

1 General

1.1. Conform to Sections of Division 01 as applicable.

1.1.1. This Section applies to and governs the Work of all Sections of Division 23.

1.1.2. Where other Mechanical Trades Sections conflict with requirements specified in this Section the Specifications of that particular Section govern.

1.2. RELATED SECTIONS

1.2.1. Conform to Section 26 05 01 – Common Work Results – Electrical.

1.3. REFERENCES

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|-----------|---|---|
| 1.3.1.1. | ANSI B31.1 to B31.9 | Piping. |
| 1.3.1.2. | ASTM | Boiler and Pressure Vessel Code, Section V: Non-destructive Examination. |
| 1.3.1.3. | CAN/CGSB-24.3-92 | Identification of Piping Systems. |
| 1.3.1.4. | CAN/CSA A23.1/A23.2-00 | Concrete Materials and Methods of Concrete Construction/Method of Tests for Concrete. |
| 1.3.1.5. | CAN/CSA S16.1-01 | Limit States Design of Steel Structures. |
| 1.3.1.6. | CAN/CSA-G40.20/G40.21-98 | General Requirements For Rolled or Welded Structural Quality Steel/Structural Quality Steel |
| 1.3.1.7. | CSA W117.2-01 | Safety in Welding, Cutting and Allied Processes. |
| 1.3.1.8. | CAN/CGSB-1.40-97 | Primer, Structural Steel, Oil Alkyd Type. |
| 1.3.1.9. | CSA B51-03 | Boiler, Pressure Vessel and Pressure Piping Code. |
| 1.3.1.10. | CSA B52-99 | Mechanical Refrigeration Code. |
| 1.3.1.11. | CSA W47.1-92(R2001) | Certification of Companies for Fusion Welding of Steel Structures. |
| 1.3.1.12. | CSA W48.-01 | Filler Metals and Allied Materials for Metal Arc Welding |
| 1.3.1.13. | CSA W59-1989(R2001)
(Imperial version) | Welded Steel Construction (Metal Arc Welding) |
| 1.3.1.14. | CSA W59-M1989(R2001)
(Metric version) | Welded Steel Construction (Metal Arc Welding) |
| 1.3.1.15. | ISO Standard 210816-1 1995 | |
| 1.3.1.16. | ISO Standard 2954 | |
| 1.3.1.17. | OPSS 1010-93 | Material Specifications for Aggregates - Granular A, B, M and Select Subgrade Material |
| 1.3.1.18. | ASHRAE 90.1-2001 | Energy standard For Buildings Except Low Rise Residential Buildings |

1.4. DESCRIPTION

- 1.4.1. Provide work in accordance with the full intent and meaning of the Drawings and Specifications as required to result in complete operating systems.
- 1.4.2. The Drawings show the arrangement and general design. The work is suitably outlined on the Drawings with regard to sizes, locations, general arrangements and installation details. The mains and connections thereto are shown more or less in diagram except where in certain cases the Drawings may include details giving the exact locations and arrangements required. Installation of specified equipment shall comply with the manufacturers installation recommendations contained in the product specific literature.

1.5. WORK COVERED BY OTHER DIVISIONS OR CONTRACTS

- 1.5.1. Refer to other Divisions of the specifications and to the Drawings for work related to the mechanical work to avoid interferences with work of other trades (and other Contractors) and to ensure proper completion of the work as a whole.

1.6. APPORTIONMENT OF THE WORK

- 1.6.1. Classify and apportion all materials and the performance of all labour to the several trades involved in accordance with all local customs, rules, regulations, jurisdictional awards, decisions, etc., insofar as they may apply and as required to efficiently execute the work involved in this contract.

1.7. PERMITS AND FEES

- 1.7.1. Obtain all permits required for the installation of mechanical trades work, arrange for inspections and tests therewith and pay all fees and costs for the permits, inspections and fees. Obtain permits immediately after notification of award of Contract.
- 1.7.2. Obtain copies of Drawings from the Owner for submission with application for permits.

1.8. MATERIALS AND EQUIPMENT

- 1.8.1. Use materials and dimensions as specified herein. Design of mechanical systems has been based on the equipment and sizes stated on the Drawings.
- 1.8.2. Locations and dimensions of openings, framing etc., where indicated on the Drawings, are based on an arrangement to suit the above. Be responsible to verify the actual size requirements of the openings, and notify the Owner immediately in case the dimensions supplied are impeded by field conditions.
- 1.8.3. Bear all costs for modification of openings resulting from failure to notify Owner prior to the fabrication or construction of openings or framing.

1.9. SUBMITTALS

1.9.1. Shop Drawings

- 1.9.1.1. Submit shop drawings in accordance with Submittals for item specified.
- 1.9.1.2. Supplement shop drawings with brochures where necessary or as required. The initial submission of shop drawings for any one trade shall include a checklist of all related specified items for that trade to ensure complete submittal and review.
- 1.9.1.3. Stamp as follows: **SHOP DRAWINGS FOR RECORD PURPOSES ONLY - CHECKED FOR CONSTRUCTION IN ACCORDANCE WITH CONTRACT DOCUMENTS.**
- 1.9.1.4. Record purpose submissions shall include:
 - Control Systems
 - Destratification Fans
 - Domestic Water Heaters
 - Ductwork Access Doors
 - Emergency Gas Detection System
 - Exhaust Fans
 - Expansion Tanks
 - Fire Extinguishers
 - Grilles, Diffusers, Registers, Louvres, Wall caps
 - Make-Up Air Units
 - Motorized Dampers
 - Natural Gas Piping Specialties
 - Piping Specialties
 - Piping Insulation
 - Plumbing Specialties
 - Plumbing Fixtures
 - Sensors, Gauging
 - Service Garage Equipment
 - Thermostats
 - Unit Heaters
- 1.9.1.5. Submit Drawings or Brochures to the Consultant, who will review such Drawings or Brochures. If items are not as specified, re-submit corrected copies.
- 1.9.1.6. General Shop Drawings showing more than one size or model will not be considered unless properly marked up.
- 1.9.1.7. Clearly indicate the materials and/or equipment being supplied, all details of construction, finish, accurate dimensions, capacities and performance on Shop Drawings and brochures. Have all drawings certified correct for construction by the manufacturer, before submission. Identify equipment Shop Drawings with designations as shown on the Drawings or in the Specifications. If not complied with, Shop Drawings will not be reviewed and will be returned to the Contractor.
- 1.9.1.8. Each Shop Drawing and/or brochure must bear the stamp and signature of a responsible official in the Contractor's and the subcontractor's organization for each

submission as evidence that the drawing has been checked against the requirements as called for in the specifications and Drawings. Also, in the case where the equipment attaches to and/or where there is external wiring connecting to other equipment, that it has been properly coordinated with this equipment, whether supplied under this or other contracts.

1.9.1.9. Revisions to shop drawings will not be allowed after they are reviewed unless further review and submission is required.

1.9.2. **Record Drawings:** Maintain an accurate dimensional record of all deviations and changes in ductwork, piping and equipment from the Contract Drawings. Transfer this information to two (2) sets of record drawings filed at the job site and submit to the Owner at the completion of the job.

1.9.3. **Installation and Start-up Instructions:** Furnish copies of installation instructions and copies of start-up instructions for any item of equipment when requested by the Owner.

1.9.4. **Operating and Maintenance Instruction Manuals**

1.9.4.1. Provide written copies of complete operating and maintenance instructions for equipment furnished under this Contract. Provide duplicate manual in electronic format on CD. Provide Operating and Maintenance Manuals as per specifications.

1.9.4.2. Bind instructions in loose-leaf 3-ring binders. When only one volume is required, provide a complete index. When more than one volume is required, include in the first book a complete index of all volumes and an individual index in each succeeding volume. Include the following manuals:

Control Shop Drawings and operating sequence including wiring of components.

Maintenance instructions including preventive maintenance instructions for components of the equipment.

Manufacturers' warranties and guarantees.

1.10. QUALITY ASSURANCE

1.10.1. Regulatory Requirements

1.10.1.1. Conform to governing Municipal or Provincial Codes, Rules and Regulations and/or Authorities having jurisdiction.

1.10.1.2. Codes and Standards referred to hereinafter are by inference, in each case, the latest issue of the Specified Code or Standard, including all revisions and amendments thereto as adopted and published at date of tender closing.

1.10.1.3. Do all work and supply all equipment in accordance with the requirements and recommendations of the latest issue of the applicable standards and codes of the:

National Standards of Canada (NS Can)
Canadian General Standards Board (CGSB)
Canadian Standards Association (CSA)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Society of Mechanical Engineers (ASME)
Ontario Building Code O.Reg. 403/97, as amended
Environmental Protection Act O. Reg. 189/94 as amended to O.Reg. 238/01 -
Refrigerants and 190/94 - Non-Venting of Refrigerants
Ontario Regulation 413/94 - Halon Fire Extinguishing Equipment
Ontario Fire Code
Ontario Ministry of Labour
American Society of Heating, Refrigerating and
Air Conditioning Engineers (ASHRAE)
Sheetmetal and Air Conditioning Contractors' National Association (SMACNA)
National Research Council Canada – Model Energy Code of Canada for Buildings
1997
American Society of Heating, Refrigeration and Air-Conditioning Engineers
(ASHRAE) Standard 90.1-2001 - Energy Standard For Buildings Except Low-Rise
Residential Buildings.

1.11. ELECTRICAL REQUIREMENTS

1.11.1. General

- 1.11.1.1. Comply with the requirements of the Electrical Safety Code.
- 1.11.1.2. All equipment specified in Division 23 or shown on the Mechanical drawings to be supplied and installed by Division 23 and wired by Division 26 unless specifically indicated otherwise. Generally, all wiring above 50 volts by Division 26 and all low voltage control wiring below 50 volts by Division 23 unless otherwise indicated.
- 1.11.1.3. The nominal electrical service available for mechanical equipment is 240 volts, 1 phase, 60 Hz and 120 volts, 1 phase, 60 Hz, unless specifically stated otherwise on the Drawings.
- 1.11.1.4. If the Owner gives approval of substitution of any item of mechanical equipment, include and pay for all necessary electrical changes (labour, materials, overhead, etc.) due to the substitution of the equipment.

2. Products – Not Used.

3. Execution

3.1. GENERAL CONSTRUCTION REQUIREMENTS

3.1.1. General

- 3.1.1.1. Conform with applicable requirements of the Occupational Health and Safety Act and Regulations for Construction Projects, Ontario Regulation 213/91 Amended to O. Reg 85/04.

3.1.2. Measurements and Deviations

- 3.1.2.1. Where any parts of the mechanical work are specifically located by dimensions on the Drawings, check and verify these dimensions on the site prior to installation.
- 3.1.2.2. Before installing ductwork and piping, review site conditions. Where interference may occur and departures from arrangements as shown are required, consult with and obtain approval from the Owner for proposed changes before proceeding with the work.
- 3.1.2.3. Should any discrepancies occur during installation of mechanical work which will necessitate major revisions to the mechanical trades work or the work of other trades or contractors, notify the Owner immediately and obtain written authorization before proceeding with the work.

3.1.3. Scaffolding and Hoisting Equipment

- 3.1.3.1. Provide all required scaffolding and hoisting equipment to carry out mechanical work as indicated on the drawings and outlined in specifications.

3.1.4. Overloading

- 3.1.4.1. During installation of mechanical work, do not load any part of the building structure with a load greater than it is capable of bearing. Bear full responsibility should any accident occur or damage result through the violation of this requirement.

3.1.5. Cutting and Patching

- 3.1.5.1. Cutting of holes up to 200 mm in diameter and related patching shall be done under Division 23. Holes and other openings larger than 200 mm in diameter, all chases, bulk-heads, furring and related patching shall be done by others. Read same for detailed information regarding cutting and patching.

3.2. PAINTING

- 3.2.1. With the exception of prime painting of miscellaneous steel or any other specific requirements as specified under the respective Sections of the Mechanical Trades Work, or equipment otherwise factory painted, all painting will be provided under Division 23.

3.2.2. Painting and Cleaning

- 3.2.2.1. Touch up minor damage to finish on equipment with standard factory applied baked enamel finish. If, in the Owner's opinion, the damage is too extensive to be remedied by touch up, replace damaged equipment.

- 3.2.2.2. Clean steel by scraping, wire brushing or other effective means to remove base scale, rust, oil, dirt or other foreign matter.
- 3.2.2.3. Apply one coat of zinc chromate iron oxide primer, conforming to CAN/CGSB-1.40M to all miscellaneous steel.
- 3.2.2.4. In the field, touch up all bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as hereinbefore specified.
- 3.2.2.5. Give two coats of primer to all surfaces which will be inaccessible after erection.
- 3.2.2.6. Thoroughly remove all foreign matter from steelwork on completion of installation.

3.3. PROTECTION

- 3.3.1. Protect all building openings before and after erection from weather and other hazards and keep in a clean and orderly manner.
- 3.3.2. Protect building openings to prevent damage or intrusion. Provide caps for curbs until construction is complete.

3.4. PERFORMANCE TESTING AND BALANCING

- 3.4.1. Assume responsibility for testing, balancing and placing all air handling and hydronic systems in operation, prior to final acceptance in presence and under direction of Owner.
- 3.4.2. Provide all instruments required to test and balance systems. Balance systems in accordance with design requirements indicated on the Drawings and in Specifications. Report to the Owner immediately any deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.
- 3.4.3. On completion of testing and balancing of all systems, submit to Owner a final typewritten report (4 copies) of findings, including complete data of pump and fan performance, pressures, air quantities, flow rates and ampere readings of all motors, taken at motor terminals when equipment is operating under full load conditions.
- 3.4.4. Submit with each copy of the report, complete sets of duct layout prints showing all locations at which test readings were taken, the air volume, velocity and static pressure in each supply and return duct, and the final reading at test points. Submit hydronic flow measurement reports showing flow rates at all heating system components.

3.5. ADJUSTMENT AND OPERATION OF SYSTEMS

- 3.5.1. When the work is complete, adjust all equipment items of the various systems for proper operation within the framework of design intent, and the operating characteristics as published by the equipment manufacturer.
- 3.5.2. Note: Additional instructions are specified under the respective Sections of this Division.

- 3.5.3. The Owner reserves the right to require the services of an authorized representative of the manufacturer in the event that any item of equipment is not adjusted properly. Arrange for such services and bear all incurred costs thereof. After completion of adjustments, place the systems in full operating condition and advise the Owner that the work is ready for acceptance.

END OF SECTION

1 General

1.1 SUMMARY

.1 Section includes:

.1 Use of mechanical systems during construction.

1.2 USE OF SYSTEMS

.1 Use of new and permanent heating and/or ventilating systems for supplying temporary heat or ventilation is not permitted during construction. In addition, the Contractor will ensure that no debris or contaminants enter new ductwork, piping, or equipment. Films or covers shall be used on open ends of ductwork and piping to prevent entry of aforementioned contaminants and debris during construction.

.2 Exhaust systems are not included in approvals for temporary heating ventilation.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Conform to Sections of Division 01 and Division 07 as applicable.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

2 Products - Not Used.

3 Execution

3.1 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

- .1 Install air vents at high points in piping systems.
- .2 Install ball type isolating valve at each automatic air valve.

- .3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with thread sealing compound or Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to installing saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom and conserve space.
- .8 Slope drainage piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and where indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as required and as indicated.
- .14 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Leave valves accessible for maintenance without removing adjacent piping.

- .5 Use ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
- .6 Install ball or butterfly valves for glycol service.
- .15 Check Valves:
 - .1 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls: Terminate flush with finished surface.
 - .2 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity where necessary.
 - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One-piece type with set screws. Chrome or nickel plated brass or Type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation shall conform to Division 07.

- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems to provide a clean system suitable for service. Isolate any heating equipment during flushing.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Consultant minimum 48 hours prior to performance of pressure tests. Conduct tests in presence of Consultant as deemed necessary.
- .2 Pework: Test as specified in relevant sections of Division 23.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Division 23.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Pay costs for repairs or replacement, re-testing and making good. Consultant shall determine whether repair or replacement is appropriate.
- .6 Insulate or conceal work only after approval and certification of tests by Consultant.

END OF SECTION

1. General

1.1. GENERAL REQUIREMENTS

- 1.1.1. Conform to Sections of Division 01 as applicable.
- 1.1.2. Conform to Section 26 05 01 – Common Work Results Electrical, as applicable.

1.2. REFERENCES

ANSI/NFPA 90A	- Air Conditioning and Ventilating Systems, Installation of.
ANSI/NFPA 90B	- Warm Air Heating and Air Conditioning Systems.
ASTM C335	- Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.
CAN/ULC-S102	- Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
CGSB 51-GP-9M	- Thermal Insulation, Mineral Fibre, Sleeving for Piping and Round Ducting.
CGSB 51-GP-52M	- Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
CSA HA Series	- CSA Standards for Aluminum and Aluminum Alloys.

1.3. DESCRIPTION

- 1.3.1.1. Furnish materials, equipment and labour required to apply thermal insulation to piping in accordance with full intent and meaning of Drawings and Specifications, including but not limited to the following:
 - Domestic Water Piping

1.4. SUBMITTALS

- 1.4.1. **Shop Drawings:** Before ordering any insulating materials, submit to the Owner a list of proposed insulation materials, exterior jackets and adhesive for the various services and equipment on the project. Must be performed in conjunction with Section 01 33 00 – Submittal Procedures.
 - 1.4.1.1. Insulating materials shall be new, undamaged and of the respective types specified for each specific application.
- 1.4.2. **QUALIFICATIONS**
 - 1.4.2.1. Use a recognized insulation applicator specializing in, and with an established

reputation for, this type of work.

1.4.3. REGULATORY REQUIREMENTS

- 1.4.3.1. Comply with all requirements of local and Provincial authorities/codes having jurisdiction.
- 1.4.3.2. Fire retardant type insulation materials, coverings and adhesives with flame spread/smoke developed ratings not exceeding 25/50 when tested in accordance with CAN/ULC-S102.
- 1.4.3.3. Properly identify insulation materials, coverings and adhesives when required by Federal and/or Provincial health and safety WHMIS legislation.

1.5. DELIVERY, STORAGE AND HANDLING

- 1.5.1.1. Retain insulation materials in original cartons or containers until immediately prior to application and keep dry during shipping and storage.
- 1.5.1.2. Keep adhesives in their original containers with manufacturer's name and catalogue number clearly stated. Protect contents against freezing.

2. Products

2.1. DOMESTIC WATER PIPING

- 2.1.1. Fibrous glass split sectional pipe insulation of thickness as listed on drawings with factory applied vapour barrier jacket and longitudinal self seal lap joint.

3. Execution

3.1. GENERAL

- 3.1.1. Perform insulation work using qualified insulation applicators, in accordance with latest trade application methods and to Owner's approval.
- 3.1.2. Clean all surfaces to be insulated to remove grime, grease, oil, moisture or other matter to ensure that insulation is applied to clean, dry surfaces.
- 3.1.3. Apply insulation under ambient temperature conditions in accordance with insulation or adhesive manufacturer's recommendations.
- 3.1.4. Do not apply insulation until piping has been tested, inspected, verified, and accepted by Owner.

- 3.1.5. Apply insulation neatly and tightly in unbroken lengths and with ends of sections firmly and squarely butted or engaged together.

3.2. DOMESTIC WATER PIPING

- 3.2.1. Apply 75mm (3”) wide butt strips of the same material as the factory applied jacket.
- 3.2.2. Insulate fittings, flanges and valves with fibrous glass insulation and finish with pre-moulded PVC cover, securely fastened and sealed to adjoining pipe covering with adhesive to form a vapour proof joint.
- 3.2.3. Do not insulate screwed union or final connection to equipment.

3.3. SURFACE FINISHES

- 3.3.1. Cover exposed piping insulation, valves and fittings with PVC jacketing for:
- Domestic Water Piping

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Electrical motors, drives and guards for mechanical equipment and systems.
 - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
 - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.
- .2 Conform to Sections in Division 01, as applicable.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 013300 – Submittal Procedures.
- .2 Provide maintenance data for incorporation into manual specified in Section 017800 – Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial/ regulations.

Part 2 Products

2.1 GENERAL

- .1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W to 3.73 kW: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208 V, unless otherwise indicated.
- .4 Motors 3.73 kW and up: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 600 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Consultant for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01780 - Closeout Submittals.

2.5 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.

- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
- .3 38 mm diameter holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

Part 3 Execution

3.1 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

END OF SECTION

1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 54 - Mechanical Identification.

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100-[01], Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-[01], Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-14.4-[M88], Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5-[M88], Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
 - .1 Thermometers.
 - .2 Pressure gauges
 - .3 Pressure/temperature gauges
 - .4 Isolating ball valves.

2 Products

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.
- .2 Ranges: to suit service.

2.2 DIRECT READING THERMOMETERS

- .1 Provide Winters Tim Series Model 9IT Industrial, variable angle type thermometer complete with 230 mm scale length, Valox impact resistant case, organic liquid filled tube, glass lens, 90mm stem, 19mm brass seperable thermowell, and dual scale.

2.3 THERMOMETER WELLS

- .1 Steel pipe: brass.

2.4 PRESSURE GAUGES

- .1 Provide FNW Mechanical Contractor's Pressure Gauge supplied complete with 115 mm dial with black and red dual pressure scales, 304 stainless steel case, acrylic lens, brass socket, 6mm NPT connection, phosphor bronze bourdon tube, and brass movement.
- .2 Include:
 - .1 Snubber for pulsating operation.
 - .2 Mini-ball isolation valve

3 Execution

3.1 GENERAL

- .1 Install gauging to be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated:
- .3 Use extensions where thermometers are installed through insulation if required.

3.3 PRESSURE GAUGES

- .1 Install in following locations:
 - .1 Suction and discharge of pumps.
 - .2 In other locations as indicated.
- .2 Install mini-ball valves for gauge isolation.
- .3 Use extensions where pressure gauges are installed through insulation if required.

END OF SECTION

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1 General

1.1 Conform to Sections of Division 01 as applicable.

1.1.1 Conform to Section 23 05 00 – Common Work Results - Mechanical as applicable.

1.2 RELATED SECTIONS

1.2.1 Conform to Section 26 05 01 – Common Works Electrical.

1.3 REFERENCES

ANSI B31.1 to B31.9 inclusive: Piping

CAN/CGSB-1.40-97

Primer, Structural Steel, Oil Alkyd Type

CSA B51-03

Boiler, Pressure Vessel, and Pressure Piping Code

CSA B52-99

Mechanical Refrigeration Code

CAN/CSA-G40.20/G40.21-98

General Requirements for Rolled or Welded
Structural Quality Steel/Structural Quality Steel

CAN/CSA-S16-01

Limit States Design of Steel Structures

CSA W47.1-92 (R2001)

Certification of Companies for Fusion Welding of
Steel Structures

CAN/CSA W48-01

Filler Metals and Allied Materials For Metal Arc
Welding.

CSA W59-M1989 (R2001)

Welded Steel Construction (Metal Arc Welding)

CAN/CSA W117.2-01

Safety in Welding, Cutting and Allied Processes

1.4 SUBMITTALS

1.4.1 **Shop Drawings:** Prepare and submit shop drawings as detailed in Section 01 33 00 - Submittal Procedures.

2 Products

2.1 MATERIALS

2.1.1 Concrete Inserts and Anchors

-Readhead by ITW

-SSS by Star

-Parabolt by USM

- Kwik-Bolt by Hilti

2.1.2 Beam Clamps

- Grinnell

- Myatt

- Hilti

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2.1.3 Concrete Grout:

- Sikagrout 212 by Sika Canada Inc.
- Embeco 636 Grout by Master Builders
- Sealtight V-3 Grout by W.R. Meadows

2.1.4 Pipe Hangers:

- Grinnell
- Myatt
- Hilti

2.1.5 Zinc-Rich Paint: Galvafroid by W.R. Meadows.

2.1.6 Primer: CAN/CGSB-1.40-M.

3 Execution

3.1 GENERAL CONSTRUCTION REQUIREMENTS

3.1.1 Attachment to Building Construction

- 3.1.1.1 Use self drilling expansion type concrete inserts for securing miscellaneous equipment and materials to masonry or concrete construction already in place, of sufficient number and size to prevent concrete from breaking away. Use of powder or power actuated fasteners will not be allowed unless prior written approval is obtained from Owner.
- 3.1.1.2 Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.
- 3.1.1.3 Provide beam clamps of 2-bolt design and of such type that rod load is transmitted only concentrically to beam web centre line. Use of "C" and "I" beam side clamps and other similar items will not be allowed without written consent of Owner.
- 3.1.1.4 Where roof or floor framing consists of open web or long span steel joists, ensure that hangers are located at or within 150 mm (6") of joist top or bottom chord panel points, otherwise provide additional structural steel as required where hanger spacing does not coincide with joist spacing. Design suspension assembly such that hanger load is transmitted only concentrically to supporting joist. Do not use "C" and "I" beam side clamps, brackets and other similar, without written consent of Owner.

- 3.1.1.5 Locate secondary structural steel members between joists at or within 150 mm (6") of top or bottom chord panel points. Where secondary structural steel member cannot be located at or near joist panel point, provide additional diagonal structural steel web member(s) designed for applicable load to nearest panel point in opposite chord member. This condition may be waived if load to be suspended between panel points is not in excess of 45 kg (100 lbs). Diagonal hangers which will induce lateral stresses in chord members of joist will not be permitted. Submit shop drawings of suspension assembly indicating location of suspension or support points, max load at each suspension point, location and size of hangers, brackets and intermediate framing members when required, and also details of connection to building structure.

3.2 PIPING CONSTRUCTION METHODS

3.2.1 General

- 3.2.1.1 Unless specified otherwise herein, construct and install piping in accordance with ANSI Sections B31.1 to B31.9 as applicable to service.

3.3 PIPE HANGERS AND SUPPORTS

3.3.1 General

- 3.3.1.1 Support or suspend piping with necessary hangers, structural supports and/or brackets as indicated on Drawings and/or as required, to prevent sagging, warping and vibration and to allow for movement due to expansion and contraction. Place hangers and supports close to fittings, valves and/or other heavy parts.
- 3.3.1.2 Do not allow loads of any nature to be transmitted through piping connections to equipment not specifically designed for such loads. Where flexible connections are not called for at connections to equipment, support pipe by stands attached to both pipe and supporting structure so that force in any direction is not transmitted to equipment.
- 3.3.1.3 Provide suitably dampened spring hangers for first 3 supports from equipment connection on piping subject to excessive movement or shock from any source, thermal expansion and contraction, selected in accordance with ANSI B31.1. Where it is evident that no undue loads will be transmitted to equipment by system concerned, i.e. small bore connections to comparatively large equipment, cold service piping not subject to shock, etc., then spring hangers may be omitted and standard hangers used.
- 3.3.1.4 Use trapeze type hangers where pipes are grouped together, unless specifically indicated otherwise on Drawings. Suspend horizontal member by adjustable rods with locking feature for maintaining level and slope. Space trapeze type hangers based on closest interval required by any pipe supported thereon. Provide any auxiliary steel required to support trapeze between building steel.

3.3.1.5 Do not hang any pipe from another pipe unless specifically indicated on Drawings.

3.3.2 **Hangers**

3.3.2.1 For insulated piping up to NPS 4 carrying liquids at temperatures 10.5 deg C (51 deg F) and higher, use standard weight clevis hangers with level adjustment and locknut.

3.3.2.2 For copper tubing provide copper coated hangers. Regulations of some municipalities require that copper tubing be taped with plastic tape at hanger location, or hanger be provided with plastic insert. Meet these requirements when required, in which case copper coating may be omitted on hanger.

3.3.2.3 Attach hanger rods to building structure by means of malleable iron beam clamps, concrete inserts, and/or approved anchors as hereinbefore specified.

3.3.3 **Hanger Spacing**

3.3.3.1 For horizontal runs of plumbing and drainage piping comply with hanger spacing requirements of OBC.

3.3.3.2 For horizontal runs of black or galvanized steel pipe, other than for plumbing service, do not exceed max distances between supports and with min dia rods as follows:

<u>Pipe Size (NPS)</u>	<u>Distance m (ft)</u>	<u>Dia. of Rod mm (in)</u>
Up thru 1-1/4	1.8 (6)	10 (3/8)
1-1/2	1.8 (6)	10 (3/8)
2	3.05 (10)	10 (3/8)
2-1/2 & 3	3.66 (12)	12 (1/2)
4	4.27 (14)	16 (5/8)
6	5.18 (17)	19 (3/4)
8	5.79 (19)	22 (7/8)
10 & 12	6.71 (22)	22 (7/8)

3.3.3.3 Provide additional hangers in locations where there are concentrated loads such as valves, specialties and other such items.

3.3.3.4 For horizontal runs of copper tubing for services other than plumbing, do not exceed 1.8 m (6 ft) between hangers for lines up to and including NPS 3/4 and 2.4 m (8 ft) for lines of NPS 1 and larger.

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MISCELLANEOUS STEEL

3.3.4 General

3.3.4.1 Supply and install miscellaneous structural supports, platforms and braces as may be required to hang or support piping unless Drawings or other Sections of Specifications state otherwise.

3.3.4.2 Submit detailed shop drawings to Owner for review before commencing fabrication.

3.3.5 Materials and Fabrication

3.3.5.1 Conform to CAN/CSA-S16 for materials, design of details and execution of work.

3.3.5.2 Conform to CAN/CSA-G40.20/G40.21, grade 300W for structural shapes, plates, and other similar items.

3.3.5.3 Use welded construction wherever practicable, with bolted joints allowed for field assembly using high strength steel bolts. Chip welds to remove slag, and grind smooth.

3.3.5.4 Conform to latest issue of following CSA Specifications.

CSA W47.1, for qualification of welders
CSA W48.1-M, for electrodes (only coated rods allowed)
CSA W59-M, for design of connections and workmanship
CSA W117.2, for safety

3.3.6 Painting and Cleaning

3.3.6.1 Touch up minor damage to finish on equipment with standard factory applied baked enamel finish. If, in Owner's Designee's opinion, damage is too extensive to be remedied by touch up, replace damaged equipment.

3.3.6.2 Clean steel by scraping, wire brushing or other effective means to remove base scale, rust, oil, dirt or other foreign matter.

3.3.6.3 Apply 1 coat of zinc chromate iron oxide primer, conforming to CAN/CGSB-1.40-M to miscellaneous steel.

3.3.6.4 In field, touch up bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as herein before specified.

3.3.6.5 Give 2 coats of primer to surfaces which will be inaccessible after erection.

3.3.6.6 Remove foreign matter from steelwork on completion of installation.

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3.3.7 With exception of prime painting of miscellaneous steel or any other specific requirements as specified above, or equipment otherwise factory painted, painting will be provided under Division 23.

3.4 **CONCRETE INSERTS**

3.4.1 Install inserts required for attachment of hangers, either for suspension of piping or equipment.

3.4.2 For masonry or poured concrete construction use expansion type units. Insert into concrete after concrete has cured. Anchors or inserts installed by explosive means shall not be used.

END OF SECTION

1 General

1.1. Conform to Sections of Division 01 as applicable.

1.1.1. Conform to Section 23 05 00 Common Work Results – Mechanical as applicable.

1.2. RELATED SECTIONS

1.2.1. Section 26 05 01 Common Work Results - Electrical.

1.3. REFERENCES

1.3.1. CGSB 24.3-92 Identification and Classification of Piping Systems.

1.4. SUBMITTALS

1.4.1. Shop Drawings

- 1.4.1.1. Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- 1.4.1.2. Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
- 1.4.1.3. Submit WHMIS MSDS - Material Safety Data Sheets in accordance with specifications.

2 Products

1.5. MANUFACTURERS

1.5.1. Pipe Labels, Identification Tapes and Tags

- Brady
- Safety Supply Co.
- S.M.S.
- Revere-Seton

1.6. MANUFACTURERS' NAMEPLATES

- 1.6.1. Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.
- 1.6.2. Indicate equipment tag number as indicated on Drawings and equipment size, model, manufacturer's name, serial number, performance rating, voltage, cycle, phase and power

of motors.

1.7. EQUIPMENT LABELS

- 1.7.1. Provide labels for all mechanical and electrical equipment installed under this Division, adequately describing the function or use of the particular equipment involved and including equipment number and equipment name generally as listed on the Drawing Schedules. Submit list of labels to the Consultant for review. Do not commence production of labels until after receipt of Consultant review.
- 1.7.2. Fit labels to electrical equipment, including, but not limited to: motor starters, pushbutton stations, control panels, time switches, disconnect switches, and contactors or relays in separate enclosures.

1.8. PIPE IDENTIFICATION

- 1.8.1. Label all piping installed under this Division to indicate the content and direction of flow.
- 1.8.2. After finished painting is complete, identify each pipe with stencils and stencil paint. Alternatively, use SMS Coil-Mark or adhesive style building service pipe markers.
- 1.8.3. Colour coding to be as per the following schedule. For all other services, provide colour coding in conformance with CAN/CGSB-24.3 and ANSI A131 as follows:

Pipe and Valve Identification				
Pipe Marker Legend	Valve Tag Legend	CGSB Hazard Classification	Background Colour	Text Colour
Raw Water	RAW	Low	Green	White
Sea Water	SEA.W	Low	Green	White
City Water	CI.W	Low	Green	White
Cold Water	C.W.	Low	Green	White
Distilled Water	DI.W	Low	Green	White
Demineralized Water	DE.W	Low	Green	White
Condenser Water Supply	COND.W.S.	Low	Green	White
Condenser Water	COND.W.R.	Low	Green	White

Return				
Chilled Water Supply	CH.W.S.	Low	Green	White
Chilled Water Return	CH.W.R.	Low	Green	White
Chilled Water	CH.W	Low	Green	White
Domestic Cold Water Supply	D.W.S.	Low	Green	White
Domestic Hot Water Supply	D.H.W.S.	Low	Green	White
Domestic Hot Water Recirc.	D.H.W.R	Low	Green	White
Hot Water Heating Supply (up to 120C)	H.W.H.S	Hazardous	Yellow	Black
Hot Water Heating Return (up to 120C)	H.W.H.R	Hazardous	Yellow	Black
High Temp. Hot Water Heating Supply (above 120C)	H.T.H.S.	Hazardous	Yellow	Black
High Temp. Hot Water Heating Return (above 120C)	H.T.W.R	Hazardous	Yellow	Black
Make-Up Water	M.U.W	Low	Green	White
Boiler Feed Water	B.F.W	Hazardous	Yellow	Black
Condensate Return - Gravity	C.R.G.	Hazardous	Yellow	Black
Condensate Return - Pumped	C.R.P.	Hazardous	Yellow	Black
Blow Off	B.O.	Hazardous	Yellow	Black
Treated Water	T.W.	Low	Green	None
Brine	B.	Low	Green	None
Waste Water	W.W.	Low	Green	None
Storm Sewer	S.S.	Low	Green	None
Sanitary Sewer	SAN.S	Low	Green	None

Combination Sanitary Storm Sewer	C.S.S.S	Low	Green	None
Acid Drain	A.D.	Hazardous	Yellow	Black
Isotope Drain	I.D.	Hazardous	Yellow	Black
Refrigerant Suction (include refrigerant No.)	REF.S	Hazardous	Yellow	Black
Engine Exhaust	E.E.	Hazardous	Yellow	Black
Fuel Oil (show type No.)	F.P. (No.)	Hazardous	Yellow	Black
Steam (indicate pressure)	S.kPa (psig)	Hazardous	Yellow	Black
Lube Oil	L.O.	Hazardous	Yellow	Black
Hydraulic Oil	H.O.	Hazardous	Yellow	Black
Instrument Air	I.A.	Low	Green	White
Gasoline	G.	Hazardous	Yellow	Black
L.P. Gas	L.P.G.	Hazardous	Yellow	Black
Natural Gas	N.G.	Hazardous	Yellow	Black
Chlorine	CHLOR.	Hazardous	Yellow	Black
Nitrogen (pressure 700 kPa and lower)	NIT.	Low	Green	White
Oxygen (not medical gas)	OXY.	Hazardous	Yellow	Black
Vacuum (not medical gas)	VAC.	Low	Green	White
Compressed Air – indicate pressure (700 kPa and lower)	C.A. kPa	Low	Green	White
Compressed Air – indicate pressure (over 700 kPa)	C.A. kPa	Hazardous	Yellow	Black
Fire Protection Water	F.P.W.	Fire Protection	Red	White
Sprinkler Water	S.W.	Fire Protection	Red	White

Carbon Dioxide (fire protection)	CO	Fire Protection	Red	White
Vent (plumbing)	V.P.	Low	Green	White
Vent	V.	Hazardous	Yellow	Black

- 1.8.4. Where outside diameter of pipe (or insulation) exceeds 75 mm (3"), provide labels with a minimum width of 64 mm (2-1/2") and 50 mm (2") high letters. Where outside diameter of pipe (or insulation) is 75 mm (3") or less, provide labels of 29 mm (1-1/8") width and 25 mm (1") high lettering. Length of labels as dictated by legend.
- 1.8.5. Supply and attach to each valve a 50mm x 50mm (2" x 2") lamacoid tag with valve number. Provide a valve chart and co-ordinate valve numbers with the "As-built" plan and schematic drawings
- 1.8.6. All control, drain, and test connection valves shall be provided with signs indicating their purpose.
- 1.8.7. Identify all fans, pumps, air handling equipment, boilers, chillers, controls, starters, switches, pushbuttons, and all other equipment as to service by lamacoid engraved nameplate.
- 1.8.8. All tags and nameplates shall be securely fastened to the device they identify.
- 1.8.9. Identification font height shall be 20 mm minimum.

1.9. CONTROLS IDENTIFICATION

- 1.9.1. Identify each piece of equipment, including sensors, controlled devices, and control panels, with a nameplate identifying the equipment and functions with a letter and number designation.
- 1.9.2. Provide a single line diagram for the control points located in each controls enclosure.
- 1.9.3. Nameplates shall be minimum size 75mm x 25mm (3" x 1") and 3.2mm (1/8") thick laminated plastic with black face and white center and 6.4mm (1/4") deep engraved lettering. Nameplates shall be securely attached to the equipment and listed in the Operating and Maintenance manual.
- 1.9.4. Printed nametags are acceptable for cabinet mounted components providing they are securely attached.
- 1.9.5. Additional labeling requirements when applicable:

- 1.9.5.1. Color code wiring consistently throughout the installation and generally match color coding of internal wiring of pre-wired components.
- 1.9.5.2. Label wiring and pneumatic tubing with point name using Thomas & Betts 12-character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring/tubing run.
- 1.9.5.3. Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.
- 1.9.5.4. Label sensors mounted in occupied spaces such as temperature, humidity and carbon dioxide sensors with point name (or TEC ID.) using Thomas & Betts 12-character label, or equal by Brady. Label to be black lettering on clear backing.
- 1.9.5.5. Label relays and controllers inside panels using Thomas & Betts 12-character label, or equal by Brady.
- 1.9.5.6. Provide blue, 12mm (½”) diameter, sticker on ceiling T-bar below ceiling mounted equipment such as VAV boxes controllers with VAV box # on the sticker with thin permanent black mark pen.
- 1.9.5.7. Provide red, 12mm (½”) diameter, sticker on ceiling T-bar below fire protection equipment mounted in ceiling space such as fire dampers.
- 1.9.5.8. Provide red, 12mm (½”) diameter, sticker on emergency light fixture frame. Include circuit # on sticker with thin permanent black mark pen.
- 1.9.5.9. Provide yellow, 12mm (½”) diameter, sticker on T-bar below fan equipment mounted in ceiling space such as exhaust fans. Include fan # on sticker with thin permanent black mark pen.

1.10. ELECTRICAL EQUIPMENT IDENTIFICATION

- 1.10.1. As specified in Division 26.

2. Products – Not Used.

3. Execution

3.1. GENERAL

- 3.1.1. Clean all surfaces before painting or attaching adhesive labels.
- 3.1.2. Locate labels and identification in conspicuous location to facilitate easy reading from operating floor.
- 3.1.3. Do not insulate, cover, or paint over labels.

3.2.EQUIPMENT LABELS

- 3.2.1. Securely adhere labels to the equipment.

3.3.PIPE IDENTIFICATION

- 3.3.1. Locate labels as follows:
 - 3.3.1.1. At every end of every pipe run, adjacent to the valve or item of equipment serviced.
 - 3.3.1.2. At all valves, tees and changes of direction.
 - 3.3.1.3. At intervals of 15 m (50'-0") along every exposed pipe run exceeding 15 m (50'-0") in length.
- 3.3.2. Locate labels so they are visible from 1.5 m (5'-0") above the adjacent floor or platform.

END OF SECTION

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Part 1 General

1.1 Conform to Sections of Division 01 as applicable.

.1 Conform to Section 23 05 00 - Common Work Results Mechanical as applicable.

1.2 REFERENCES

.1 Perform testing and balancing in accordance with the current issue of the Associated Air Balance Council Standards for Total System Balance and SMACNA Standards where applicable. Use recently calibrated instruments and state date of calibration in all reports.

1.3 Definitions

.1 **"BALANCING"** to proportion and regulate flows from and to the equipment at appropriate pressures in accordance with the design intent.

.2 **"TESTING"** to measure, interpret and report in writing, such parameters as may be required to verify design compliance and as hereafter specified.

1.4 DESCRIPTION

.1 The work to be performed under this Section includes the performance testing and balancing of heating, ventilating and air conditioning system equipment and of the air and duct systems, including all labour, materials and equipment required to carry out this work, and co-operating with the mechanical contractor who will operate the systems and upon request from this contractor, make any required adjustments to the systems to meet the specified and intended performance.

.1 The principal items of work are as follows:

- Performance testing and balancing of all equipment
- Survey the installed automatic controls and verify their functional performance

1.5 DESIGN REQUIREMENTS, PERFORMANCE REQUIREMENTS

.1 Tolerances

.1 Balance all equipment to the performance parameters indicated on drawings and in the specifications. If interpretation, clarification or additions to performance

.2 Parameters are required, request such information from the Owner.

.3 Balance systems to within the following tolerances:

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Equipment and Low pressure ducts
0 to 0.5 kPa (0 to 2" W.G.) 5% of full flow

1.6 SUBMITTALS

.1 Reports

.1 Submit final report upon completion of TAB. Submit to Owner.

.2 **Record Drawings:** Record, in red ink, any changes to the set of plans submitted with the review and recommendation report while the work progresses. At the completion of the work submit to the Owner.

1.7 QUALITY ASSURANCE

.1 **Qualifications:** Use an independent Testing and Balancing Firm with a minimum of five years' experience in this type of work to carry out performance testing and balancing.

1.8 SEQUENCING AND SCHEDULING

.1 Coordinate balancing work so as maintain turn-over schedule for facility. Advise Commissioning Agent 96 hours prior to the start of balancing work.

Part 2 Products

2.1 MATERIALS

.1 Supply all test equipment required to perform the work of this Section.

Part 3 Execution

3.1 GENERAL

.1 Coordination and Cooperation

.1 The Testing and Balancing Firm will co-operate with the Mechanical Contractor giving adequate prior notification of request for services of tradesmen, and co-ordinating his efforts so that items requiring replacement and/or delivery time (sheaves, motors, etc.) are tested as early as possible.

.2 The Mechanical Contractor and the pertinent trades shall co-operate with the Testing and Balancing Firm and shall provide the following assistance and/or services:

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- Schedule sufficient time so that the initial testing and balancing can be completed and co-ordinate with the trades involved.
 - Keep the Testing and Balancing Company informed of any major changes made during construction and provide them with a set of drawings and approved shop drawings.
 - Provide immediate labour from pertinent mechanical trades and tools, equipment and materials to make equipment and system alterations and adjustments, as required including control adjustments.
 - Make available all equipment data (Shop Drawing Performance Data and operating instructions) to the Testing and Balancing Firm.
- .3 As part of the co-ordination effort, the Mechanical Contractor shall be fully responsible for the systems having been constructed and adjusted to provide optimum performance. Any re-adjusting required as the result of spot checks by the Owner shall be done at no additional cost to the Owner.

3.2 PROCEDURE

.1 General

- .1 Review all pertinent plans, specifications, shop drawings, interference drawings and other documentation to become fully familiar with the systems and their specified and intended performance.
- .2 Report any objectionable noise or vibration.
- .3 Operate, test and balance all equipment over their entire design range of operation including return air and supply air. Record sufficient data to verify compliance with design requirements.

.2 Data Required

- .1 Submit the following data as a minimum. If this contractor's standard forms provide for additional data, submit this data as well. Indicate where tests were not specifically made. Do not repeat design data or other values not specifically tested.
- .2 Motors
 - Manufacturer
 - Model and Serial number
 - Rated amperage and voltage
 - Rated horsepower
 - Rated RPM
 - Corrected full load amperage
 - Measured amperage and voltage

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- Calculated kW (BHP)
- Measured RPM
- Sheave size, type and manufacturer

.3 Make-up Air Units

- Manufacturer
- Model and Serial number
- Rated L/s (CFM)
- Rated RPM
- Rated coil/filter pressures (suction and discharge)
- Measured L/s (CFM)
- Measured RPM
- Measured coil/filter pressures (suction and discharge)
- Pulley size, type and manufacturer
- Belt size and quantity

.4 Air Systems (including inlets and outlets)

- Grille, register or diffuser reference number and manufacturer
- Grille, register or diffuser location
- Design flow rates in L/s (CFM) at terminals
- Measured flow rates in L/s (CFM) at terminals

.3 **Site Visits:** Visit the site as required to carry out testing and balancing of the equipment to establish system flows.

.4 **Final Report:** Submit the final report to the Consultant. Submit four (4) type-written copies of the final report.

3.3 ACCEPTANCE AND FOLLOW-UP

.1 **Deficiencies:** Report any deficiencies in the equipment performance resulting in design requirements being unobtainable immediately to the Owner.

.2 **Acceptance**

- .1 The substantial performance of the Mechanical Contractor shall be considered reached when the final Balancing Reports from this Section are accepted by the Owner and in the opinion of the Owner all systems and equipment have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.

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3.4 ADDITIONAL TESTING

- .1 The Owner may request such additional testing in conjunction with this project as is deemed necessary.

END OF SECTION

1. General

1.1. Conform to Sections of Division 01 as applicable.

1.2. RELATED SECTIONS

1.2.1. Section 23 05 00 - Common Work Results - Mechanical

1.2.2. Section 23 05 12 - Thermal Insulation for Piping.

1.3. REFERENCES

ANSI/NFPA 90A	Air Conditioning and Ventilating Systems, Installation of.
ANSI/NFPA 90B	Warm Air Heating and Air Conditioning Systems.
ASTM A167-99	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM C335-95	Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.
ASTM C411-97	Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
ASTM C547-00	Thermal Insulation, Mineral Fibre, Sleeving for Piping and Round Ducting (replaces CGSB 51-GP-9M)
ASTM C553-02	Thermal Insulation, Mineral Fibre, Blanket for Piping, Ducting, Machinery and boilers. (replaces CGSB 51-11M)
CAN/ULC S701-01	Thermal Insulation, Polystyrene, Boards and Pipe Covering (replaces CAN/CGSB-51.20)
CAN/CGSB-51.12	Cement, Thermal Insulating and Finishing.
CAN/CGSB-51.40	Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
CAN/ULC-S102-1988(R2000)	Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
CGSB 51-GP-52M	Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
CGSB 51-GP-53-95	Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels and Round Ducts.
CSA HA Series	CSA Standards for Aluminum and Aluminum Alloys.
MNECB 1997	Model National Energy Code of Canada for Buildings
ASHRAE 90.1-2001	Energy Standard for Buildings Except Low Rise Residential buildings.

1.4. DESCRIPTION

- 1.4.1. Furnish materials, equipment and labour required to apply thermal insulation to ductwork and equipment in accordance with full intent and meaning of Drawings and Specifications, including but not limited to the following:

Sheet metal work

1.5. SUBMITTALS

- 1.5.1. Product Data:

- 1.5.1.1. Submit product data in accordance with Section 01 33 00 – Submittal Procedures.
- 1.5.1.2. Before ordering any insulating materials, submit to the Owner a list of proposed insulation materials, exterior jackets and adhesive for the various services and equipment on the project. Deviation from the approved list will not be allowed.

1.6. QUALITY ASSURANCE

- 1.6.1. Insulating materials shall be new, undamaged and of the respective types specified for each specific application.
- 1.6.2. Qualifications
- 1.6.2.1. Use a recognized insulation applicator specializing in, and with an established reputation for, this type of work.
- 1.6.3. Regulatory Requirements
- 1.6.3.1. Comply with all requirements of local and Provincial authorities having jurisdiction, Ontario Building Code and Underwriters' Laboratory of Canada.
- 1.6.3.2. Fire retardant type insulation materials, coverings and adhesives with flame spread/smoke developed ratings not exceeding 25/50 when tested in accordance with CAN/ULC-S102.
- 1.6.3.3. Properly identify insulation materials, coverings and adhesives when required by Federal and/or Provincial health and safety WHMIS legislation.

1.7. DELIVERY, STORAGE AND HANDLING

- 1.7.1. Retain insulation materials in original cartons or containers until immediately prior to application and keep dry during shipping and storage.
- 1.7.2. Keep adhesives in their original containers with manufacturer's name and catalogue number clearly stated. Protect contents against freezing.

2. Products

2.1. SHEET METAL

- 2.1.1. Insulate exposed and exterior round ductwork with flexible batt type insulation of 48 kg/m³ (3 lb./ft³) density, 40mm (1 ½”) thickness with reinforced foil flame resistant kraft facing. Secure insulation to ductwork with fire resistant adhesive and scrim foil pressure sensitive tape.

3. Execution

3.1. GENERAL

- 3.1.1. Perform insulation work using qualified insulation applicators, in accordance with latest trade application methods and to approval of Owner.
- 3.1.2. Clean all surfaces to be insulated to remove grime, grease, oil, moisture or other matter to ensure that insulation is applied to clean dry surfaces.
- 3.1.3. Apply insulation under ambient temperature conditions in accordance with insulation or adhesive manufacturer's recommendations.
- 3.1.4. Do not apply insulation until ductwork has been tested, inspected, verified, and accepted by the Owner.
- 3.1.5. Apply insulation neatly and tightly in unbroken lengths and with ends of sections firmly and squarely butted or engaged together. Lap scrim foil pressure sensitive tape at all joints. Extend insulation through sleeves in walls (except fire walls) or other openings in building to make insulation and vapour barrier continuous and of uniform diameter.
- 3.1.6. Terminate insulation at each side of fire walls and pack the space between wall sleeve and duct as specified in Section 23 05 00 - Common Work Results Mechanical.

3.2. SHEET METAL

- 3.2.1. Fasten insulation to concealed rectangular ductwork and to both concealed and exposed round ductwork with Foster 85-20 or Bakor 230-38 adhesive, applied in 150 mm (6") wide strips at 300 mm (12") centres. Tightly butt all edges and joints and seal with 75 mm (3") wide pressure sensitive scrim foil tape. Use tying cord only to temporarily secure insulation until adhesive has set.

- 3.2.2. Insulate access doors or removable panels in ductwork as separate units to permit opening or removal without damage to adjoining insulation or provide pre-insulated units.

END OF SECTION

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1 General

1.1 SUMMARY

.1 Related Sections:

- .1 Section 22 42 02 - Plumbing Fixtures.
- .2 Conform to Sections of Division 01, as applicable.

1.2 NATURAL GAS SYSTEMS

.1 Operation tests:

- .1 Measure gas pressure at tank outlet and at burner manifold.
- .2 Verify details of temperature and pressure compensation at tank.
- .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
- .4 Check terminals of vents for gas pressure regulators.

1.3 DOMESTIC WATER SUPPLY SYSTEMS

- .1 Refer to Section 22 11 18 – Domestic Water Piping – Copper for performance verification requirements.

1.4 SANITARY DRAINAGE SYSTEMS

- .1 Ensure that traps are fully and permanently primed.
- .2 Ensure that fixtures are properly anchored, connected to system.
- .3 Operate flush tank and operate each fixture to verify drainage and no leakage.
- .4 Cleanouts: Refer to Section 22 42 02 - Plumbing Fixtures.

2 Products - Not Used.

3 Execution - Not Used.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Conform to Sections of Division 01, as applicable.

1.2 SUBMITTALS

- .1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals. Include equipment literature, operating instructions, maintenance instructions, part lists, and other pertinent data for all equipment and systems covered by this Section.

2 Products

2.1 GAS DETECTION SYSTEM

- .1 GDS-1: Gas Detection Controller & Sensors
 - .1 System controller and sensors to be mounted at least 4' above finished floor.
 - .2 Controller: Provide Quatrosense Environmental Ltd. (QEL) Model M-CONTROLLERX- digital analog controller supplied complete with NEMA 1 epoxy painted steel general purpose enclosure, LED digital display with scroll, LED status lights, audio indicator, 3 DPDT rated 5 Amp resistive 3.7 Amp inductive relay outputs, independent relay assignment, 4 parallel RS-485 digital input ports, RS-422 to host computer output port, RS-232 output programming port, 24V power.
 - .3 NO₂ and CO Detectors: QEL Gas sensor/transmitter supplied complete with polycarbonate/ABS blend fire retardant enclosure, alphanumeric display, electrochemical sensor type, less than 60 second response time, user selectable analog/digital output, 24V power. Unit to be compatible with CO/NO₂ gas detection system.
 - .1 CO Sensor Model CTS-M5160X: 0-125 pm factory set range.
 - .2 NO₂ Sensor Model CTS-M5150X: 0-6 ppm factory set range.
- .2 EF-1 & 2: Direct Drive Sidewall Propeller Exhaust Fan
 - .1 Exhaust fans shall be energized upon detection of NO₂ or CO gas above specified limits. EF-1 & 2 shall be interlocked with MUA-1 and MD-1&2. Equipment will de-energize as gas level returns within allowable limit.
 - .2 For fan spec and data, refer to Design Drawings or Section 23 34 00 – HVAC Fans.
- .3 MUA-1: Direct-fired Make-up Air Unit.

- .1 Make-up air unit MUA-1 shall be interlocked with MD-1 & 2 and Exhaust Fans EF-1 & 2. Equipment will be energized upon detection of NO₂ or CO levels above the specified limit. Equipment will de-energize as gas level returns within allowable limit.
- .2 For specific unit information, refer to Design Drawings or Section 23 74 00 – Packaged Outdoor HVAC Equipment.

2.2 WELDING FILTER CART

- .1 FC-1: Nederman mobile welding cart.
 - .1 Supply complete with 2 meter-long adjustable swiveling roto moulded plastic extraction arm with aluminum frame, extraction hood with damper, protective grate with LED light, optional spark protection accessory, and optional HEPA filter.
 - .2 Unit shall use 120/1/60 power.
 - .3 For unit's airflow capacity, refer to Design Drawings.

2.3 DESTRATIFICATION FANS

- .1 DF-1, 2 & 3: Provide Big Ass Fans Model Powerfoil X3.0 Destratification Fan.
 - .1 Construction: 3m (10') fan diameter, 8 extruded aluminum powerfoil airfoils with mill finish and safety yellow powerfoil winglets.
 - .2 Mounting: Small I-beam standard mounting, airfoil retainers, A36 steel mounting post with powder coat finish, precision cut aluminum hub, hub clips, safety cables.
 - .3 Controls: Grade 8 variable frequency drive with ABS/PVC based enclosure and built-in heat sink, wall controller with 45.72m (150') factory assembled Cat5 cable, and onboard fan controller. Smart sense control system, supplied complete with ABS controller housing, aluminum controller cover and mounting plate, interface housing, one internal temperature sensor, one remote temperature sensor with ABS sensor housing, summer, winter and manual mode, and AC adapter.
 - .4 Motor: Nitro seal drive (stober) gearbox, 1 HP motor using 200-250/1/60 power.

3 Execution

3.1 INSTALLATION

- .1 Install equipment as indicated and to manufacturers instructions.
- .2 Refer to Operation and Maintenance manuals for maintenance requirements.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for piping, valves and fittings for gas fired equipment.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 78 00 - Closeout Submittals.
 - .3 Section 23 05 05 - Installation of Pipework.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
 - .2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM B75M-99, Standard Specification for Seamless Copper Tube Metric.
 - .4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
 - .1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.
 - .2 CAN/CSA B149.2-00, Propane Storage and Handling Code.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
- .2 Indicate on manufacturers catalogue literature following: valves.
- .3 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:
 - .1 Do construction in accordance with occupational Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
 - .4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan (WMP).
 - .5 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.

Part 2 Products

2.1 MATERIALS

2.2 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
- .2 Copper tube: to ASTM B837.

2.3 JOINTING MATERIAL

- .1 Screwed fittings: pulverized lead paste.

- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Brazing: to ASTM B837.

2.4 FITTINGS

- .1 Steel pipe fittings, screwed, flanged or welded:
 - .1 Malleable iron: screwed, banded, Class 150.
 - .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
 - .3 Welding: butt-welding fittings.
 - .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
 - .5 Bolts and nuts: to ASME B18.2.1.
 - .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
 - .1 Cast copper fittings: to ASME B16.18.
 - .2 Wrought copper fittings: to ASME B16.22.

2.5 VALVES

- .1 Provincial Code approved, ball type.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

- .1 Install in accordance with Section 23 05 01 - Installation of Pipework, applicable Provincial/Territorial Codes, CAN/CSA B149.1, CAN/CSA B149.2, supplemented as specified.
- .2 Install drip points:
 - .1 At low points in piping system.
 - .2 At connections to equipment.

3.3 VALVES

- .1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Test system in accordance with CAN/CSA B149.1 CAN/CSA B149.2 and requirements of authorities having jurisdiction.

3.5 ADJUSTING

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1 CAN/CSA B149.2.
- .2 Pre-Start-Up Inspections:
 - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
 - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

- .1 Perform cleaning operations as specified and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 Conform to Sections of Division 01 as applicable.

1.1.1 Conform to Section 23 05 00 - Common Work Results Mechanical as applicable.

1.2 RELATED SECTIONS

1.2.1 Section 23 33 00 - Air Duct Accessories.

1.2.2 Section 23 37 13 – Diffusers, Registers and Grilles.

1.3 REFERENCES

ASTM A167-99	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM A653/A653M-02	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
NFPA 96(1991)	Vapour Removal From Cooking Equipment
NFPA 90A	Installation of Air Conditioning and Ventilation Systems
NFPA 90B	Installation of Warm Air Heating And Air Conditioning Systems
SMACNA	HVAC Duct Constrictions Standards, Metal and Flexible (1985).
SMACNA	HVAC Duct Conscription Leakage Test Manual (1985)

1.4 REGULATORY REQUIREMENTS

1.4.1 Conform to the requirements of local by-laws, Ministry of Labour Regulations, and authorities having jurisdiction.

1.5 SUBMITTALS

1.5.1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

1.5.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

2 Products

2.1 SHEET METAL WORK - GENERAL

- 2.1.1 Furnish sheet metal work in accordance with material specifications and construction details specified herein, and conforming to standard and recommended practices as defined by SMACNA Duct Construction Standards.
- 2.1.2 Furnish all ductwork constructed to SMACNA 1" standards for pressure classification, unless noted otherwise on Drawings.
- 2.1.3 Furnish ductwork of galvanized steel sheet with Z-275 (G90) designation zinc coating to ASTM A653/A653M.
- 2.1.4 Furnish ducts of sizes shown on Drawings. For acoustically lined ducts, do not adjust duct size to accommodate liner thickness, actual dimensions are shown on Drawings.
- 2.1.5 Fabricate ductwork free from vibration, rattle or drumming under operating conditions. Furnish necessary reinforcements, bracing, framing, gasketing, etc., to comply with performance criteria.
- 2.1.6 Furnish sleeves at duct penetrations through walls and floors, fabricated from same material and thickness sheet material as for ductwork. Furnish closure plates each side of wall to cover sleeve. Provide sleeve as per fire damper manufacturer's recommendations if duct passes through a rated assembly.
- 2.1.7 Seal all transverse and longitudinal joints with water based high pressure duct sealant to Class A requirements.

2.1.8 ROUND DUCTWORK TYPE III - LOW PRESSURE

- 2.1.8.1 Construct round ductwork to specifications established by National Warm Air Heating Association. Use snap lock seam type duct conforming to following gauges:

<u>Duct Diameter</u>	<u>Thickness of Sheet Metal</u>
203 mm and under	0.5 mm (26 ga.)
229 to 330 mm	0.5 mm (26 ga.)
356 mm and above	0.6 mm (24 ga.)

2.1.8.2 GIRTH JOINTS AS FOLLOWS:

<u>Duct Diameter</u>	<u>Type of Construction</u>
203 mm and under	Crimped and beaded
229 mm and above	Crimped and beaded

- 2.1.8.3 Lap slip joints in direction of flow. Make external diameter of edged end same as internal

diameter of belled end on slip joints. Seal entire surface of overlap with water based high velocity duct sealer compound. Construct butterfly disc type balancing dampers of 16 gauge metal, complete with locking quadrant (ECCO KS-145 or equal).

2.1.8.4 GAS DRYER VENTING

Gas dryer venting as per manufacturers recommendations and requirements.

3 Execution

3.1 INSTALLATION - GENERAL

3.1.1 Refer to and comply with applicable requirements specified in Section 23 05 00 - Common Work Results - Mechanical.

3.1.2 Install miscellaneous steel framing, supports, braces, etc., as may be required to hang or support ductwork as specified herein, and as shown on Drawings.

3.1.3 Install ductwork in arrangement shown on Drawings in accordance with standards and recommended practices off ASHRAE and SMACNA. Provide required offsets and transitions, whether specifically indicated or not, to facilitate duct arrangement and to avoid interference with building structure, piping, equipment and services.

3.1.4 Install ductwork in locations and at elevations appropriate to ceiling height shown on Drawings. Where required to be concealed, install ductwork in furred spaces provided in walls and ceilings. Where there is no provision for concealed ductwork, install as close as possible to walls, partitions and overhead structures to attain maximum headroom and clearance.

3.1.5 Install sleeves where ducts pass through walls or floors. Pack space between duct and sleeve with mineral wool and seal both ends with non-inflammable fire resistant sealing compound. Install sheet metal closure plates on each side of wall to cover sleeve.

3.1.6 Install beam clamps or supplementary steel to secure hanger rods, angles and straps to structural steel framing.

3.1.7 Where shape of duct changes, install transition piece so that angle of side of transition piece does not exceed 15 degrees from straight run of duct being connected, unless shown otherwise on Drawings.

3.1.8 Slope fresh air intake ducts down at 1:100 to permit moisture induced by air intake to be drained.

3.1.9 Seal all transverse and longitudinal joints with water based high pressure duct sealant to Class A requirements.

3.2 SUPPORTS AND HANGERS - RECTANGULAR DUCTWORK

3.2.1 Install supports and hangers at intervals not over 2400mm (8'-0") centres for ducts up to 1500 mm (5'-0") in width and at 1200 mm (4'-0") centres for ducts 1500 mm (5'-0") in width and

over.

- 3.2.2 Install miscellaneous steel angles or channels as required between joists or building steel for structural support of duct where building framing spacing does not coincide with the required hanger spacing.

3.3 ROUND DUCTWORK

- 3.3.1 Secure joints with sheet metal screws and seal with tape or sealant.

3.4 CLEANING AND TESTING OF DUCTWORK

- 3.4.1 Inspect and test ductwork for air leakage at joints and connections to equipment, under normal operating conditions.
- 3.4.2 Test ductwork before ducts are insulated or concealed.
- 3.4.3 Immediately correct defects discovered during tests and retest systems to complete satisfaction of Owner.
- 3.4.4 Clean interior of air handlers with industrial type vacuum cleaner prior to final turnover. On completion of cleaning process, install new filter media before placing systems in final operation.

END OF SECTION

1 General

1.1 Conform to Sections of Division 01 as applicable.

1.1.1 Conform to Section 23 05 00 - Common Work Results - Mechanical as applicable.

1.2 REFERENCES

ASHRAE	American Society of Heating Refrigerating and Air-Conditioning engineers INC.
ASTM A167-99	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM A653/A653M-02	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
NFPA 96 (1991)	Vapour Removal from Cooking Equipment
NFPA 90A	Installation of Air Conditioning and Ventilation Systems
NFPA 90B	Installation of Warm Air Heating and Air Conditioning Systems
SMACNA	Sheet Metal and Air Conditioning Contractors National Association

1.3 SUBMITTALS

1.3.1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

1.3.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals. Include equipment literature, operating instructions, maintenance instructions, parts lists, and other pertinent data for all equipment and systems covered by this Section.

1.4 QUALITY ASSURANCE

1.4.1 **Regulatory Requirements:** Conform to the requirements of local by-laws, Ministry of Labour Regulations, and authorities having jurisdiction.

2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 CONTROL/MOTORIZED DAMPERS

- 2.2.1 Furnish Tamco series 9000BF thermally insulated motorized dampers, supplied with extruded aluminum thermally broken frame, extruded aluminum opposed action blades, silicone blade and jamb seals, “installed-in-duct” type mounting arrangement.
- 2.2.2 Use 24VAC proportional direct coupled spring return actuator (by controls contractor).
- 2.2.3 Note: field verify damper size prior to ordering. If installed in wall sleeve, wall sleeve to be thermally broken and insulated as well.

3 Execution

3.1 INSTALLATION

- 3.1.1 Refer to and comply with applicable requirements specified in Section 23 05 00 - Common Work Results - Mechanical.
- 3.1.2 Install miscellaneous steel framing, supports, braces, etc. as may be required to hang or support equipment and ductwork as specified herein, and as shown on Drawings.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Fans, motors, accessories and hardware for commercial use.
- .2 Related Sections
 - .1 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - .2 Conform to Sections in Division 01, as applicable.

1.2 REFERENCES

- .1 Air Conditioning and Mechanical Contractors (AMCA)
 - .1 AMCA Publication 99-2003, Standards Handbook.
 - .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
 - .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
 - .4 Sound ratings: comply with AMCA 301, tested to AMCA 300.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

1.4 SUBMITTALS

- .1 Submittals, product data and shop drawings to be in accordance with Section 013300 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Provide maintenance data for incorporation into manual specified in Section 017800 – Closeout Submittals.
- .3 Provide on submittals, shop drawings:
 - .1 Fan performance curves showing point of operation, kW and efficiency.
 - .2 Sound rating data at point of operation.
- .4 Indicate on submittals, shop drawings:
 - .1 Motors, sheaves, bearings, shaft details.
 - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:
 - .1 Matched sets of belts.
 - .2 Bearings and seals.
 - .3 Addresses of suppliers.
 - .4 List of specialized tools necessary for adjusting, repairing or replacing.

Part 2 Products

2.1 FANS GENERAL

- .1 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment unless otherwise specified.
 - .2 For use with variable speed controllers.
 - .3 Sizes as indicated on Design Drawings.
- .2 Factory primed before assembly in colour standard to manufacturer.
- .3 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

2.2 CENTRIFUGAL FANS

- .1 Fan wheels:
 - .1 Welded steel construction, unless otherwise specified.
 - .2 Maximum operating speed of centrifugal fans not more than 40-50 % of first critical speed.
 - .3 Forward curved blades, unless otherwise specified.
- .2 For Make-up Air Unit MUA-1:
 - .1 Acceptable fan assembly shall be a double width, double inlet, belt-drive type housed forward curved fan dynamically balanced as an assembly, as shown in schedule. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Copper lubrication lines shall be provided and extend from the bearings and attached with grease fittings to the fan base assembly near access door. If not supplied at the factory, contractor shall mount copper lube lines in the field. Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door.
 - .2 Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 50mm deflection spring vibration type isolators inside cabinetry.
 - .3 Further details on MUA-1 found in Section 23 74 00 – Packaged Outdoor HVAC Equipment, and on Design Drawings.
- .3 Exhaust Fan EF-3 shall be Nutone Model QTX3N090C washroom ceiling exhaust fan.
 - .1 Fan shall be supplied complete with 26-gauge galvanized steel housing, hanger bars, polymeric grille, centrifugal blower, removable blower assembly, resilient anti-vibration motor mounts, plug-in permanently lubricated motor, 150mm diameter connector.
 - .2 Shall be supplied with Model 843AL wall cap and spring damper and birdscreen.
 - .3 Capacity indicated on Design Drawings.
- .4 Bearings: Grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals.
- .5 Housings:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater. Material as indicated. For smaller wheels, braced, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
 - .3 Provide airtight access doors with handles, or as indicated.
- .6 Variable volume control devices:
 - .1 Mounted by fan manufacturer.

- .2 Adjustable inlet vanes: operated from a mechanism linked to each damper vane. On DWDI fans interconnect vanes to operate in unison if applicable. Provide locking devices for manual operation.

2.3 MIXED FLOW AXIAL FANS

- .1 Boat Storage Area exhaust fans EF-1 & 2 shall be Greenheck Model QEI-12-I-5 belt-driven mixed flow fan.
 - .1 Construction: Housing shall be continuously welded steel with concrete gray permatector coating, welded steel air-straightening vanes and inlet/outlet flanges.
 - .2 The unit shall have ceiling hung mounting with “E” motor mounting position, hanging spring isolators and lifting lugs.
 - .3 Electrical power requirement: 230/1/60.
 - .4 Fan/Motor shall be 1/2 HP ODP with all-welded wheel and camber blades, NEMA-1 toggle switch, belt guard, bolted access door, heavy-duty motor supports and extended lube lines.
 - .5 Capacity indicated on Design Drawings.

2.4 DESTRATIFICATION FANS

- .1 DF-1,2 & 3: Destratification fans shall be Big Ass Fan Model Powerfoil X3.0, large-diameter, 8-bladed ceiling destratification fan.
 - .1 Further specifications on DF-1,2 & 3 found in Section 23 10 01 – Service Garage Specialties.

Part 3 Execution

3.1 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings specified in appropriate sections with flexible electrical leads and flexible connections in accordance with Section 23 33 00 – Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

3.2 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand design conditions as specified.

END OF SECTION

1 General

1.1 Conform to Sections of Division 01 as applicable.

1.1.1 Conform to Section 23 05 00 – Common Work Results-Mechanical as applicable.

1.2 RELATED SECTIONS

1.2.1 Pipe, fittings and valves: refer to piping standards appended to Section 23 05 00 – Common Work Results - Mechanical.

1.3 REFERENCES

ASHRAE
CSA
SMACNA

1.4 SUBMITTALS

1.4.1 Shop Drawings: Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

1.4.2 Operational and Maintenance Data: Provide equipment literature, operating instructions, maintenance instructions, part lists, and other pertinent data for all equipment and systems covered by this Section. Coordinate with Section 01 78 00 – Closeout Submittals.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements: Conform to the requirements of local by-laws, Ministry of Labour Regulations, and authorities having jurisdiction.

2 Products

2.1 DIFFUSERS, REGISTERS AND GRILLES

2.1.1 General

2.1.1.1 Refer to Design Drawings for neck size, dimensions, capacity, etc. of grilles, registers and diffusers.

2.1.1.2 Furnish items to deliver indicated air quantities shown with throw to reach intended space limits without increasing sound level of room. Furnish blank-off baffles where required. Furnish equalizing deflectors on diffusers and in other locations as shown or required.

2.1.1.3 Coordinate placing of diffusers, registers and grilles in ceilings with electrical and ceiling installation trades and exact location to final approval of Architect.

2.1.1.4 Unless otherwise noted, furnish other grilles, registers and diffusers factory painted.

3 Execution

3.1 INSTALLATION

- 3.1.1 Refer to and comply with applicable requirements specified in Section 23 05 00 – Common Work Results-Mechanical.
- 3.1.2 Install miscellaneous steel framing, supports, braces, etc. as may be required to hang or support equipment and ductwork as specified herein, and as shown on Drawings.
 - 3.1.2.1 Install beam clamps or supplementary steel to secure hanger rods, angles and straps to structural steel framing.
 - 3.1.2.2 In suspended ceiling areas, adjust final location of grilles and diffusers to suit reflected ceiling plan.
 - 3.1.2.3 In occupied areas paint interior of ductwork for at least 600 mm (24") behind supply and exhaust grilles with matte black paint so as to render ductwork invisible from occupied space.

END OF SECTION

1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.
- .2 Conform to Sections in Division 01 and Division 09, as applicable.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
 - .1 ANSI/NFPA 96-04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .5 Society of Automotive Engineers (SAE)

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01330 – Submittal Procedures.
- .2 Provide maintenance data for incorporation into manual specified in Section 01780 – Closeout Submittals.
- .3 Indicate following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.

2 Products

2.1 WALL CAPS

- .1 Refer to Design Drawings for wall cap sizes and locations.

- .2 Thickness: to ASHRAE and SMACNA.
- .3 Fabrication: to ASHRAE and SMACNA.
- .4 Joints: to ASHRAE and SMACNA and/or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint considered class A seal.
- .5 Supports: as indicated.
- .6 Complete with integral insect screen of SS wire mesh.
- .7 Vertical backdraft dampers where required.

2.2 COMBUSTION VENTING

- .1 Air intake for UH-1 shall be no less than 940mm from WH-1 exhaust flue vent.
- .2 Air intake for WH-1 shall be no less than 305mm from WH-1 exhaust flue vent.
- .3 For unit heaters UH-1,2 & 3, provide concentric vent adapter box, installed tight to column as indicated on Design Drawings.
- .4 Venting not to be installed above windows.

3 Execution

3.1 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and braces as indicated.
- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for self-contained multizone and single zone, gas, electric, hot water and refrigeration packaged rooftop HVAC units.
 - .2 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)
 - .1 ANSI/ARI 210/240-[03], Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - .2 ARI 270-[95], Sound Rating of Outdoor Unitary Equipment.
- .2 ANSI/UL 1995 B-[1998], Standard for Heating and Cooling Equipment.
- .3 National Fire Protection Association
 - .1 NFPA 90A-[02], Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submitted shop drawings must indicate:
 - .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
 - .2 Piping, valves, fitting shipped loose showing final location in assembly.
 - .3 Control equipment shipped loose, showing final location in assembly.
 - .4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
 - .5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.
 - .6 Pump and fan performance curves.
 - .7 Details of vibration isolation.
 - .8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

- .1 Greenheck.

2.2 MAKE-UP AIR UNITS

- .1 Make-Up Air Unit MUA-1 shall be Greenheck Model DGX-110-H12 direct-fired make-up air unit.
 - .1 Construction shall be made for complete left hand access with heavy gauge, double-wall G90 galvanized steel housing with 25mm insulation and concrete gray permatector coating, insulated bottom paneling, weatherhood with aluminum birdscreen.
 - .2 Filters shall be aluminum and washable with concrete gray permatector coating.
 - .3 Access panels shall be removable.
 - .4 Inlet damper shall be Model VCD-23 low leakage.
 - .5 Fan/Motor assembly shall include a forward curved steel blower and motor, adjustable V-belt drive, with static free belts.
 - .6 Fan shall face in the top discharge position. Motor shall be 1 HP ODP, using 230/1/60 power.
 - .7 Burner shall feature 25:1 turndown capability, made from high quality cast aluminum with stainless steel mixing plates. Burner shall feature electronic modulation control, flame safeguard with optional digital fault indicator, and high/low gas pressure switches.
 - .8 Controls shall include control center with heat inlet air sensor, 24V distribution center with control transformer, magnetic motor starter, distribution terminal strip, single point power connection, factory-mounted disconnect switch.
 - .9 Unit shall be ordered with a remote panel and service receptacle (both shipped loose).

2.3 REMOTE PANEL

- .1 Provide remote readout panel for MUA-1 containing:
 - .1 Signal lights indicating system status, heating system failure and dirty filters.
 - .2 Check switches proving signal light operation.
 - .3 System on-off switch.
- .2 Provide gauges in remote panel indicating outside air and discharge air temperatures.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install as per manufacturers' instructions.

3.3 FIELD QUALITY CONTROL

- .1 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
- .2 Verify accessibility, cleanability, drainage of any drain pans for coils, humidifiers.
- .3 Performance Verification:
 - .1 Make-Up Air Units:
 - .1 Check for smooth, vibration-less, correct rotation of supply fan impeller.
 - .2 Measure supply fan capacity.
 - .3 Adjust impeller speed as necessary and repeat measurement of fan capacity.
 - .4 Measure pressure drop each component of air handling unit.
 - .5 Measure DBT, WBT of SA.
 - .6 Measure flow rates (minimum and maximum) of SA.
 - .7 Simulate maximum heating load and:
 - .1 Verify temperature rise across heat exchanger.
 - .2 Perform flue gas analysis. Adjust for peak efficiency.
 - .3 Verify combustion air flow to heat exchanger.
 - .4 Simulate minimum heating load and repeat measurements.
 - .8 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.
 - .9 Verify operating control strategies, including:
 - .1 Burner operation and high limit.
 - .2 Early morning warm-up cycle.
 - .3 Freeze protection.
 - .4 Alarms.
 - .5 Voltage drop across thermostat wiring.
 - .6 Operation of remote panel including pilot lights, failure modes.

3.4 CLEANING

- .1 Perform cleaning operations in accordance with Owner's requirements and manufacturer's recommendations.

- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, garbage, dirt/dust, tools and equipment.

END OF SECTION

1 General

1.1 RELATED SECTIONS

- .1 Conform to Sections in Division 01, as applicable.

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
- .3 Product data/shop drawings to include:
 - .1 Mounting methods.
 - .2 Physical size.
 - .3 Layout and diagrams of unit heaters.
 - .4 kW rating, voltage, phase.
 - .5 Cabinet material thickness.
 - .6 Finish.

2 Products

2.1 NATURAL GAS-FIRED UNIT HEATERS

- .1 Unit heaters UH-1 & 2 shall be Modine Model PTC 55SS0111FBAN natural gas-fired, horizontal discharge, separated combustion, high-efficiency, condensing unit heater.
 - .1 Construction shall consist of 20-gauge aluminized steel cabinet with baked-on polyester powder paint, adjustable air deflector blades, with finger proof fan guard.
 - .2 Fan shall be quiet-operation fan.
 - .3 Burner shall include tubular stainless steel heat exchanger, direct-spark ignition, in-shot burner, factory-installed power exhaustor, and single stage gas control.
 - .4 Controls shall include supply air and flue gas high limit safety controls, control terminal board and low-voltage terminal connections, fan delay timer, condensate drain overflow switch.
 - .5 Unit shall include optional concentric vent adapter box.
 - .6 Electrical requirements: 115/1/60 power.
- .2 Unit Heater UH-2 & 3 shall be Modine Model PTC 85SS0111FBAN natural gas-fired, horizontal discharge, separated combustion, high-efficiency, condensing unit heater.
 - .1 Unit details identical to those outlined in Part 2.1.1.1 to 2.1.1.6 on this Section.

3 Execution

3.1 INSTALLATION

- .1 Suspend unit heaters from ceiling or mount on wall as indicated.

3.2 FIELD QUALITY CONTROL

- .1 Test cut-out protection when air movement is obstructed.
- .2 Test fan delay switch to assure dissipation of heat after element shut down.
- .3 Test unit cut-off when fan motor overload protection has operated.
- .4 Ensure that heaters and controls operate correctly.

END OF SECTION