20 gpm) with a UV dosage of 30,000 microwatts per second per cm5.

2.7.4. The package shall be sized to meet the requirements for the complete water treatment system hereafter identified.

2.7.5. The package shall be self contained with all controls and UV treatment chamber mounted in one package. Non-wetted components including the cabinet housing shall be constructed of 304 stainless steel. Wetted components including the treatment chamber shall be constructed of 316L stainless steel.

2.8. QUALITY MONITORS/QUALITY CONTROLLERS

2.8.1. Supply and install, where shown on Drawings or where required for a complete water treatment system, [quality monitors][quality controllers].

2.8.2. The unit shall be as manufactured by Culligan, BioLab.

2.8.3. Quality monitor shall give direct reading of water quality by long sweep needle indicator. Unit range shall be [0-2 MegOhm][0-20 Meg Ohm]. The unit shall be temperature compensated to have an accuracy of +/- 10% between 4.4 deg. C. (40 deg. F.) and 40.6 deg. C. (105 deg. F.). Unit shall be suitable for table or wall mounting. Unit shall be supplied with 2.4 m (8 ft.) power cord and a 12 mm (1/2 in.) replaceable cell on a 1.8 m (6 ft.) cord.

2.8.4. Quality controller shall give direct reading of water quality by long sweep needle indicator. The unit shall have an adjustable dial for setting the water quality. Unit range shall be 0-0.2 MegOhm][0-20 MegOhm]. The unit shall continuously monitor the water quality and shall indicate that the unit is on and that the water quality is above setpoint with a green indicator light. Should the water quality drop below setpoint the unit shall indicate with a “red” indicator light and contacts for monitoring at the CEMS. The unit shall be temperature compensated to have a accuracy of +/- 2% between 4.4 deg. C. (40 deg. F.) and 40.6 deg. C. (105 deg. F.). Unit shall be suitable for table or wall mounting. Unit shall be supplied with 2.4 m (8 ft.) power cord and a 12 mm (1/2 in.) replaceable cell on a 1.8 m (6 ft.) cord.

3. Execution

3.1. INSTALLATION

3.2. COMPLETE WATER TREATMENT SYSTEM

3.2.1. The complete water treatment system shall be factory assembled and tested. Provide all interconnecting piping and isolation valves for each major component for a fully operational system. Provide all interconnecting wiring and low voltage transformation for any component requiring power for a fully operational system. The fully assembled unit shall require only one power connection (575V) and one power connection (110V) by Electrical Division. The unit shall be mounted on an epoxy coated skid and delivered to the site as one complete unit. If site conditions require the unit to be delivered in sections, provide all interconnecting piping and wiring between the sections.

3.3. MIXED MEDIA/CARBON FILTER PACKAGE

3.3.1. The package shall be factory assembled and tested. Provide all interconnecting wiring and piping as required for a fully operational system.

3.3.2. The package shall be factory assembled and tested as part of the Complete Water Treatment System.

3.3.3. Install in strict accordance with the manufacturer’s current installation instructions.

3.4. WATEVR SOFTENER PACKAGE

3.4.1. The package shall be factory assembled and tested. Provide all interconnecting wiring and piping as required for a fully operational system.

3.4.2. The package shall be factory assembled and tested as part of the Complete Water Treatment System.

3.4.3. Install in strict accordance with the manufacturer’s current installation instructions.

3.5. REVERSE OSMOSIS PACKAGE

3.5.1. The package shall be factory assembled and tested. Provide all interconnecting wiring and piping as required for a fully operational system.

3.5.2. The package shall be factory assembled and tested as part of the Complete Water Treatment System.

3.5.3. Install in strict accordance with the manufacturer’s current installation instructions.

3.6. REVERSE OSMOSIS STORAGE TANKS

3.6.1. The storage tank shall be factory assembled and tested. Provide all interconnecting piping as required for a fully operational system.

3.6.2. The storage tanks shall be factory assembled and tested as part of the Reverse Osmosis System.

3.6.3. Install in strict accordance with the manufacturer’s current installation instructions.

3.7. UV STERILIZER PACKAGE

3.7.1. The package shall be factory assembled and tested. Provide all interconnecting wiring and piping as required for a full operational system.

3.7.2. The package shall be factory assembled and tested as part of the Complete Water Treatment System.

3.7.3. Install in strict accordance with the manufacturer's current installation instructions.

END OF SECTION

23 05 93.16 Testing and Balancing Piping Systems

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 21 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. NOT USED

3. Execution

3.1. INSTALLATION

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

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

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

3.1.4. 1-1/2 times the system working pressure but not less than 1035 kPa (150 psig)

3.1.5. OR

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

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

3.1.8. After completion of the testing, balance the water systems. Adjust the circuits by means of balancing valves.

3.1.9. Where multiple branch hot or chilled recirculation lines are installed, the flow in these shall be balanced to ensure hot or chilled water, as applicable, at all fixtures or equipment.

3.1.10. Balance on water lines shall be obtained by inserting thermometers between the pipe and insulation of the various return lines and adjusting flow until all thermometers read the same appropriate system temperature.

3.1.11. Submit report showing the balanced temperatures at all systems.

3.1.12. The balancing of the water and air systems shall be performed by the same balancing company.

3.1.13. Acceptable balancing companies are:

.1 Design Test

.2 Pro-Air Testing Inc.

.3 VPG Associates

.4 Airwaso

.5 Leslie Danhart Inc.

.6 Air Audit

.7 Dynamic Flow Balancing Ltd.

.8 Vital Canada Group Inc.

.9 Design Test

END OF SECTION

23 05 93.26 Testing and Balancing Air Systems

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 21 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

1.2. QUALITY ASSURANCE

1.2.1. Acceptable balancing companies are limited to the following:

.1 Design Test
.2 Pro-Air Testing Inc.
.3 VPG Associates
.4 Airwaso
.5 Leslie Danhart Inc.
.6 Air Audit
.7 Dynamic Flow Balancing Ltd.
.8 Vital Canada Group Inc.
.9 Design Test

2. Products

2.1. NOT USED

3. Execution

3.1. SYSTEM BALANCING

3.1.1. Balance the complete air system including air volumes and control settings under maximum system pressure drop conditions (filter at replacement condition). Test the entire system for noise, tightness of joints and proper functioning of the system. Make noise tests under minimum system pressure drop conditions (highest air velocities and clean filter conditions). Make necessary alterations and repeat the tests until satisfactory operation is achieved.

3.1.2. Adjust minimum outside air controller and adjust return air and exhaust air damper linkages to ensure correct air quantities.

3.1.3. Employ one of the qualified Independent Balancing Company to balance the air systems.

3.1.4. The Independent Balancing Company measures and reports upon the air volume at each diffuser, register and grille. Report shall also show the air quantity handled by each fan, the static pressure upstream and downstream of the fan, the fan speed and the motor current. Also to be reported upon are the air flow at outdoor, return and exhaust air dampers under conditions of minimum outdoor air.

3.1.5. Provide assistance to the air balancing company and shall provide control settings, new filters, and other incidentals and equipment required for the measurements.

3.1.6. Air volumes measured by the balancing company shall be within plus or minus 5% of those shown on Drawings for diffusers, grilles and registers and within 10% for fans.

3.1.7. In all cases where measurements by the balancing company show failure to comply with the Drawings and Specifications, engage the balancing company to rebalance the system at no increase to Contract price.

3.1.8. The balancing of the air and water systems shall be performed by the same balancing company.

END OF SECTION

23 11 23.00 Propane Gas Piping Systems

1. General

1.1. WORK INCLUDED

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

1.1.2. Conform to Section 23 35 16.00 - ELECTRIC POWER GENERATOR.

2. Products

2.1. MATERIALS

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

- .1 Schedule 40 steel, ASTM A106 or ASTM A53 up to 250mm (NPS 10)
- .2 Standard weight steel, ASTM A106 or ASTM A53 larger than 250mm (NPS 10)
- .3 Steel fittings, ANSI/ASME B16.3, Welded
- .4 Malleable Iron fittings, threaded, up to 63mm (2-1/2 in.) diameter for connections close to equipment and dirt pockets
- .5 Factory-applied, three-layer coating of epoxy, adhesive, and PE protective coating for underground steel pipe.
  - .1 Epoxy paint, adhesive, and heat-shrink PE sleeves joint cover kits.

2.1.2. Underground plastic pipe and fittings

- .1 Polyethylene Pipe (PE), ASTM D2513, SDR 11
- .2 PE Fittings, ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type with dimensions matching PE pipe.
- .3 PE Transition Fittings, factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A106, black steel, Schedule 40, Type E or S, Grade B.
- .4 Tracer wire
- .5 Anodeless Service-Line Risers: Factory fabricated and leak tested.
  - .1 Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
  - .2 Casing: Steel pipe complying with ASTM A53/A106, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
  - .3 Aboveground Portion: PE transition fitting.
  - .4 Threaded outlet or flanged or suitable for welded connection.
  - .5 Tracer wire connection.
  - .6 Ultraviolet shield.
  - .7 Stake supports with factory finish to match steel pipe casing or carrier pipe.
- .6 Transition Service-Line Risers: Factory fabricated and leak tested.

.1 Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet connected to steel pipe complying with ASTM A53/A106, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.

.2 Outlet shall be threaded or flanged or suitable for welded connection.

.3 Bridging sleeve over mechanical coupling.

.4 Factory-connected anode.

.5 Tracer wire connection.

.6 Ultraviolet shield.

.7 Stake supports with factory finish to match steel pipe casing or carrier pipe.

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

.1 Ball or plug type

.2 CSA/CGA B3.16

.3 Supervisory switch (where specified or shown)

2.1.4. Electrically operated solenoid valves, normally closed, 2-position type in accordance with CSA Z21.21 and SCA C22.2 suitable for 120 Volt operation with electronic actuator and general purpose enclosure. Valves with pneumatically actuated components are not permitted.

2.1.5. Manual isolation valve supervisory switch:

.1 Potter PTS-C Plug type

.2 NEMA 6P enclosure for outdoor installation

.3 Hex key and tamper resistant screws

2.1.6. Roof penetrations:

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

3. Execution

3.1. INSTALLATION

3.1.1. Connect to the bulk storage tank and provide all downstream pipe and appurtenances.

3.1.2. The bulk storage tank is by the propane gas service provider or their agent.

3.1.3. Provide pressure reducing valves and overprotection devices where shown or as required for conformance with CSA B149.1 for equipment supplied under this Contract.

3.1.4. Pipe relief from pressure reducing valves to outdoors. Vent-less pressure reducing valves may be used where permitted by the Authority Having Jurisdiction.

3.1.5. Weld all distribution piping within the building, and utilize screwed and/or flanged fittings at equipment only.

3.1.6. Paint natural gas piping in its entirety an approved colour in accordance with CSA B149.1. Banding is not permitted.

3.1.7. Provide thermal expansion control for gas piping on the roof as required by CSA B149.1.

3.1.8. Install underground, PE, natural-gas piping according to ASTM D2774.

3.1.9. Provide manually operated remote shutdown for the domestic hot water heater room:

.1 Provide push/pull emergency stop switch with red mushroom operator (EPO) with normally closed contact wired in series with each control panel for all gas-fired equipment in the boiler room:

.1 Depression of the EPO interrupts power to all equipment control panels until manually reset.

.2 Locate an EPO outside the boiler room at each entrance. Where entrances are not enclosed to the elements, locate the EPO in a clear weather tight enclosure

.3 Provide all interconnected wiring as required for a complete and operational system

3.1.10. As an alternative to the above, provide manually operated remote natural gas shutdown for the domestic hot water heater room:

.1 Provide normally closed, electronically operated solenoid valve(s) or valve assembly that includes one or more valves, as required, to suit natural gas service size with no appreciable pressure drop

.2 Provide isolation and lockable bypass valve for emergency operation

.3 Power solenoid valves with emergency power where available. Coordinate with Electrical Division

.4 Provide push/pull emergency stop switch with red mushroom operator (EPO) with normally closed contact wired in series with solenoid valve(s)

.1 Depression of the EPO interrupts power to all solenoid valves until manually reset

.2 Locate an EPO outside the boiler room at each entrance. Where entrances are not enclosed to the elements, locate the EPO in a clear weather tight enclosure away from public access

.3 Provide all interconnected wiring as required for a complete and operational system

.4 Power solenoid valves with emergency power where available. Provide UPS power to maintain valve in open position during short power outages or while transitioning to emergency power. Coordinate with Electrical Division.

END OF SECTION

23 31 13.00 Ductwork and Specialties

1. General

1.1. WORK INCLUDED

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

1.2. SUBMITTALS

1.2.1. Shop Drawings

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

.2 Submit Shop Drawings of each supporting structural assembly required in the ductwork systems, designed by an engineer licensed to practice in the place of work in the appropriate discipline. Same design engineer stamps each and every Shop Drawing.

1.2.2. Samples: Submit samples as required.

1.2.3. Submit marked up prints showing detailed locations of all devices mounted in or on ductwork, dimensioning their locations.

2. Products

2.1. MATERIALS

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

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

2.1.3. Flexible ducting:

.1 Flexible fabric ducting shall be Flexmaster Fabriflex FAB-4. ULC listing S110.

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

.3 Acoustic flexible metal ducting shall be Flexmaster Triple-Lock Acoustic Flexible ducting T/L-A-T/L consisting of perforated aluminum inner core, 38 mm (1-1/2 inch) insulation, and aluminum outer covering. ULC listing S110.

.4 Thermal flexible metal ducting shall be Flexmaster Triple-Lock Acoustic Flexible ducting ULC listing S110.

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

2.1.5. Flexible Connections:

.1 Ventfabrics, Duro Dyne or Dyne-Air.

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

.3 For fans in excess of 0.5 kPa (2 in. wg.) connections shall be minimum 1,080 gm/sq.m. (32 oz/sq.yd.) non-toxic neoprene coated fibreglass fabric equal to Neoprene N.T.

.4 For all flexible connections located outside the building (e.g. roof top units) flexible connections shall be fire retardant Hypalon coated fibreglass fabric and shall be a minimum 9915 gm/sq.m. (27 oz./sq.yd.) equal to Hypalon.

.5 For all systems where the temperature may exceed 112 deg. C. (235 deg. F.) silicone rubber coated fibreglass shall be used, and shall be equal to Silicone H1-T. Submit flexible connections for review before installation.

2.1.6. Dampers:

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

.2 Fire Dampers: Underwriters' Laboratories Classified to ANSI/UL 555 Standard for Fire Dampers and CAN/ULC S112 Standard Method of Fire Test of Fire Damper Assemblies or ANSI/UL 555C Standard for Ceiling Dampers as applicable.

.1 Fire dampers shall be curtain type, rated as 'Dynamic', and shall have the blades clear of the air stream. Fire dampers shall be Type B or Type C as required to suit system air velocity and pressure. Fire dampers in return and exhaust systems may be Type A with the blades in the air stream where permitted by the Engineer's Representative. Dampers shall be multi-sectional as required to suit size and UL/ULC Listing requirements. Where the specified curtain fire dampers are limited by the UL/ULC Listing for maximum size, they shall be substituted with multi-blade type complete with power actuation and/or fusible link as required to satisfy the fire rating of the partition.

.2 Fire-stop flaps or ceiling mounted fire dampers shall be as shown in the Underwriters' Laboratories Listing for the specific ceiling assembly used.

.3 Combination Smoke and Fire Dampers: Multi-blade type complete with operating shaft, stainless steel side seals and fire resistant insulating blade seals. Dampers shall bear label for 1-1/2 hours and shall be of the same manufacturer as noted for fire dampers. Damper shall be open/closed from motor operator and fully closed on melting of fusible link. Limit switches shall be provided to show position of damper blades. Leakage through dampers shall not exceed 50.8 L/s (10 cfm/sq.ft.) of damper area at 1.0 kPa (4.0 in. wg.) of differential pressure when tested in accordance with AMCA Standard 500. Submit test data with Shop Drawings.

.4 Smoke Dampers: Similar to dampers described above but without fusible link.

.5 Positive Seal Shut-off Dampers:

.1 Isolation type, positive seal, bubble tight damper at a differential pressure of 2.5 kPa (10 in. wg.). Damper shall be constructed with 1.9837 mm (0.0781 in - 14 USS gauge) thick, Type 304 stainless steel dish shaped disc with a knife-edge that seals against a T-304 stainless steel frame. The frame shall have a closed-cell neoprene rubber gasket that creates a gasket-to-knife edge seal. The damper shall have a ¼ turn worm-geared actuator with handwheel. The actuator shall have an aluminum base and cover. The rated torque shall be 225 Joules (2,000 in. lbs.) with a gear ratio of 30:1. The actuator shall be fully lubricated and self-locking.

.2 The damper shall be all weld design, all pressure retaining weld joints and seams shall be continuously welded. Weld joints and seams requiring only intermittent welds by design shall not be continuously welded interior weld joints, where possible, shall be continuously welded to provide a smooth interior design, as a minimum, all welds shall be wire brushed and/or buffed to remove heat discolouration, burrs and sharp edges. All welding procedures, welders, and

welder operators shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX. All production welds shall be visually inspected in accordance with standard procedure incorporating the workmanship acceptance criteria in Section 5 and 6 of A.N.S.I./ANWS D9.1-1990. Specification of Welding of Sheet Metal.

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

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

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

.9 Motorized dampers for Control Operation: In accordance with applicable requirements control systems (pneumatic) or central energy management systems section.

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

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

2.1.9. Hardware and Accessories:

.1 Spin-in connections shall be specifically built for that purpose. Dampers shall be a minimum 1 gauge heavier than the ductwork in which it is installed and shall have a full length shaft pivoted at two diametrically opposed points. An indicator shall be attached to the shaft to indicate the damper position.

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

.3 Turning vanes shall be either double thickness or single thickness with extended leading and trailing edges as specified in ASHRAE and SMACNA Standards. Rails shall be securely set in the elbow so that they cannot loosen. Turning vanes shall be Dyn-Air or equal.

2.2. FABRICATION

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

2.2.2. Provide dishwasher and kitchen exhaust ducts in accordance with Section 23 31 16.29 – SPECIAL DUCTWORK.

3. Execution

3.1. INSTALLATION

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

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

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

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

TABLE 1: HANGERS

DUCT DIMENSION	HANGER CONSTRUCTION
Horizontal rectangular duct	
Up to 1500 mm (60 in.) for Low Pressure Ductwork Only	Two 25 mm (1 in.) x 16 US gauge straps with two screws on side of duct one screw on bottom. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
For all sizes of Medium and High Pressure Ductwork up to 3000 mm (120 in.) and Low Pressure Ductwork from 1525 mm to 3000 mm (61 in. x 120 in.)	50 mm x 50 mm x 6 mm (2 in. x 2 in. x 1/4 in.) trapeze hanger with two 9 mm (3/8 in.) dia. rods. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
3000 mm to 6000 mm (120 in. to 240 in.)	65 mm x 65 mm x 5 mm (2-1/2 in. x 2-1/2 in. x 3/16 in.) trapeze hanger with two 9 mm (3/8 in.) dia. rods. Hangers shall be at each joint but in no case more than a maximum 1200 mm (48 in.) on centres.
Horizontal round duct	
Up to 450 mm (18 in.)	One 25 mm (1 in.) x 16 US gauge hanger ring supported from one 25 mm (1 in.) x 16 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
475 mm to 900 mm (19 in. to 36 in.)	One 25 mm (1 in.) x 12 US gauge hanger ring supported from 25 mm (1 in.) x 12 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
925 mm to 1250 mm (37 in. to 50 in.)	One 25 mm (1 in.) x 12 US gauge hanger ring supported from 25 mm (1 in.) x 12 US gauge hanger strap. Hanger shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.
1275 mm to 2100 mm (51 in. to 84 in.)	Two 38 mm (1-1/2 in.) x 12 US gauge hanger connected to the 32 mm x 32 mm x 3 mm (1-1/4 in. x 1-1/4 in. x 1/8 in.) angle girth reinforcing of duct hanger. Hangers shall be at each joint but in no case more than a maximum 2400 mm (96 in.) on centres.

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

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

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

TABLE 2: LOW PRESSURE DUCT CONSTRUCTION

MAX. DUCT DIMENSION	SHEET METAL US GAUGE	TRANSVERSE JOINT CONNECTION AND BRACING
Up to 300 mm (12 in.)	26	Flat drive or flat 'S' no bracing
325 mm to 425 mm (13 in. to 18 in.)	24	Flat drive or flat 'S' no bracing
475 mm to 750 mm (19 in. to 30 in.)	24	25 mm (1 in.) standing 'T' bracing 25 mm x 25 mm x 3 mm (1 in. x 1 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
775 mm to 1050 mm (31 in. to 42 in.)	22	25 mm (1 in.) standing 'T' bracing 25 mm x 25 mm x 3 mm (1 in. x 1 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
1075 mm to 1200 mm (43 in. to 48 in.)	22	38 mm (1-1/2 in.) standing 'T; bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1500 mm (60 in.) centres.
1225 mm to 1350 mm (49 in. to 54 in.)	22	38 mm (1-1/2 in.) standing 'T; bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.
1375 mm to 1500 mm (55 in. to 60 in.)	20	38 mm (1-1/2 in.) standing 'T; bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.
1525 mm to 2100 mm (61 in. to 84 in.)	20	38 mm (1-1/2 in.) standing 'T; bracing 38 mm x 38 mm x 3 mm (1-1/2 in. x 1-1/2 in. x 1/8 in.) at maximum 1200 mm (48 in.) centres.
2125 mm to 2400 mm (85 in. to 96 in.)	18	50 mm (2 in.) standing 'T' bracing 38 mm x 38 mm x 5 mm (1-1/2 in. x 1-1/2 in. x 3/16 in.) at maximum 600 mm (24 in.) centres.
2425 mm to 3000 mm (97 in. to 120 in.)	18	50 mm (2 in.) standing 'T' bracing 50 mm x 50 mm x 6 mm (2 in. x 2 in. x 1/4 in.) at maximum 600 mm (24 in.) centres.
3025 mm and over (121 in. and over)	18	As above with addition of tie rods at 300 mm (120 in.) centres for joint bracing.

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

.2 Locate bracings mid-way between joints.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.1.18. Provide access ports at convenient locations in all main ducts and main branch take-offs with airtight covers and extension sleeves through insulation to allow air meter readings. Access ports shall be approved by the Engineer's Representative and the testing company before installation.

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

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

3.1.21. Provide splitter dampers as shown on Standard Details.

3.1.22. Incorporate counterbalanced backdraft dampers where shown. Adjust counterweights to the minimum pressure required to relieve the system pressure. Incorporate gravity backdraft dampers where shown.

3.1.23. Install motorized dampers where directed.

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

3.1.25. Where fire dampers for ducts shown on Drawings require a change of type and/or powered actuation due to dimension limitations to satisfy the cUL Classification requirements, provide transitions as required to adjust duct dimensions while maintaining the equivalent circular duct diameter to avoid exceeding any specific listed maximum dimension. Where transitions are not possible or dimensions cannot be adjusted to avoid powered actuation, provide power from the closest available emergency power source as required. Review all conditions with the Engineer's Representative in advance of fabrication.

3.1.26. Install combination smoke and fire dampers and smoke dampers where shown. Ensure operators are accessible for maintenance.

3.1.27. Receive automatic dampers from separate Section on site, and set in place under the supervision of the control manufacturer.

3.1.28. Provide access panels at all fire dampers, gravity dampers, motorized dampers, coils, heaters, humidifiers, fan bearings or similar equipment requiring occasional maintenance or inspection. Panels shall be 600 mm x 450 mm (24 in. x 18 in.) or full width of duct if less than 450 mm (18 in.) wide. Panels shall be of double wall construction and shall be internally insulated on insulated ducts. Frame shall be of structural angle with welded corners, gasketed to receive the panel. Panel shall be held in place with 4 window sash locks.

3.1.29. Paint visible internal surface behind each grille or register flat black.

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

3.1.31. Install kitchen and dishwasher exhaust ducts in accordance with Section 23 31 16.29 – SPECIAL DUCTWORK.

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

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

3.1.34. All exposed open ends of ductwork located less than 2000mm (79 in) above the finished floor that do not have a diffuser, grille or register shall have a protective screen mounted in a suitable frame to connect the screen securely to the duct, wall and floor as applicable. The screen shall be installed and painted matte black and shall not be capable of passage of anything larger than a 15mm (1/2 in.) sphere through the openings..

END OF SECTION

23 31 16.29 Special Ductwork

1. General

1.1. WORK INCLUDED

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

1.1.2. Conform to Section 23 31 13.00 - DUCTWORK AND SPECIALTIES.

1.1.3. Special ductwork shall conform to SMACNA - HVAC Duct Construction Standards and all other applicable standards.

1.2. SUBMITTALS

1.2.1. Shop Drawings

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

2. Products

2.1. MATERIALS

2.1.1. KITCHEN EXHAUST DUCTWORK

.1 Fabricate unlisted kitchen exhaust air ducts of Type 302 stainless steel. Provide thickness in accordance with NFPA 96.

.2 Provide ULC Listed kitchen exhaust air duct.

2.1.2. DISHWASHER EXHAUST DUCTWORK

.1 Fabricate dish washer exhaust air ducts of 1.27mm (0.050 – 18 USS Ga) Type 304L Stainless steel

.2 Fabricate dishwasher exhaust air ducts of minimum 1.1480 mm thick (0.0452 in - 17 B&S gauge) and slip joints minimum 1.2903 mm thick (0.0508 in. - 16 B&S gauge) aluminum alloy 3003.

3. Execution

3.1. INSTALLATION

3.1.1. Kitchen exhaust ductwork

.1 Install listed kitchen exhaust systems in accordance with manufacturer's directions.

.2 Install unlisted kitchen hood and dishwasher exhaust air ducts with all welded joints. In each 3700 mm (12 ft.) of duct run provide a 300 mm x 300 mm (12 in. x 12 in.) access panel run mounted in a gasketed stainless steel frame and held in place with 2 window sash locks. Access doors shall be of the same material as the duct. Access doors shall be located in the top and sides of kitchen exhaust ductwork only.

.3 Install unlisted kitchen exhaust duct in accordance with NFPA 96, upstream and downstream of any filtration device, from the kitchen exhaust hood up to termination to the outdoors.

END OF SECTION

23 34 13.00 Axial Flow Fans

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Electrical hard wire supply and primary connections to electrical components - under Electrical Division.

1.3. SUBMITTALS

1.3.1. Shop Drawings:

.1 Submit Shop Drawings of all axial flow fans with catalogued components to be supplied. Include manufacturer's data sheets for discharge volume for all fans at specified primary exhaust, performance criteria, ratings, and physical dimensions and finishes. Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted. Provide outlet velocity and both inlet and outlet sound power readings for the eight octave bands.

1.3.2. Manufacturer's Data

.1 Conform to AMCA standard 205, 211 and 311. Fans shall be tested in accordance with ANSI/AMCA Standard 210 and AMCA Standard 300 in an AMCA accredited laboratory and shall be certified to bear the AMCA seal for air and sound performance.

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

2. Products

2.1. MATERIALS

2.1.1. Except as otherwise indicated, all axial flow fans shall be Cook, FlaktWoods, Greenheck, PennBarry, Soler & Palau or Twin City.

2.1.2. All fans shall comply with UL/cUL 705.

2.1.3. All fans used to convey grease laden air shall comply with UL/cUL 762, meet NFPA 96A, and have a grease collection device.

2.1.4. Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. Housing shall be heavy gauge steel with a continuously welded seam and integral inlet and outlet flanges pre-punched for mounting.

2.1.5. All steel fan components shall be coated with an electrostatically applied, baked polyester powder coating or other equivalent protective coating.

2.1.6. Fan propeller shall use cast aluminum or steel airfoil blades. The propeller shall be keyed and secured to the shaft with a split taper bushing, and retaining plate. The assembled wheel shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.

2.1.7. Blower shaft shall be accurately turned and polished steel. Shaft shall be sized for a critical speed of at least 125% of the maximum RPM.

2.1.8. Motor shall be direct drive as shown in the Fan Schedule.

.1 Direct drive motor shall have external electrical terminal box.

.2 Belt drive motor shall have adjustable motor plate utilizing threaded studs for positive belt tensioning.

.3 Belts shall be oil and heat resistant, non-static type.

.4 Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts.

.5 Drives shall be sized for 150% of the installed motor horsepower.

.6 Motors shall be in accordance with the requirements of Section 20 05 13.00 - ELECTRIC MOTORS. See Fan Schedule for hp (wattage) ratings.

2.1.9. Bearings shall be heavy duty, grease lubricated, anti-friction ball or spherical roller, self-aligning, block type and selected for a minimum L50 life in excess of 200,000 hours at maximum load. All inaccessible bearings shall be provided with prefilled factory extended lubrication lines fitted with grease fittings terminating at the case exterior. Permanently lubricated bearings are not acceptable.

2.1.10. Vibration isolation shall be provided as specified in Section 20 05 48.00 - VIBRATION AND NOISE CONTROL.

2.1.11. All fans, without ducts or dampers on the inlet or outlet, including fans in plenums, shall have protective screens on the openings.

2.1.12. Fans shall be suitable for operation with variable frequency drives where indicated in the Fan Schedule or as required to meet the requirements of their sequences of operation.

2.1.13. Axial flow fans shall be in accordance with the Fan Schedule.

2.1.14. ELECTRICAL ROOM COOLING FAN, TF-L02-01

.1 When the room temperature rises above 29.4 deg.C. (85 deg.F.) [User Adjustable] the fan shall start.

.2 A local Hand/OFF/AUTO selector switch shall be located next to the thermostat to over-ride the thermostat.

3. Execution

3.1. INSTALLATION

3.1.1. Install fans in locations shown on plans.

3.1.2. Align shafts, belt drive and motor, adjust belt tension, ensure all set screws are tight and check motor rotation before start-up.

3.1.3. Protect motors and fans during construction.

3.1.4. Provide an access door in the adjacent ductwork 450 mm x 450 mm (18 in. x 18 in.) minimum size or larger if required to remove the motor.

3.1.5. Duct transitions shall be rigidly connected directly to the fan inlet and outlet flanges or connections. Flexible connections required for isolation from the duct system shall be located on the inlet and outlet of the transition piece representing the greatest cross sectional area and lowest velocity. Vibration isolation shall include for the weight of the transitions.

END OF SECTION

23 34 16.00 Centrifugal Fans

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Electrical hard wire supply and primary connections to electrical components - under Electrical Division.

1.3. SUBMITTALS

1.3.1. Shop Drawings:

.1 Submit Shop Drawings of all fans with catalogued components to be supplied. Include manufacturer's data sheets for, performance criteria, ratings, and physical dimensions and finishes. Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted. Provide outlet velocity and both inlet and outlet sound power readings for the eight octave bands.

1.3.2. Manufacturer's Data

.1 Conform to AMCA standard 205, 211 and 311. Fans shall be tested in accordance with ANSI/AMCA Standard 210 and AMCA Standard 300 in an AMCA accredited laboratory and shall be certified to bear the AMCA seal for air and sound performance.

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

2. Products

2.1. MATERIALS

2.1.1. Except as otherwise indicated, all centrifugal and utility fans shall be Carnes, Cook, FlaktWoods, Greenheck, PennBarry, Soler & Palau or Twin City.

2.1.2. All fans shall comply with UL/cUL 705.

2.1.3. All fans used to convey grease laden air shall comply with UL/cUL 762, meet NFPA 96A and have a grease collection device. UL/CUL 762 applies to all fans used in a kitchen application. They must be installed in accordance with NFPA 96.

2.1.4. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The scroll wrapper and side panels shall be steel. The entire fan housing shall have continuously welded seams for leak-proof operation. Bearing support shall be constructed of welded steel members.

2.1.5. All steel fan components shall be coated with an electrostatically applied, baked polyester powder coating or other equivalent protective coating.

2.1.6. Unless shown otherwise, fan wheels handling more than 472 L/s (1000 cfm) shall be of the non-overloading backward inclined centrifugal type. Wheel hub shall be keyed and securely attached to the fan shaft. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency. The assembled wheel shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.

2.1.7. Each fan shall be provided with fan sheave, motor sheave, matched V-belts and belt guard.

.1 Belt guard shall be OSHA compliant and completely cover the motor pulley and belt(s).

.2 Where motor is 7.5 kW (10 hp) or less, motor sheave shall be variable pitch.

.3 Where motor exceeds 7.5 kW (10 hp) motor sheave shall be variable pitch, to be replaced with a correctly sized fixed pitch sheave after balancing.

.4 Motors shall be in accordance with the requirements of Section 20 05 13.00 - ELECTRIC MOTORS. See Schedule for hp (wattage) ratings.

.5 Belt drive motor shall have adjustable motor plate utilizing threaded studs for positive belt tensioning. Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower.

.6 All fans, with the exception of utility fans, shall have arrangement 3 drive or arrangement 2 drive for smaller fans.

2.1.8. Permanently lubricated bearings are not acceptable. Bearings on shafts 24 mm (15/16 in.) diameter and larger shall be pillow block, self-aligning ball or roller bearings with seals and grease nipple. In addition, bearings on shafts 36.5 mm (1-7/16 in.) diameter and larger shall have grease nipple and grease relief valve. Bearings on shafts smaller than 24 mm (15/16 in.) diameter shall be pillow block, self-aligning ball bearings with seals and with grease nipple. Make all bearings accessible for lubrication and service, unless otherwise permitted by the Engineer's Representative. Where it is difficult to provide such access, provide extended lubrication lines. When such lines extend to pillow block bearings, provide a grease relief valve. Bearings shall be selected for a minimum L50 life in excess of 200,000 hours at maximum load.

2.1.9. Blower shaft shall be accurately turned and polished steel. Shaft shall be sized for a critical speed of at least 125% of the maximum RPM. The ends of fan shafts shall be centered depressions to allow for mechanical tachometer readings.

2.1.10. All fans, without ducts or dampers on the inlet or outlet, including fans in plenums, shall have protective screens on the openings.

2.1.11. Provide access doors on the fan scroll. Doors shall be hinged, in reinforced angle frames and provided with clamping devices. Minimum size shall be 450 mm x 350 mm (18 in. x 14 in.) or full width of fan scroll, if scroll is less than 450 mm (18 in.) wide.

2.1.12. Provide drain connections as shown. Drains shall be minimum 25 mm (1 in.) pipe size, half coupling, welded into the bottom of the scroll with a square headed, threaded, brass plug. Drain shall be extended clear of fan scroll.

2.1.13. Vibration isolation shall be provided as specified in Section 20 05 48.00 - VIBRATION AND NOISE CONTROL.

2.1.14. Utility fans shall conform to the Specification for centrifugal fans above with the exception of the drive arrangement and belt guard. Drive shall be standard utility arrangement and belt guard may be omitted if a hood is provided over the drive.

2.1.15. Fans shall be suitable for operation with variable frequency drives where indicated in the Fan Schedule or as required to meet the requirements of Section 23 09 23.00 - SEQUENCES OF OPERATION.

2.1.16. Centrifugal and utility fans shall be in accordance with the Fan Schedule.

2.1.17. KITCHEN EXHUAST FANS EF-L03-02, EF-L03-03 AND EF-L03-04

.1 Each fan shall be controlled by a local switch located on the wall adjacent to the exhuast hood that it serves.

.2 Regardless of the local switch, each fan shall start when any heat-producing cooking appliance under the hood it serves is turned on.

.3 Upon activation of the extinguishing system in the hood served by each fan, the fan shall start, or continue to run.

3. Execution

3.1. INSTALLATION

3.1.1. Install fans in locations shown on plans.

3.1.2. Align shafts, belt drive and motor, adjust belt tension, ensure all set screws are tight and check motor rotation before start-up.

3.1.3. Protect motors and fans during construction.

3.1.4. Install all fan components, including controllers, shipped loose to site. Mechanical Division to install wiring between components as required.

END OF SECTION

23 34 33.00 Air Curtains

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

2.1.1. Air curtains shall be Powered Aire, Miniveil, Enersheild, Sigma or Berner. Each unit consists of a factory assembled casing, centrifugal fans, stainless steel inlet screen, discharge nozzle, motor(s), and access panels for motor and fan assembly. The air curtain shall deliver the specified air volume at a uniform outlet velocity across the entire length of the discharge nozzle area.

2.1.2. Casing shall be not less then 1.214 mm thick (0.0478 in. - 18 MSG) stainless steel. Provide access to the control specified below with top and bottom access panels.

2.1.3. Unit shall come complete with galvanized discharge nozzle extension where unit is recessed mounted within the ceiling space.

2.1.4. Unit support shall be integral to the unit frame or casing. All weight bearing structural support shall be formed 1.897 mm thick (0.0747 in. - 14 MSG) stainless steel and galvanized steel. Units shall be furnished in single increments of sufficient structural strength to be supported from the top or back per manufacturer’s instructions

2.1.5. Inlet screen shall be 0.912 mm thick (0.0359 in. - 20 MSG) perforated type stainless steel.

2.1.6. Discharge nozzle shall be high efficiency discharge plenum. Air curtain shall create a positive air seal with directional air foil vane. The vane shall facilitate a deflection of the air stream by +/- 20 degrees.

2.1.7. Fans shall be galvanized forward curved centrifugal type, double inlet design, with zinc plated hubs.

2.1.8. Motors shall be ODP, multi-speed, resiliently mounted, continuous duty, air over with integral thermal-overload protection. Bearings shall be heavy duty type permanently lubricated, shielded ball bearings of equal size.

2.1.9. Controls

.1 Provide unit mounted control panel to house the unit controls complete with non-fused disconnect.

.2 Provide remote mounted automatic door switch in the door area to activate the unit each time the door opens and deactivate the unit each time the door closes.

.3 Provide an adjustable time delay (adjustable from 2.0 to 120 seconds) to maintain air curtain operation until a specified time after the door closes. Provide a unit mounted Hand/off/Auto switch to override this automatic door switch.

.4 Provide a unit mounted High/Low/off speed selector switch

.5 Provide a thermostat to control the unit and over-ride the door switch if heating in the space is required. Fan to run on slower speed when heating while doors are closed.

2.1.10. Provide mounting brackets as required to clear any obstructions over the door

2.1.11. Unit shall not vibrate or rattle at any speed.

2.1.12. Air curtains shall have capacities as shown in the Cabinet Heater Schedule.

3. Execution

3.1. INSTALLATION

3.1.1. Install in accordance with manufacturer's current installation guidelines.

3.1.2. Start-up each air curtain in accordance with the manufacturer's Operations and Maintenance Manual and Installation Instructions. Adjust air-directional vanes as necessary.

3.1.3. After electrical circuitry has been energized, start unit to confirm motor rotation and unit operation.

END OF SECTION

23 34 63.00 Roof Exhaust Fans

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Electrical hard wire supply and primary connections to electrical components - under Electrical Division.

1.2.2. Supply and installation of built-up wood curb and flashings - under Section 06100 and 07600.

1.3. SUBMITTALS

1.3.1. Shop Drawings:

.1 Submit Shop Drawings of all roof exhaust fans with catalogued components to be supplied. Include manufacturer's data sheets for discharge volume for all fans at specified primary exhaust, performance criteria, ratings, and physical dimensions and finishes. Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted. Provide outlet velocity and both inlet and outlet sound power readings for the eight octave bands.

1.3.2. Manufacturer's Data:

.1 Conform to AMCA standard 205, 211 and 311. Fans shall be tested in accordance with ANSI/AMCA Standard 210 and AMCA Standard 300 in an AMCA accredited laboratory and shall be certified to bear the AMCA seal for air and sound performance.

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

2. Products

2.1. MATERIALS

2.1.1. Except as otherwise indicated, all roof exhaust fan shall be Carnes, Cook, FlaktWoods, Greenheck, PennBarry or Twin City.

2.1.2. All fans shall comply with UL/cUL 705.

2.1.3. All fans used to convey grease laden air shall comply with UL/cUL 762, meet NFPA 96A and have a grease collection device. UL/CUL 762 applies to all fans used in a kitchen application. They must be installed in accordance with NFPA 96.

2.1.4. Low silhouette exhausters shall be of bolted and welded construction utilizing corrosion resistant fasteners. The fan shall be enclosed with a galvanized steel hood with the entire assembly primed with a zinc rich primer or, an aluminum hood, treated to prevent corrosion. The hood shall be bolted to the fan housing and shall be removable to allow unobstructed access to the motor and power assembly. The aluminum base shall have continuously welded curb cap corners for maximum leak protection.

2.1.5. Dome type exhausters shall be of bolted and welded construction utilizing corrosion resistant fasteners. Motor cover, shroud, curb cap, and lower wind band shall be constructed of heavy gauge aluminum and treated to reduce corrosion. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Shroud shall have an integral rolled bead for added strength.

2.1.6. Wheel shall be non-overloading centrifugal backward inclined, constructed of aluminum. Wheel inlet shall overlap an aerodynamic aluminum inlet cone or venturi to provide maximum performance and efficiency. The assembled wheel shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.

2.1.7. The motor, bearings and drives shall be mounted on a steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream.

2.1.8. Units shall be complete with a galvanized bird screen treated to prevent corrosion.

2.1.9. Bearings shall be heavy duty, grease lubricated, anti-friction ball or spherical roller, self-aligning, pillow block type and selected for a minimum L50 life in excess of 200,000 hours at maximum load.

2.1.10. Blower shaft shall be sized for a critical speed of at least 125% of the maximum RPM.

2.1.11. Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

2.1.12. All steel fan components shall be coated with an electrostatically applied, baked polyester powder coating or other equivalent protective coating.

2.1.13. Motors shall be in accordance with the requirements of Section 20 05 13.00 - ELECTRIC MOTORS. See Fan Schedule for hp (wattage) ratings.

2.1.14. Where motor operated dampers are not shown, gravity dampers shall be provided at the fan by this Section.

2.1.15. Unit shall be mounted on a prefabricated roof curb to match the fan size. Curb shall be flat for flat roofs and pitched to suit slope of roof for pitched roofs. All exhaust curbs, except for kitchen and laboratories, shall be acoustically lined. Unit shall be nominally 450 mm (18 in.) high.

2.1.16. Vibration isolation shall be provided as specified in Section 20 05 48.00 - VIBRATION AND NOISE CONROL.

2.1.17. Roof exhaust fans shall be in accordance with the Fan Schedule.

2.1.18. WASHROOM EXHAUST FANS EF-L02-01, EF-L03-01, EF-L02-03

.1 These fans shall be controlled by the lighting control for the washroom they serve.

2.1.19. STORAGE AREA VENTILATION FAN EF-L02-02

.1 Fan shall be interlocked with the operation of RTU-1 to run continuously whenever RTU-1 is operating.

3. Execution

3.1. INSTALLATION

.1 Install fans in locations shown on plans.

.2 Align shafts, belt drive and motor, adjust belt tension, ensure all set screws are tight and check motor rotation before start-up.

.3 Protect motors and fans during construction.

END OF SECTION

23 35 19.00 Kitchen Exhaust Hoods

1. General

1.1. WORK INCLUDED

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

1.1.2. Conform to Section 26 05 00.00 - GENERAL INSTRUCTIONS FOR ELECTRICAL SECTIONS.

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. The installation only of pressure sensors set into - under Section 23 31 13.00 - DUCTWORK AND SPECIALTIES.

1.2.2. Electrical hard wire supply and primary connections to electrical components - under Electrical Division.

2. Products

2.1. MATERIALS

2.1.1. Kitchen exhaust hoods and associated fire suppression systems will be purchased by the Owner and installed by the Mechanical Division. Details of the exhaust hoods are attached to the end of this specification section for information.

3. Execution

3.1. INSTALLATION

3.1.1. Kitchen exhaust system shall be designed to fit within the space allocated with sufficient space for servicing all equipment.

3.1.2. Co-ordinate all work with the respective trades.

3.1.3. Perform all control piping and wiring required for a completely functioning kitchen exhaust system.

3.1.4. Unit shall be tested on site to ensure correct operation of unit with kitchen hoods. Provide written test results.

3.1.5. Testing of kitchen exhaust system shall include on site testing of all components as a complete system. Testing shall be with all filters, at both clean and dirty conditions in place. Test for air flow under all working conditions including 100% exhaust, wash cycle, fire shut-down mode and for filter working conditions.

END OF SECTION

23 37 13.00 Diffusers, Grilles and Registers

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

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

1.2.2. Door grilles - under Architectural Division - Grilles.

1.3. SUBMITTALS

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

2. Products

2.1. MATERIALS

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

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

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

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

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

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

2.2. SQUARE SUPPLY DIFFUSERS

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

.1 All diffusers shown as type “P1” shall be as specified above but with 300 mm x 300 mm (12 in. x 12 in.) face size for installation in ceiling specified by the architect.

2.3. WALL AND DUCT GRILLES

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

2.4. RETURN, EXHAUST AND TRANSFER GRILLES

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

3. Execution

3.1. INSTALLATION

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

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

3.1.3. For exposed ductwork installations, all connections to grilles shall be oversized and shall have in-turned flanges to meet the flange of the grilles and the duct. Out-turned or exposed flanges with screw mounting shall not be accepted.

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

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

3.1.6. Install mounting frame tied into plaster and gypsum board ceilings to allow lay in type diffusers to rest on the frame.

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

3.1.8. Contractor shall caulk around edges of linear diffusers in installations with imperfect walls.

END OF SECTION

23 51 33.00 Positive Pressure Vent and Chimney Systems

1. General

1.1. WORK INCLUDED

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

1.2. RELATED WORK SPECIFIED ELSEWHERE

1.2.1. Supply and installation of guy wire roof anchors - under Division 7.

1.2.2. Supply and installation of roof flashings only - under Division 7.

1.3. SUBMITTALS

1.3.1. Shop Drawings: Submit Shop Drawings of the entire system being supplied, including details and catalogue cuts of any standard components being incorporated into the system.

1.3.2. System layout shall be designed and installed in compliance with manufacturer's installation instructions and all applicable local codes.

1.3.3. Provide details for chimney support system, including all guy wire locations, wind loads, etc. as required.

2. Products

2.1. MATERIALS

2.1.1. The vent and chimney system shall be continuous from the appliance's flue outlet to the termination to atmosphere outside the building. All system components shall be ULC Listed and supplied from the same manufacturer.

2.1.2. Guy wires and accessories shall be stainless steel with all necessary components for proper support

2.1.3. Double Wall, positive pressure, condensing or non-condensing low heat applications

.1 Vent and chimney system shall be sized to suit natural gas appliance, factory built, suitable for Category II, III or IV condensing or non-condensing appliances or as specified by the appliance manufacturer. ULC Listed for maximum continuous flue gas temperature of 249 Deg. C. (480 Deg. F.) and a minimum positive pressure rating of 1.49 kPa (6 in. W.C.) and tested at 3.73 kPa (15 in. W.C.).

.2 System shall include:

.1 Type AL29-4C stainless steel inner liner, with a minimum wall thickness of .016" for 3" through 7" diameter vents, .019" for 8" through 12" and .024" for 14" through 16" diameter vents.

.2 Aluminized non-corrosive steel outer casing, with a minimum wall thickness of 0.016" for 3" through 6", 0.024" for 7" through 16" for outdoor portion of system.

.3 Type 304 stainless steel non-corrosive outer casing, with a minimum wall thickness of 0.016" for 3" through 6", 0.024" for 7" through 16" for outdoor portion of system.

.4 13mm (1/2 in.) air space between the flue and jacket.

.5 All section joints with a triple lipped directional silicone gasket for sealing and a built in mechanical locking band.

.6 All necessary braces, supports, cleanouts at the end of each horizontal section, roof flashings, roof and wall penetrations, storm collars, base support, and flue termination.

.7 Utilize low-loss rain cap or double cone rain cap terminations on non-condensing applications only. Utilize velocity cone or straight terminations on condensing systems.

.3 ULC Listed for 50 mm (2 in.) clearance to combustibles

.4 Chimney and breeching shall be Selkirk type CI Plus, Schebler Co. model eVent, Duravent FasNseal W2, or Chiminèe Lining model IPPL.

3. Execution

3.1. INSTALLATION

3.1.1. Route the vent system to maintain minimum clearance to combustibles as specified by the manufacturer.

3.1.2. Conform to the manufacturer's installation instructions, ULC listing and the requirements for the Authority Having Jurisdiction.

3.1.3. Inspect and clean the system before the final connection to the appliances.

3.1.4. Support any dampers or fans installed in conjunction with the vent system independently from the vent system. Protect the vent system from twisting or movement due to fan torque or vibration.

3.1.5. Height of chimney shall be at least 900 mm (3 ft.) higher than any portion of the building within 3000 mm (10 ft.). and shall be self-supported up to 3000 mm (10 ft.) as appropriate to suit diameter.

3.1.6. Guy wires, where required, shall run from chimney to guy wire supports located approximately mid-span of beams. Refer to Structural Drawings for locations.

END OF SECTION

23 74 13.13 Small Packaged (Modular) Roof Mounted Air Conditioning Units

1. General

1.1. WORK INCLUDED

1.1.1. Conform to Section 21 05 00.00 – GENERAL INSTRUCTIONS FOR MECHANICAL SECTIONS.

2. Products

2.1. MATERIALS

2.1.1. This section shall apply to RTU-01, RTU-02, RTU-03, RTU-04 and MUA-01. Packaged heat/cool roof top units shall be Aaon, Daikin-McQuay, Carrier, Lennox, or JCI. Make-up air unit shall be Modine, Engineered Air, Dravo, Temprite, Resnor, Aaon or Bousquet.

2.1.2. Units shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Cooling capacity, heating capacity and fan performance shall be ARI certified. Complete unit shall be ETL- Canada listed.

2.1.3. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include final balancing of the supply and return fan assemblies, a refrigeration circuit run test, a unit control system operations checkout, test and adjustment of the gas furnace, a unit refrigerant leak test and a final unit inspection.

2.1.4. Each unit shall be complete with one or more of the following components as shown.

.1 ECM variable speed supply air fan section with centrifugal fans.

.2 Air cooled refrigeration section

.3 In-direct Propane gas-fired heating section

.4 Economizer fan and damper section

.5 Roof top enclosure

.6 Remote space 7 Day Programmable Heating/cooling thermostat with Tenant Override capability

.7 Filter section

.8 Roof mounting frame and curb Co-ordinate vibration isolation rails if required for sound sensitive applications

.9 Gas pressure regulator

2.1.5. Provide weatherproof rooftop enclosure for all above components, complete with an outside air inlet. Factory install piping and wiring of all components, complete with all safety and operating controls, and make ready for field connection of power and thermostat wiring to terminal strip, and gas piping to gas inlet.

2.1.6. Each unit shall have the capacity shown in the Roof Top Unit Schedules with 35 deg. C. (95 deg. F.) ambient air entering the condenser.

2.2. CASING

2.2.1. Exterior panels shall be double-wall construction. Insulation shall be a minimum of 1" thick with an R-value of 4.0, and shall be neoprene coated glass fiber. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance.

2.2.2. The frame and unit base shall be heavy gauge galvanized steel. Unit base shall overhang the roof curb for water runoff and shall have a formed recess that seats on the roof curb gasketing to provide a positive weather tight seal

2.2.3. Service doors shall be provided for the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

2.2.4. Stainless steel drain pans shall be sloped in two directions and comply with ASHRAE Standard 62.1. The drain pan shall extend beyond the leaving side of the coil.

2.3. FAN SECTION

2.3.1. Supply air fan shall be centrifugal with capacity to deliver the air quantity shown as outlined in the Roof Top Unit Schedule. Reinforce casings to prevent drumming.

2.3.2. Fan assemblies shall be statically and dynamically balanced for quiet operation. Provide slide out rails for servicing and maintenance of the fan. All fan assemblies shall employ solid steel fan shafts. Bearings shall be sized to provide an L-50 life of 250,000 hours.

2.3.3. The fan assembly shall have adjustable pitched sheaves on the motor. Bushings shall be used on all sheaves to allow for easy removal of the pulleys from the fan and motor shaft. Fixed bore pulleys fastened to the shaft by setscrews will not be allowed. The drives shall be selected with a 1.2 service factor.

2.3.4. Variable air volume systems, or units serving single zones shall be provided with variable speed drives to reduce airflow at cooling loads below 50% per ASHRAE 90.1-2010.

2.3.5. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. Acceptable alternate is a premium efficiency open drip proof motor suitable for use with a variable speed drive. Motor safeties shall include thermal overload protection and phase failure protection. Provide variable speed drive integral with the unit. If VFDs are used, note that harmonic filters are not integrated with the unit.

2.4. FILTER SECTION

1.1.1. Filter section shall be complete with Farr D/C or other approved manufacturer of 50 mm (2 in.) thick pre-filter consisting of throw away media in permanent frames. Media shall have an efficiency of 50 mm (2 in.) Merv 13-85%.

2.5. ECONOMIZER

2.5.1. Unit shall be provided with an outdoor air economizer section. The economizer shall include outdoor, return, and exhaust air dampers. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit.

2.5.2. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be opposed blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 4 cfm / square foot of damper area at 1” differential pressure per ASHRAE 90.1 Energy Standard.

2.5.3. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. If powered economiser is to be provided, delete barometric

2.5.4. Powered economizer shall provide free cooling using up to 100% outside air at all outside temperatures below 23.9 deg. C. (75 deg. F.) and minimum of approximately 10% outside air shall be provided above this temperature. Outside air damper shall close when unit is shut down. Include powered economiser option depending on return air path conditions Exhaust fans shall be direct drive, axial type. Blades shall be constructed with fabricated steel and shall be securely attached to fan shafts. All exhaust fan assemblies shall be statically and dynamically balanced. Motors shall be permanently lubricated, heavy-duty type, carefully matched to the fan load. Ground and polished steel fan shafts shall be mounted in permanently lubricated and sealed ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speeds.

2.5.5. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for “free” cooling. If outdoor air is suitable for “free” cooling, the outdoor air dampers shall modulate in response to the unit’s temperature control system.

2.6. REFRIGERATION AND CONDENSING SECTIONS

2.6.1. Coils shall have seamless copper tubes, mechanically bonded to aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes.

2.6.2. Air cooled refrigeration section shall provide stable operation down to 12.8 deg. C. (55 deg. F.) Only include where required, otherwise economiser will be sufficient outside air temperature.

2.6.3. Optional low ambient cooling to 0 degrees F shall be provided. Include only if required, otherwise delete.

2.6.4. Condenser fans shall be direct drive, axial type designed for low tip speed and vertical air discharge These fans are standard arrangement. Condenser fan rpm shall be 1140 rpm maximum. Fan blades shall be constructed of steel and riveted to a steel center hub. Condenser fan motors shall be heavy-duty, inherently protected, three-phase, non-reversing type with permanently lubricated ball bearing and integral rain shield.

2.6.5. The condenser fan shall be dynamically designed for low noise generation with low tip speeds. Fan blade shall be of a composite material.

2.6.6. All units of 6.5 ton capacity and above shall have minimum two independent refrigeration circuits.

2.6.7. Each circuit shall have fan cycling on at least one condenser fan to maintain positive head pressure. An ambient thermostat shall prevent the refrigeration system from operating below 20º F.

2.6.8. Each unit shall have multiple, heavy-duty scroll compressors. Each compressor shall be complete with gauge ports, crankcase heater, sight-glass, anti-slug protection, motor overload protection and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure. Compressors shall be isolated with resilient rubber isolators to decrease noise transmission.

2.6.9. Compressors

.1 The unit shall have multiple scroll compressors. One of the compressors shall be inverter driven and the unit controller must control the speed of the compressor to maintain the discharge air temperature.

2.6.10. Each circuit shall be complete with isolation ball valves on the suction and discharge sides of the compressor, a low pressure control, filter-drier, liquid moisture indicator/sight-glass, thermostatic expansion valve, and a manual reset high pressure safety switch. The thermal expansion valve shall be capable of modulation from 100% to 25% of its rated capacity. Sight-glasses shall be accessible for viewing without disrupting unit operation.

2.6.11. The refrigeration circuit shall have both low and high pressure safety switches. Temperature sensors shall be provided for measuring suction and discharge temperature of the refrigerant.

2.6.12. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for compressor startup under low head pressure conditions. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.

2.6.13. Each circuit shall be dehydrated and factory charged with Refrigerant 410A and oil.

2.7. HEATING SECTION

2.7.1. Propane gas fired heating section shall provide indirect heating through an aluminized steel or stainless steel heat exchanger if the return air is greater than 30% of the outside air volume; or Type 409 stainless steel heat exchanger if the return air is less than 30% of the outside air volume. Provide electric ignition with remote flame sensor. Unit shall be suitable for 1.74 kPa (7 in.wg.) gas pressure. The natural gas section shall be capable of modulating at a 10:1 staging ratio.

2.8. ELECTRICAL

2.8.1. Each unit shall be wired and tested at the factory before shipment. Wiring shall comply with all applicable UL and CSA standards. All wiring shall be number coded per the electrical wiring diagrams. All electrical components shall be labeled according to the electrical diagram and be CSA recognized where applicable.

2.8.2. Unit shall be suitable for 208/3/60 power supply as scheduled.

2.8.3. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit.

2.8.4. Provide mechanical screw-type lugs designed for copper conductors and sized to handle 125% of total heater load in the control panel for terminating power wiring. Provide a complete wiring diagram permanently attached to the inside of the control panel cover.

2.8.5. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

2.8.6. A GFI receptacle shall be unit mounted. The receptacle shall be powered by a factory installed and wired 120 V, 20 amp power supply. The power supply shall be wired to the line side of the unit's main disconnect, so the receptacle is powered when the main unit disconnect is off. This option shall include a GFI receptacle, transformer, and a branch circuit disconnect.

2.9. ROOF CURB

1.1.2. Provide a roof mounting frame for each unit.Roof curb shall be prefabricated 14-gauge galvanized steel, mounting curb for field assembly on the roof decking . The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and

condensing section. The curb shall be a minimum of 14" high. Gasket shall be provided for field mounting between the unit base and roof curb.

2.10. CONTROLS

2.10.1. Each unit shall be equipped with a microprocessor based direct digital control (DDC) system. The unit control system shall include all required temperature and pressure sensors, input/output boards, main microprocessor and operator interface. The unit control system shall perform all unit control functions including scheduling, unit diagnostics and safeties.

2.10.2. The stand-alone microprocessor controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand-alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

2.10.3. The microprocessor control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

2.10.4. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

2.10.5. The microprocessor controller shall have a built-in adjustable time schedule. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

2.10.6. The unit is to be programmed with a night setback or setup function, with a signal provided from a space sensor. Sensor options shall include a zone sensor with tenant override switch plus heating and cooling set point adjustment.

2.10.7. Provide a seven day programmable heating/cooling thermostat with integral selection switch for each unit. Provide a key-locked tamper-proof cover for each thermostat.

2.10.8. At the main micro-processor controller provide a unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:

.1 Return air temperature

.2 Discharge air temperature

.3 Outdoor air temperature

.4 Space air temp

.5 Outdoor enthalpy, high/low

.6 Dirty filter indication

.7 Airflow verification

.8 Cooling status

.9 Control temperature (Changeover)

.10 Cooling status/capacity

.11 Unit status

.12 All time schedules

.13 Active alarms w/time and date

.14 Previous alarms with time and date

.1 Optimal start

.2 System operating hours

.3 Fan

.4 Exhaust fan

.5 Cooling

.6 Individual compressor

.7 Heating

.8 Economizer

.9 Tenant override

2.10.9. On constant volume applications, the DDC controller shall include a supply air fan speed reset sequence. The speed of the supply fan shall be modulated from high speed to low speed based on: Include the supply fan reset sequence for constant volume applications

.1 Status of Compressor staging

2.11. SEQUENCE OF OPERATION

2.11.1. The unit shall be controlled on a time of day. The unit shall accept the programmed room temperature setpoint based on time of day, and current room temperature.

2.11.2. The supply air fan shall remain operational when the space is in occupied mode.

2.11.3. On a call for cooling, the RTU controller shall modulate both the supply air fan and the D/X cooling stages in sequence to maintain the current space temperature setpoint based on the current space conditions. When the cooling demand is less than 50%, the controller shall reduce the fan speed accordingly.

2.11.4. On a call for heating, the RTU shall operate the fan at 50% (programmable) speed and modulate the gas burner to maintain the current space temperature setpoint based on the current space conditions.

2.11.5. When the RTU is in un-occupied mode, the fan shall cycle with the D/X cooling stages and the gas burner as required to maintain the space unoccupied setpoint.

3. Execution

3.1. INSTALLATION

3.1.1. Provide all control wiring from thermostat and thermostat sub-base.

3.1.2.

3.1.3. Gas fired roof top unit shall not be installed closer than 2 m (6 ft.) to the edge of the roof.

3.1.4. Start up and test all unit functions and ensure proper operation. Factory technician to provide copy of start-up log to Owner and to demonstrate operation and maintenance to Owner.

END OF SECTION

23 77 13.00 Expansion Tanks

1. General

1.1. WORK INCLUDED

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

1.2. SUBMITTALS

1.2.1. Shop Drawings: Submit Shop Drawings of the tank support frames for structural review, and tank Drawings, including details and catalogue cuts of any standard components being incorporated into the system.

2. Products

2.1. MATERIALS

2.1.1. Replaceable bladder type expansion tanks shall be pre-charged replaceable bladder type equal to Explanflex Type 'AL', ITT Series 'B', Armstrong Type 'L', or Amtrol Extrol Series 'L' stamped 800 kPa (125 psi) operating pressure.

.1 Tanks shall be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.

.2 Tanks shall be all steel construction and replaceable bladder shall be heavy duty butyl rubber compound.

.3 Tank shall include 38mm (1-1/2 in.) threaded bottom inlet, air pressure gauge, 19mm (3/4 in.) drain valve, and air inlet connection to facilitate adjusting of pre-charge pressure to meet actual system conditions.

.4 Tanks shall be complete with ring base, and lifting rings.

.5 Tanks shall have capacities as indicated in the Expansion Tank Schedule.

2.1.2. Water Pressure Reducing Valve: Watts, or Cash Acme, equal to Watts UB5, screwed with low lead bronze body for operating pressures up to 2070 kPa (300 psi) at 71 deg. C. (160 deg. F.). Upstream from pressure reducing valve, Provide backflow prevention in accordance with Section 22 11 13.00 PIPES, VALVES, AND FITTINGS (PLUMBING SYSTEMS). Downstream from pressure reducing valve, provide a pressure relief valve. All components of valves in contact with water shall be non-ferrous. Set pressure reducing valve at 140 kPa (20 psig) and pressure relief valve at 210 kPa (30 psig). Pipe pressure relief valve to nearest floor or hub drain.

3. Execution

3.1. INSTALLATION

3.1.1. Expansion tanks shall be self-supporting and shall be placed on 100mm housekeeping pads.

3.1.2. Provide 19 mm (3/4 in.) drain line to nearest floor drain.

END OF SECTION

23 82 36.00 Wall Fin Convectors

1. General

1.1. WORK INCLUDED

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

1.2. SUBMITTALS

1.2.1. Shop Drawings: Submit Shop Drawings of unit enclosures, including unit sizes, capacities, connections, and construction details. Shop Drawing shall clearly show amount of expansion on each section and method of control.

2. Products

2.1. MATERIALS

2.1.1. Type “EB” electric wall fin convectors shall be Ouelett Series OMB mini aluminum draft barrier.

2.1.2. Wall fin convectors (bare fin or within enclosure) shall be of the lengths and have capacity as shown on the Mechanical Drawings.

2.1.3. Convector element in finished space within enclosure:

.1 Capacity shall be as shown on Drawings

.2 Stainless steel tubular heating element with aluminum fins and floating heating element on high-temperature nylon bushings reducing expansion noises.

2.1.4. Standard Unit Enclosure:

.1 2 mm thick (0.0787 in. - 14 US gauge) aluminum front cover

.2 1.2141 mm thick (0.0478 in. - 18 US gauge) satin coated steel cabinet

.3 Pencil-proof openings less than 6.4mm (0.25 in.).

.4 Trim strips and end caps to ensure a neat appearance

.5 Finish shall be custom colour to be selected by the Architect.

2.1.5. Provide a built-in thermostat with tamperproof control.

2.1.6. Units shall be suitable for 208/1/60 electrical supply.

3. Execution

3.1. INSTALLATION

3.1.1. Site measure for each section before fabrication and installation to ensure a correct fit of all components.

3.1.2. Electric wall fin heaters shall operate under their own local control.

END OF SECTION

23 82 39.13 Cabinet Heaters

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

2.1.1. Electric cabinet Heaters shall be Ouelett Series OCA.

2.1.2. Cabinets shall be of type shown and shall be not less then 1.2141 mm thick (0.0478 in. - 18 US gauge) steel, with custom colour finish to be slected by the Architect. Provide access to the control.

2.1.3. Unit shall not vibrate or rattle at any speed.

2.1.4. Provide built-in thermostat with tamperproof control.

2.1.5. Cabinet heaters shall have capacities as shown in the Cabinet Heater Schedule.

3. Execution

3.1. INSTALLATION

3.1.1. Install in accordance with manufacturer’s current installation guidelines.

3.1.2. Electric cabinet unit heaters shall operate under their own local control.

END OF SECTION

23 82 39.19 Unit Heaters

1. General

1.1. WORK INCLUDED

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

2. Products

2.1. MATERIALS

2.1.1. Electric unit heaters shall be Ouelett Series OAS.

2.1.2. Cabinets shall be of type shown and shall be not less then 1.2141 mm thick (0.0478 in. - 18 US gauge) steel, with custom colour finish to be slected by the Architect. Provide access to the control.

2.1.3. Unit shall not vibrate or rattle at any speed.

2.1.4. Provide built-in thermostat with tamperproof control.

2.1.5. Unit heaters shall have capacities as shown in the Unit Heater Schedule.

3. Execution

3.1. INSTALLATION

3.1.1. Install in accordance with manufacturer’s current installation guidelines.

END OF SECTION

EQUIPMENT NO.			UH-01		UH-02		FFH-01		AC-01		AC-02		AC-03					
Make			OAS		OAS		OCA		Berner		Berner		Berner					
Model			OAS03008AM		OAS03008AM		OCA08038		ALC08-1060EB056		ALC08-1060EB056		IDC12-3096EX					
Size																		
Maximum Air Flow Rate	cfm	L/s	510.0	241	510.0	241	500.0	236	1682.0	794	1682.0	794	4443.0	2,097		--		--
Air Pressure Drop	In H2O	Pa		--		--		--		--		--		--		--		--
HEATING CAPACITY	MBH	kW	10.2	3.0	10.2	3.0	27.3	8.0	19.1	5.6	19.1	5.6	61.5	18.0		--		--
Entering Water Temperature	°F	°C		--		--		--		--		--		--		--		--
Water Flow Rate	USgpm	L/min		--		--		--		--		--		--		--		--
Water Pressure Drop	ft H2O	kPa		--		--		--		--		--		--		--		--
COOLING CAPACITY	MBH	kW		--		--		--		--		--		--		--		--
Entering Air Temperature (db)	°F	°C		--		--		--		--		--		--		--		--
Entering Air Temperature (wb)	°F	°C		--		--		--		--		--		--		--		--
Leaving Air Temperature (db)	°F	°C		--		--		--		--		--		--		--		--
Leaving Air Temperature (wb)	°F	°C		--		--		--		--		--		--		--		--
Entering Water Temperature	°F	°C		--		--		--		--		--		--		--		--
Water Flow Rate	USgpm	L/min		--		--		--		--		--		--		--		--
Water Pressure Drop	ft H2O	kPa		-		-		-		-		-		-		-		-
Motor	hp	kW	0.03	0.02	0.03	0.02	0.07	0.05	0.20	0.15	0.20	0.15	3@1/2	3@0.37		--		--
REMARKS																		

EQUIPMENT NO.																		
Make																		
Model																		
Size																		
Maximum Air Flow Rate	cfm	L/s		--		--		--		--		--		--		--		--
Air Pressure Drop	In H2O	Pa		--		--		--		--		--		--		--		--
HEATING CAPACITY	MBH	kW		--		--		--		--		--		--		--		--
Entering Water Temperature	°F	°C		--		--		--		--		--		--		--		--
Water Flow Rate	USgpm	L/min		--		--		--		--		--		--		--		--
Water Pressure Drop	ft H2O	kPa		--		--		--		--		--		--		--		--
COOLING CAPACITY	MBH	kW		--		--		--		--		--		--		--		--
Entering Air Temperature (db)	°F	°C		--		--		--		--		--		--		--		--
Entering Air Temperature (wb)	°F	°C		--		--		--		--		--		--		--		--
Leaving Air Temperature (db)	°F	°C		--		--		--		--		--		--		--		--
Leaving Air Temperature (wb)	°F	°C		--		--		--		--		--		--		--		--
Entering Water Temperature	°F	°C		--		--		--		--		--		--		--		--
Water Flow Rate	USgpm	L/min		--		--		--		--		--		--		--		--
Water Pressure Drop	ft H2O	kPa		-		-		-		-		-		-		-		-
Motor	hp	kW		--		--		--		--		--		--		--		--
REMARKS																		

EQUIPMENT NO.			DHWH-01		DHWH-02		DHWH-03											
Make			PVI Industries		PVI Industries		PVI Industries											
Model			20L 100A-GCL		20L 100A-GCL		20L 100A-GCL											
Size																		
Storage Capacity	USgal	L	100	379	100	379	100	379		--		--		--		--		--
Recovery @ 100ºF Rise	GPH	L	233.0	68	233.0	68	233.0	68		--		--		--		--		--
Entering Water Temperature	°F	°C	40.0	4.4	40.0	4.4	40.0	4.4		--		--		--		--		--
Leaving Water Temperature	°F	°C	140.0	60.0	140.0	60.0	140.0	60.0		--		--		--		--		--
Gas Pressure	psig	kPa	0.25	2	0.25	2	0.25	2		--		--		--		--		--
Steam Pressure	psig	kPa		--		--		--		--		--		--		--		--
Steam Flow Rate	Lb/hr	Kg/hr		--		--		--		--		--		--		--		--
ELECTRICAL DATA																		
Number of Elements																		
Max kW per Element	KW																	
Total kW	KW																	
Volt/Phase/Cycle			120/1/60		120/1/60		120/1/60											
Motor	hp	kW		--		--		--		--		--		--		--		--
Remarks			Propane		Propane		Propane											

EQUIPMENT NO.																		
Make																		
Model																		
Size																		
Storage Capacity	USgal	L		--		--		--		--		--		--		--		--
Recovery	USgal	L		--		--		--		--		--		--		--		--
Entering Water Temperature	°F	°C		--		--		--		--		--		--		--		--
Leaving Water Temperature	°F	°C		--		--		--		--		--		--		--		--
Gas Pressure	psig	kPa		--		--		--		--		--		--		--		--
Steam Pressure	psig	kPa		--		--		--		--		--		--		--		--
Steam Flow Rate	Lb/hr	Kg/hr		--		--		--		--		--		--		--		--
ELECTRICAL DATA																		
Number of Elements																		
Max kW per Element	KW																	
Total kW	KW																	
Volt/Phase/Cycle																		
Motor	hp	kW		--		--		--		--		--		--		--		--
Remarks																		

EQUIPMENT NO.			ET-01		ET-02									
Make			Bell & Gossett		Bell & Gossett									
Model No.			1BN350LF		1BN368LF									
Location			L1 Service Room		L2 Storage Room									
System			Domestic Cold Water		Domestic Hot Water									
Approximate System Volume	gal	litres	360	1363	320	1211								
Fluid			Water		Water									
Minimum Temperature	deg f	deg C	40	4.4	40	4.4								
Maximum Temperature	deg f	deg C	40	4.4	140	60.0								
Precharge Pressure	psi	kPa	45	310	30	207								
System Fill Pressure	psi	kPa	45	310	30	207								
Maximum System Pressure	psi	kPa	60	414	45	310								
Fluid Expansion	gallon	litres		--	4.8	18								
Acceptance Factor			0.201		0.251									
Minimum Tank Volume	gallons	litres	528.0	1998	22.0	83								
Tank Dimensions														
Height	inches	mm	96	2438	31	787								
Diameter	inches	mm	48	1219	16	406								
Remarks			Hydropneumatic Tank		DHW									

EQUIPMENT NO.			EF-L02-01		EF-L03-01		EF-L03-02		EF-L03-03		EF-L03-04		TF-L02-01		EF-L02-02		EF-L02-03	
System			Sanitary Exhaust		Sanitary Exhaust		Kitchen Exhaust		Kitchen Exhaust		Kitchen Exhaust		Transfer Air		General Exhaust		Sanitary Exhaust	
Location			L2 Roof		L3 Roof		L3 Roof		L3 Roof		L3 Roof		L2 Electrical Room		L2 Roof		L2 Roof	
Service			Washroom		Washroom		Kitchen		Kitchen		Kitchen		Electrical Room		Loading & Storage		Washroom	
Airflow Rate	cfm	L/s	155	73	150	71	605	286	700	330	840	396	155	73	300	142	100	47
External Static Pressure	In H2O	Pa	0.50	124	0.50	124	0.75	187	0.75	187	1.0	249	0.25	62	0.25	62	0.50	124
Total Static Pressure	In H2O	Pa		--		--		--		--		--		--		--		--
Brake	hp	kW		--		--		--		--		--		--		--		--
Motor	hp	kW	0.167	0.12	0.167	0.12	0.50	0.37	0.50	0.37	0.20	0.15		--	0.25	0.19	0.125	0.09
SOUND DATA																		
2nd Band	Inlet	Outlet	75		75		77	84	79	85	79	86	55		77		58	
3rd Band	Inlet	Outlet	78		78		75	74	77	77	80	81	58		78		63	
4th Band	Inlet	Outlet	66		66		67	74	71	77	77	80	57		67		53	
5th Band	Inlet	Outlet	60		60		65	68	68	71	72	76	53		62		48	
Make			Cook		Cook		Cook		Cook		Cook		Cook		Cook		Cook	
Model			60C2B		60C3B		80CPS		80CPS		80CPS		GN-168		ACE-B		ACE-D	
Type			Downblast Centrifugal		Downblast Centrifugal		Flat Blade Centrifugal Blower		Flat Blade Centrifugal Blower		Flat Blade Centrifugal Blower		Inline Fan		Downblast Centrifugal		Downblast Centrifugal	
Size																		
RPM			1725		1725		1725		1725		1725				1623		1324	
Variable Inlet Vanes	Yes/No																	
Variable Frequency Drive	Yes/No		No		No		No		No		No		No		No		No	
Fan Efficiency	%																	
Remarks																		

EQUIPMENT NO.			**P-DHWR-01**													
System			Domestic Water													
Location			L2 Storage Room													
Service			Hot Water Recirc													
Fluid			Water													
Fluid Flow	USgpm	L/min	2	6		--		--		--		--		--		--
Head	ft H2O	kPa	25.00	74.60		--		--		--		--		--		--
Brake	hp	kW		--		--		--		--		--		--		--
Motor	hp	kW	0.17	0.12		--		--		--		--		--		--
RPM			3300													
Make			Bell & Gossett													
Model			PL-36B													
Variable Frequency Drives	Yes / No		No													
Pump Efficiency	%															
Remarks																
EQUIPMENT NO.																
System																
Location																
Service																
Fluid																
Fluid Flow	USgpm	L/min		--		--		--		--		--		--		--
Head	ft H2O	kPa		--		--		--		--		--		--		--
Brake	hp	kW		--		--		--		--		--		--		--
Motor	hp	kW		--		--		--		--		--		--		--
RPM																
Make																
Model																
Variable Frequency Drives	Yes / No															
Pump Efficiency	%															
Remarks																

EQUIPMENT NO.			RTU-01		RTU-02		RTU-03		RTU-04		MUA-01							
SUPPLY FAN	cfm	L/s	3,000	1,416	1,750	826	4,400	2,077	4,450	2,100	2,145	1,012		--		--		--
External Static Pressure	In H2O	Pa	1.5	373	1.5	373	1.5	373	1.5	373	0.8	187		--		--		--
RPM			1,042		1,413		1,179		1,184		1,446							
Motor	hp	kW	3.0	2.24	2.0	1.49	5.0	3.73	5.0	3.73	0.8	0.61		--		--		--
Fan Control (vfd/viv/cv)																		
Outlet sound Power Levels 1 to 6																		
Supply Fan Efficiency	%																	
RETURN FAN	cfm	L/s	2,445	1,154	1,600	755	4,400	2,077	4,300	2,030		--		--		--		--
External Static Pressure	In H2O	Pa	1.25	311	1.25	311	1.25	311	1.25	311		--		--		--		--
RPM																		
Motor	hp	kW		--		--		--		--		--		--		--		--
Fan Control (vfd/viv/cv)																		
Inlet sound Power Levels 1 to 6																		
Return Fan Efficiency	%																	
COOLING (total)	MBH	kW	119.9	35	61.7	18	154.0	45	153.8	45	114.7	34		--		--		--
Sensible Capacity	MBH	kW	78.7	23	45.1	13	112.1	33	113.2	33	57.8	17		--		--		--
Entering Air Temperature (db)	°F	°C	76.9	24.9	76.2	24.6	75.9	24.4	75.8	24.3	84.2	29.0		--		--		--
Entering Air Temperature (wb)	°F	°C	64.5	18.1	63.8	17.7	63.7	17.6	63.5	17.5	73.4	23.0		--		--		--
Leaving Air Temperature (db)	°F	°C	51.8	11.0	51.7	10.9	51.6	10.9	51.6	10.9	75.0	23.9		--		--		--
Leaving Air Temperature (wb)	°F	°C	50.1	10.1	51.2	10.7	51.2	10.7	51.1	10.6	62.5	16.9		--		--		--
EER	BTU/Wh																	
HEATING	MBH	kW	144.0	42	86.0	25	144.0	42	144.0	42	250.0	73		--		--		--
Entering Air Temperature (db)	°F	°C	55.6	13.1	61.1	16.2	62.2	16.8	63.4	17.4	-23.8	-31.0		--		--		--
Type (gas/elec/glycol)			Propane		Propane		Propane		Propane		Propane							
Stages of Electrical Heating																		
Entering Glycol Temperature	°F	°C		--		--		--		--		--		--		--		--
Glycol Flow Rate	USgpm	L/min		--		--		--		--		--		--		--		--
Glycol Pressure Drop	ft H2O	kPa		--		--		--		--		--		--		--		--
Gas Pressure Supplied	psig	kPa	0.25	2	0.25	2	0.25	2	0.25	2	0.25	2		--		--		--
Heating Efficiency	%																	
FILTERS																		
Pre-filter	in.	mm.		--		--		--		--		--		--		--		--
Final filter	in.	mm.		--		--		--		--		--		--		--		--
HUMIDIFICATION (integral)	lbs/hr	kg/hr										--		--		--		--
UNIT WEIGHT			1363lb		897lb		1483lb		1483lb		3212lb							
CONDENSER																		
Ambient Air Temperature	°F	°C	86.0	30.0	86.0	30.0	86.0	30.0	86.0	30.0		--		--		--		--
No. of Compressers																		
Compressor Motor (each)	hp	kW		--		--		--		--		--		--		--		--
ELECTRICAL																		
Volts/Phase/Cycle			208/3/60		208/3/60		208/3/60		208/3/60		208/3/60							
Maximum Circuit Ampacity			54		30		73		73		53.1							
REMARKS																		