Part 1 General

1.1 General

.1 This section covers items common to all sections of Division 15.

1.2 Equipment List

.1 Complete list of equipment and materials to be used on this project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

.2 Submit for approval.

1.3 Equipment Installation

.1 Unions or flanges: provide for ease of maintenance and disassembly.

.2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.

.3 Equipment drains: pipe to floor drains.

.4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

1.4 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with good practice as per City requirements.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.5 Anchor Bolts and Template

.1 Supply anchor bolts and templates for installation by other divisions.

1.6 Trial Usage

.1 The Contract Administrator or the City may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 All HVAC systems and building system controls.

.2 All plumbing and domestic water systems.

.3 All fire protection systems.

.4 All compressed air and service systems.

1.7 Protection of Openings

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.8 Electrical

.1 Electrical work to conform to Division 16 including the following:

.1 Unless noted otherwise, control wiring under 50 V to be supplied and installed by the Mechanical Control Subcontractor (Division 15900) in accordance with Division 16 specifications.

.2 Control wiring over 120 V is to be installed by Division 16.

.2 Motors to be provided with mechanical equipment.

.3 Variable frequency drives provided by Division 16.

1.9 Motors

.1 Provide motors for mechanical equipment as specified.

.2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Contract Administrator for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

.3 Motors under 373 W (½ HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.

.4 Motors 373 W (½ HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated, unless otherwise specified or indicated.

1.10 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 specified.

.3 For motors under 7.5 kW (10 HP): 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 (10 HP) 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 to be 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 center line adjustment.

.8 Supply one set of spare belts for each set installed.

1.11 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 (18 gauge) sheet metal tops and bottoms.
- .3 38 mm (1-1/2") diameter holes on both shaft centers 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 (16 gauge) 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.

1.12 Equipment Supports

.1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Division 15.

.2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of CAN/CSA-G40.20/G40.21-M92 "General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels". Submit structural calculations with shop drawings.

.3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 50 mm (2") larger than equipment dimensions all around.

1.13 Temporary Use of Systems

.1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under the following conditions:

.1 Entire system is complete, pressure tested, cleaned, flushed out.

.2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.

.3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.4 There is no possibility of damage from any cause.

.5 Supply ventilation systems are protected by filters, which shall be inspected daily, changed every 2 weeks or more frequently as required.

.6 Return systems have approved filters over all openings, inlets, outlets.

.7 All systems will be:

.1 operated as per manufacturer's recommendations or instructions,

.2 operated by Contractor,

.3 monitored continuously by Contractor.

.8 Warranties and guarantees are not thereby relaxed.

.9 Regular preventative and all other manufacturer's recommended maintenance routines are performed by the Contractor at his own expense and under supervision of the Contract Administrator.

.10 Before substantial completion, entire system to be refurbished, cleaned internally and externally, restored to "as-new" condition, filters in air systems replaced.

.2 Filters referred to herein are over and above those specified elsewhere in this specification.

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

1.14 Preparation for Firestopping

.1 Firestopping material within annular space between pipes, ducts, insulation and adjacent fire separation shall be in accordance with ASTM E-814 (UL1479) fire test.

.2 The material shall be installed in accordance with UL through penetration firestop system #161 where pipes penetrate rated floors.

.3 Uninsulated unheated pipes not subject to movement: no special preparation.

.4 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe to move without damaging firestopping material.

.5 Insulated pipes and ducts: ensure integrity of insulation and vapour barrier at fire separation.

1.15 Tests

.1 Give 24 h written notice of date for tests.

.2 Insulate or conceal work only after testing and approval by Contract Administrator.

.3 Conduct tests in presence of Contract Administrator.

.4 Bear costs including retesting and making good.

.5 Piping:

.1 General: maintain test pressure without loss for 4 h unless otherwise specified.

.2 Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure or minimum 860 kPa (125 psi), whichever is greater.

.3 Test drainage, waste and vent piping to National Plumbing Code and authorities having jurisdiction.

.4 Test domestic hot, cold and recirculation water piping at 1-1/2 times system operating pressure or minimum 860 kPa (125 psi), whichever is greater.

.5 Test fire systems in accordance with authorities having jurisdiction and as specified elsewhere.

.6 Equipment: test as specified in relevant sections.

.7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.16 Painting

.1 To Section 09900 – Finish Painting.

.2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

.3 Prime and touch up marred finished paintwork to match original.

.4 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.17 Spare Parts

.1 Furnish spare parts in accordance with Section 01780 - Closeout Submittals.

.1 One set of belts for each piece of machinery.

.2 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.3 One head gasket set for each heat exchanger.

.4 Five fusible links for each different type of link installed.

.2 Spare parts are to be provided to an identified the City's representative complete with transmittal documents showing all materials provided and date of supply. The City's representative to sign for all materials received.

1.18 Special Tools

.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01780 - Closeout Submittals.

.2 Furnish one commercial quality grease gun and adaptor to suit different types of grease fittings. Provide grease to suit manufacturer's recommendations for all greasable systems.

.3 Spare parts are to be provided to an identified the City's representative complete with transmittal documents showing all materials provided and date of supply. the City's representative to sign for all materials received.

1.19 Access Doors

.1 Supply access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.

.2 Flush mounted 600 x 600 mm (24" x 24") for body entry and 300 x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

.3 Material:

.1 Use prime coated steel.

.4 Installation:

.1 Locate so that concealed items are accessible.

.2 Locate so that hand or body entry (as applicable) is achieved.

.3 Installation is specified in applicable sections.

.5 Approvals:

.1 Where access doors are to be installed in fire rated assemblies, provide ULC listed and labelled access doors meeting rating requirements.

.6 Acceptable material: Acudor Access Doors.

1.20 Drain Valves

.1 Locate where indicated on the drawings, and at low points and at section isolating valves unless otherwise specified.

.2 Minimum NPS 3/4 unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.

1.21 Demonstration and Operating and Maintenance Instructions

.1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.2 Where specified elsewhere in Division 15, manufacturers to provide demonstrations and instructions.

.3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Where deemed necessary, Contract Administrator may record these demonstrations on video tape for future reference.

1.22 Operation and Maintenance Manual

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01780 - Closeout Submittals.

.2 Operation and maintenance manual to be approved by, and final copies deposited with, Contract Administrator before final inspection.

.3 Operation data to include:

.1 Control schematics for each system including environmental controls.

.2 Description of each system and its controls.

.3 Description of operation of each system at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for each system and each component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data shall include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified elsewhere.

.4 Testing, adjusting and balancing reports as specified in Section 15950 - Testing, Adjusting and Balancing (TAB) of Mechanical Systems.

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless so directed by Contract Administrator.

.2 Make changes as required and re-submit as directed by Contract Administrator.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.23 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01330 - Submittal Procedures.

.2 Shop drawings and product data shall show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances. eg. access door swing spaces.

.3 Shop drawings and product data shall be accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify as to current model production.

.5 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 01330 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.24 Existing Systems

.1 Connections into existing systems to be made at time approved by Contract Administrator. Request written approval of time when connections can be made.

.2 Be responsible for damage to existing plant by this work.

1.25 Cleaning

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

.2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

1.26 As-Built Drawings

.1 .1 Site records:

.1 Contract Administrator will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection at all times.

.2 .2 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm (1/2") high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).

.3 Submit to Contract Administrator for approval and make corrections as directed.

.4 TAB to be performed using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.3 .3 Submit copies of as-built drawings for inclusion in final TAB report.

1.27 Breakdown of Costs and Progress Claims

.1 Price to be broken down at the time of tender in accordance with Contract Documents.

.2 Following award of contract, each section of this Division is to provide breakdown of tendered prices into categories required for submission of Progress Claim. Sufficient categories to be provided to permit evaluation of the claim and approval of payment. Modify or add categories as requested.

.3 Progress claims to indicate for each category:

.1 Total

.2 Total to date

.3 Monthly claim

.4 Categories to include or as appropriate for the project:

.1 Refurbishment

.2 Air conditioning units

.3 Flexible connections and vibration isolation

.4 Hydronic system piping, valves, coils, wallfin heaters, unit heaters and pumps

.5 Ductwork

.6 Terminal units

.7 Diffusers and grilles

.8 Pipe insulation

.9 Duct insulation

.10 Identification

.11 Controls

.12 Testing and balancing

END OF SECTION

Part 1 General

1.1 References

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

- .1 ANSI/ASME B31.1-2004, Power Piping.
- .2 ANSI/ASME Boiler and Pressure Vessel Code-2004:
  - .1 Section 1: Power Boilers.
  - .2 Section V: Nondestructive Examination.
  - .3 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

- .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)

- .1 AWS C1.1-2000, Recommended Practices for Resistance Welding.
- .2 AWS Z49.1-1999, Safety in Welding, Cutting and Allied Processes.
- .3 AWS WI-80, Welding Inspection 2nd Edition.

.4 Canadian Standards Association (CSA)

- .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .2 CSA W47.2-M1987(R2003), Certification of Companies for Fusion Welding of Aluminum.
- .3 CSA W48-06, "Filler Metals and Allied Materials for Metal Arc Welding".
- .4 CSA B51-2003, Boiler, Pressure Vessel and Pressure Piping Code.
- .5 CAN/CSA-W117.2-06, Safety in Welding, Cutting and Allied Processes.
- .6 CSA W178.1-02, Certification of Welding Inspection Organizations.
- .7 CSA W178.2-01, Certification of Welding Inspectors.

.5 Manitoba Labour – Certificate of Authorization Program.

.6 Manitoba Regulation 108/87R as amended by Regulation 80/2005 "Steam and Pressure Plants Regulation"

1.2 Welders Qualifications

.1 Welding qualifications to be in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction in the province of application.

.3 Furnish welder's qualifications to Contract Administrator and authority having jurisdiction.

.4 Each welder to possess identification symbol issued by authority having jurisdiction.

1.3 Inspectors Qualifications

.1 Inspectors to be qualified to CSA W178.2.

1.4 Welding Procedures

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures to be available for inspection at all times.

.3 Safety in welding, cutting and allied processes to be in accordance with CAN/CSA-W117.2 and AWSZ 49.1.

1.5 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with City requirements.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 Electrodes

.1 Electrodes: in accordance with CSA W48.

Part 3 Execution

3.1 Workmanship

.1 Welding to be in accordance with ANSI/ASME B31.9, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B2.1 series, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

3.2 Installation Requirements

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: according to the following schedule:

Schedule:
T: Forged tee or reducing tee
S: Socolet
W: Weldolet

HEADER	BRANCH													
		12(1/2")	20(3/4")	25(1")	32(1-1/4")	38(1-1/2")	50(2")	65(2-1/2")	75(3")	100(4")	150(6")	200(8")	250(10")	300(12")
	12(1/2")	T												
	20(3/4")	T	T											
	25(1")	T	T	T										
	32(1-1/4")	T	T	T	T									
	38(1-1/2")	T	T	T	T	T								
	50(2")	S	S	S	T	T	T							
	65(2-1/2")	S	S	S	S	T	T	T						
	75(3")	S	S	S	S	S	T	T	T					
	100(4")	S	S	S	S	S	T	T	T	T				
	150(6")	S	S	S	S	S	W	T	T	T	T			
	200(8")	S	S	S	S	S	W	W	W	T	T	T		
	250(10")	S	S	S	S	S	W	W	W	W	T	T	T	
	300(12")	S	S	S	S	S	W	W	W	W	W	T	T	T

3.3 Inspection and Tests – General Requirements

.1 Review all weld quality requirements and defect limits of applicable codes and standards with Contract Administrator before any work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Contract Administrator.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect all welds during early stages of welding procedures in accordance with AWS W1. Repair or replace all defects as required by codes and as specified herein.

3.4 Specialist Examinations and Tests

.1 General

.1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Contract Administrator.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test all welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.

.2 Hydrostatically test all welds to requirements of ANSI/ASME B31.9.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:

.1 Upon failure of any weld by visual examination, perform additional testing as directed by Contract Administrator of a total of up to 10% of all welds, selected at random by Contract Administrator by radiographic tests.

.5 Radiographic testing of piping systems following failure of visual examination:

.1 Spot radiography to CAN/CGSB-48.2:

.1 Conduct spot radiographic tests of tie-in welds, or welds selected at random by Contract Administrator from all welds which would be most difficult to repair in event of failure after system is operational.

.2 Radiographic film:

.1 Identify each radiographic film with date, location, name of welder, and submit to Contract Administrator. Replace film if rejected because of poor quality.

.3 Interpretation of radiographic films:

.1 To be by qualified radiographer.

.4 Failure of radiographic tests:

.1 If any weld fails tests, tests will be extended to all welds made by welder responsible.

3.5 Defects Causing Rejection

.1 As described in ANSI/ASME B31.9, and ANSI/ASME Boiler and Pressure Vessels Code.

3.6 Repair of Welds Which Failed Test

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

END OF SECTION

Part 1 General

1.1 General Conditions

.1 Mechanical General Conditions 15010 shall be part of this section.

1.2 Work Included

.1 The work described in this section includes testing work for the following systems:

- .1 Plumbing and drainage.
- .2 Domestic water supply.
- .3 Fire protection system.
- .4 Heating water system.
- .5 Natural gas piping.

Part 2 Products

.1 Refer to relevant sections of specification for materials by system.

Part 3 Execution

3.1 Test Requirements

.1 Plumbing and drainage shall be tested in full conformance with the requirements of the National Plumbing Code of Canada, and as required by local inspection authority.

.2 Domestic water and plant water piping shall be tested to a pressure of 350 KPa over the expected working pressure. Test to be completed with air over water and maintained over 6 hours with no loss.

.3 The fire protection system shall be inspected and tested as required by the authorities. Generally, all piping and fittings in the standpipe system shall be hydrostatically tested at a pressure of 1360 KPa for 2 hours without evidence of loss or leakage.

.4 The hot water heating systems shall be tested to a pressure of 690 KPa over the design working pressure, plus system height for a period of twelve (12) hours.

.5 Natural gas piping shall be tested as required by B149.1.

3.2 Procedures

.1 The testing of the individual systems shall be completed by the trade responsible for installing the system.

.2 Provide all necessary equipment and perform all work required to field test all piping systems, including all remedial and re-testing work.

.3 Clean all piping systems by flushing with water or blowing with air with all valves wide open prior to testing and before installing any primary element instrumentation on the piping systems.

.4 Timely notification shall be given to the Engineer of the schedule for all tests. A minimum of three working days is required to schedule witnessing of tests.

.5 All piping must pass all field tests in the presence of the Engineer.

.6 Completion of tests is not evidence of acceptance of tested part of Contract.

.7 No claim for damage will be made for injury or breakage of parts due to tests.

.8 Piping, which has to be concealed prior to the completion of the service as a whole, shall be tested in sections to the pressures and for the periods specified, prior to the piping being concealed.

.9 No insulation shall be applied until testing has been completed.

END OF SECTION

Part 1 General

1.1 Related Sections

.1 Section 03300 Cast-in-Place Concrete

.2 Section 05500 Metal Fabrications

.3 Section 15010 – Mechanical General Requirements

1.2 References

.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.9- 2004, Building Services Piping, (SI Edition).

.2 American Society for Testing and Materials (ASTM)

.1 ASTM A125- 96(2001), Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307- 04, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563- 04a, Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP-58- 2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP-69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP-89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

1.3 Design Requirements

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.9 or MSS SP-58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.4 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01330 - Submittal Procedures.

.2 Submit shop drawings and product data for following items:

.1 All bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

1.5 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01780 - Closeout Submittals.

Part 2 Products

2.1 General

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.9 and MSS SP-58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 Pipe Hangers

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture for use in crawlspaces, outside installation, all plant process areas and all mechanical rooms.

.2 Use electro-plating galvanizing process or hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment structural: Suspension from lower flange of I-Beam.

.1 Cold piping NPS 2 maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm (3/8") UL listed

.2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP-58 and MSS-SP-69.

.3 Upper attachment structural: Suspension from upper flange of I-Beam.

.1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.

.2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut, UL listed.

.4 Upper attachment to concrete.

.1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm (1/4") minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate, UL listed to MSS-SP-69.

.5 Shop and field-fabricated assemblies.

.1 Trapeze hanger assemblies: in accordance with requirements of ASME B31.9 and MSS-SP-58.

.2 Steel brackets: in accordance with requirements of ASME B31.9 and MSS-SP-58.

.6 Hanger rods: threaded rod material to MSS SP-58.

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.3 Do not use 22 mm (7/8") or 28mm (1 1/8") rod.

.7 Pipe attachments: material to MSS SP-58.

.1 Attachments for steel piping: carbon steel, galvanized finish.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports to fit over insulation.

.8 Adjustable clevis: material to MSS SP-69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.

.10 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: epoxy coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.

2.3 Riser Clamps

.1 Steel or cast iron pipe: galvanized carbon steel to MSS-SP-58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42.

.3 Bolts: to ASTM A307, or SAE GR5.

.4 Nuts: to ASTM A563, or SAE GR2.

2.4 Insulation Protection Shields

.1 Insulated cold piping:

.1 64 kg/m^3 (4 pcf) density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m (10 ft.) span.

.2 Insulated hot piping:

.1 Curved plate 300 mm (12") long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP-69.

2.5 Equipment Supports

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of CAN/CSA-G40.20. Submit calculations with shop drawings.

2.6 Equipment Anchor Bolts and Templates

.1 Provide templates to ensure accurate location of anchor bolts.

2.7 Housekeeping Pads

.1 For base-mounted equipment: Concrete, at least 100 mm (4") high, 50 mm (2") larger all around than equipment, and with chamfered edges.

2.8 Anchors

.1 Construct pipe anchors in accordance with Section 15010, the details shown on the drawings and as specified herein.

.2 Submit calculations and dimensional drawings, including welding procedures under the seal of a Professional Engineer registered in the Province of Manitoba.

2.9 Seals

.1 Annular space compression seals:

.1 Nitrile elastomeric segment elements, sized to suit pipe O.D. and opening I.D., compatible with diesel fuel and water.

.2 Glass reinforced nylon pressure plates.

.3 Type 304 stainless steel compression cap screw and nut.

.4 Service temperature: -40°C to +120°C (-40° to 250°F).

.5 Acceptable material: Thunderline "Link Seal", service type "O", or equivalent.

Part 3 Execution

3.1 Workmanship

.1 Hangers and supports are to secure all equipment in place, prevent vibration, maintain uniform slope and provide for expansion and contraction.

.2 Locate supports adjacent to equipment to prevent undue stresses in piping and equipment.

.3 Review all drawings prior to drilling for inserts and supports for piping systems.

.4 Obtain Engineer's approval prior to using percussion type fastenings.

.5 Use of piping or equipment for hanger supports or piercing of ductwork is not permitted.

.6 Use of perforated band iron, wire or chain as hangers is not permitted.

.7 Install all hangers, supports, anchors and seals in accordance with the manufacturer's recommendations.

3.2 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: Install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 The vertical movement of pipework is 13 mm (1/2") or more,

.2 The transfer of load to adjacent hangers or connected equipment is not permitted.

3.3 Hanger Spacing

.1 Plumbing piping: most stringent requirements of National Plumbing Code, or authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas piping: to CAN/CGA-B149.1 Natural Gas and Propane Installation Code.

.1 For piping up to NPS ½: provide supports every 1.8 m (6 ft.).

.4 Copper piping: up to NPS 1/2: every 1.5 m (5 ft.).

.5 Provide hangers for steel and copper piping systems as follows:

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m (7 ft.)	1.8 m (6 ft.)
1-1/2	2.7 m (9 ft.)	2.4 m (8 ft.)
2	3.0 m (10 ft.)	2.7 m (9 ft.)
2-1/2	3.6 m (12 ft.)	3.0 m (10 ft.)
3	3.6 m (12 ft.)	3.0 m (10 ft.)
3-1/2	3.9 m (13 ft.)	3.3 m (11 ft.)
4	4.2 m (14 ft.)	3.6 m (12 ft.)
5	4.8 m (16 ft.)	
6	5.1 m (17 ft.)	
8	5.7 m (19 ft.)	
10	6.6 m (22 ft.)	
12	6.9 m (23 ft.)	

.6 Provide hangers within 300 mm (12") of each horizontal elbow.

.7 Pipework greater than NPS 12: to MSS SP-69.

.8 For flexible joint roll groove pipe, support in accordance with 3.3.6, but not less than one hanger at each joint.

3.4 Hanger Installation

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 45° from vertical.

.2 Where horizontal pipe movement is less than 13 mm (1/2"), offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 Final Adjustment

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.
.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.
.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.7 Seals Installation

.1 Clean I.D. of opening cored or formed for seal to fit into.

.2 Remove all projections of materials which project into the cored opening or create an irregular surface for the seal to bear on.

.3 Assemble seal around pipe passing through opening.

.4 Position and tighten seal fasteners in accordance with the manufacturer's recommendations.

3.8 Painting

.1 Shall be in accordance with Section 09900 – Finish Painting.

.2 Supports, anchors and seals inaccessible after installation shall be painted prior to installation.

.3 All pipe supports, hangers and anchors that do not have a galvanized finish are to receive a minimum of two coats of corrosion resistant primer and two finish coats of colour specified for service, and as specified in Section 09911 and 09912. Galvanized parts will receive a minimum of one coat of primer and one coat of colour.

END OF SECTION

Part 1 General

1.1 Shop Drawings

.1 Submit shop drawings in accordance with Section 01330 - Submittal Procedures.

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

Part 2 Products

2.1 General

.1 Size and shape of bases type and performance of vibration isolation to be as indicated.

2.2 Elastomeric Pads

.1 Type EP1 - neoprene waffle or ribbed; 9mm (3/8") minimum thick; 50 durometer; maximum loading 350 kPa (50 psi).

.2 Type EP2 - rubber waffle or ribbed; 9mm (3/8") minimum thick; 30 durometer natural rubber; maximum loading 415 kPa (60 psi).

.3 Type EP3 - neoprene-steel-neoprene; 9mm (3/8") minimum thick neoprene bonded to 1.71mm (1/16") steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa (50 psi).

.4 Type EP4 - rubber-steel-rubber; 9mm (3/8") minimum thick rubber bonded to 1.71mm (1/16") steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa (50 psi).

2.3 Elastomeric Mounts

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 Springs

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.

.3 Cadmium plate for all installations.

.4 Colour code springs.

2.5 Spring Mount

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg (2000 lbs) maximum.

2.6 Hangers

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, molded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with molded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

Part 3 Execution

3.1 Installation

.1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25mm (1") minimum static deflection as follows:

.1 Up to NPS4: first 3points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50mm (2").

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.2 Site Visit

.1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Contract Administrator.

.2 Provide Contract Administrator with notice 48h in advance of visit.

.3 Make adjustments and corrections in accordance with written report.

END OF SECTION

Part 1 General

1.1 Related Sections

.1 Section 09900 – Finish Painting

1.2 Product Data

.1 Submit product data in accordance with Section 01330 - Submittal Procedures.

.2 Product data to include paint colour chips, all other products specified in this section.

1.3 Samples

.1 Submit samples in accordance with Section 01330 - Submittal Procedures.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

Part 2 Products

2.1 Manufacturer's Equipment Nameplates

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers to be raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: Manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 System Nameplates

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size # mm	Size mm (inches)	No. of Lines	Height of Letters mm (inches)
1	10 x 50 (3/8" x 2")	1	3 (1/8")
2	13 x 75 (1/2" x 3")	1	5 (3/10")
3	13 x 75 (1/2" x 3")	2	3 (1/8")
4	20 x 100 (3/4" x 4")	1	8 (5/16")
5	20 x 100 (3/4" x 4")	2	5 (3/10")
6	20 x 200 (3/4" x 8")	1	8 (5/16")
7	25 x 125 (1" x 5")	1	12 (1/2")
8	25 x 125 (1" x 5")	2	8 (5/16")
9	35 x 200 (1 3/8" x 8")	1	20 (3/4")

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: Use size # 5.

.2 Equipment in Mechanical Rooms: Use size # 9.

2.3 Existing Identification Systems

.1 Where existing identification system does not cover for new work, use identification system specified this section.

.2 Before starting work, obtain written approval of identification system from Contract Administrator.

2.4 Piping Systems Governed by Codes

.1 Identification:

.1 Natural gas: To CAN/CGA B149.1.

.2 Propane gas: To CAN/CGA B149.2.

.3 Sprinklers: To NFPA13.

.4 Standpipe and hose systems: To NFPA14.

2.5 Identification of Piping Systems

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75mm (3"): 100mm (4") long x 50mm (2") high.

.2 Outside diameter of pipe or insulation 75mm (3") and greater: 150mm (6") long x 50mm (2") high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20mm (3/4") and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (392°F).

.7 Colours and Legends:

.1 Where not listed, obtain direction from Contract Administrator.

.2 Colours for legends, arrows: To following table:

Background colour:	Legend, arrows:
Yellow	Blacke
Green	White
Red	White

.3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
City water	Green	CITY WATER
Heating water supply	Yellow	HEATING SUPPLY
Heating water return	Yellow	HEATING RETURN
Heating glycol supply	Yellow	HEATING GLY SUPPLY
Heating glycol return	Yellow	HEATING GLY SUPPLY
Chilled drinking water	Green	CH. DRINK WTR
Drinking water return	Green	CH. DRINK WTR. CIRC
Domestic hot water supply	Green	DOM. HW SUPPLY

Contents	Background Colour Marking	Legend
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Waste water	Green	WASTE WATER
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Gas regulator vents	to Codes	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Conduit for low voltage control wiring	To Section 15950	

2.6 Identification Ductwork Systems

.1 50mm (2") high stencilled letters and directional arrows 150mm (6") long x 50mm (2") high.

.2 Colours: Black, or co-coordinated with base colour to ensure strong contrast.

2.7 Valves, Controllers

.1 Brass tags with 12mm (1/2") high stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 Controls Components Identification

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 Language

.1 Identification to be in English.

Part 3 Execution

3.1 Timing

.1 Provide identification only after all painting specified Section 09900 – Finish Painting.

3.2 Installation

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and/or CSA registration plates as required by respective agency.

3.3 Nameplates

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection

.1 Do not paint, insulate or cover in any way.

3.4 Location of Identification on Piping and Ductwork Systems

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification to be easily and accurately readable from usual operating areas and from access points.

.1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 Valves, Controllers

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

END OF SECTION

Part 1 General

1.1 Related Sections

.1 Section 15950 - Testing, Adjusting and Balancing (TAB) of Mechanical Systems .

1.2 References

.1 American Society for Testing and Materials.

.1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

Part 2 PRODUCTS

2.1 Cleaning Solutions

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system (1 lb. per 20 IG).

.2 Sodium carbonate: 0.40 kg per 100 L water in system (1 lb. per 20 IG).

.3 Low-foaming detergent: 0.01 kg per 100 L water in system (0.35 ounces per 20 IG).

Part 3 Execution

3.1 Cleaning Hydronic and Steam Systems

.1 Timing

.1 Systems to be operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist .

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

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

.6 Complete analysis of water to be used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems

.1 Systems to be free from construction debris, dirt and other foreign material.

.2 Control valves to be operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers to be clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Use water meter to record volume of water in system to +/- 0.5%.

.3 Add chemicals under direct supervision of chemical treatment supplier.

.4 Closed loop systems: circulate system cleaner at 60°C (140°F) for at least 36 hours. Drain as quickly as possible. Refill with water plus inhibitors. Test concentrations and adjust to recommended levels.

.5 Flush velocity in system mains and branches to be adequate so as to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.6 Add chemical solution to system.

.7 Establish circulation, raise temperature slowly to maximum design or 82°C (180°F) minimum. Circulate for 12 hours, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38°C (100°F). Drain as quickly as possible. Refill with clean water. Circulate for 6 hours at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

.8 Glycol Systems:

.1 In addition to procedures specified above perform procedures specified herein.

.2 Test to prove concentration will prevent freezing to -40°C (-40°F). Test inhibitor strength and include in procedural report. Refer to ASTM E202.

3.2 Start-up of Hydronic Systems

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure all air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified Section 15188 - HVAC Water Treatment Systems .

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and all other noises.

.10 Bring system up to design temperature and pressure slowly.

.11 Perform TAB as specified Section 15950 - Testing, Adjusting and Balancing (TAB) of Mechanical Systems.

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 If sliding type expansion joints bind or if bellows type expansion joints flex incorrectly , shut down system, re-align, repeat start-up procedures.

.15 Re-tighten all bolts, etc. using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.16 Check operation of drain valves.

.17 Adjust valve stem packings as systems settle down.

.18 Fully open all balancing valves (except those that are factory-set).

.19 Check operation of over-temperature protection devices on circulating pumps.

.20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

Part 1 General

1.1 Related Sections

.1 Section 07840 - Firestopping.

.2 Section 15095 - Cleaning and Start-up of Mechanical Piping Systems.

Part 2 Products

.1 Not Used.

Part 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 all systems, equipment and components for observation of operation, inspection, servicing, maintenance.

.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, components.

3.3 Drains

.1 Install piping with grade in direction of flow except as indicated or specified otherwise.

.2 Install drain valve where indicated on the drawings, at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 Air Vents

.1 Install manual air vents at high points in piping systems.

.2 Install 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.

.4 Over NPS 2: Isolating flanges.

3.6 Pipework Installation

.1 Provide clearances and access for maintenance of equipment, valves, fittings as specified and as per manufacturer's installation instructions.

.2 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of the main. Hole saw (or drill) and ream main so as to maintain full inside diameter of branch line prior to welding saddle.

.5 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.6 Install so as to minimize furring space, maximize headroom, conserve space.

.7 Except where indicated, install so as to permit separate thermal insulation of each pipe.

.8 Group piping wherever possible and as indicated.

.9 Ream pipes, remove scale and other foreign material before assembly.

.10 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.11 Valves: Install with stems above the horizontal position unless otherwise 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 (1/4") minimum clearance all round between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.

.2 All other floors: Terminate 25 mm (1") above finished floor.

.3 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.

.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 all 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 to Section 07840 - Firestopping.

.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 in accordance with requirements of Section 01740 - Cleaning supplemented as specified in Section 15095- Cleaning and Start-up of Mechanical Piping Systems for all steam, hydronic heating and chilled water systems and all systems circulating glycol.

3.11 Pressure Testing of Equipment and Pipework

.1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.

.2 Pipework:

.1 Hydraulically test hydronic piping systems at 1 ½ times system operating pressure or minimum 960 kPa (125 psi) whichever is greater.

.2 Test drainage, waste and vent piping to the National Plumbing Code and authorities having jurisdiction.

.3 Test domestic hot, cold and recirculation water piping at 1 ½ times system operating pressure or 960 kPa (125 psi) whichever is greater.

.4 Test fire systems in accordance with authorities having jurisdiction and as specified elsewhere.

.3 Maintain specified test pressure without loss for four (4) hours minimum unless specified for longer period of time elsewhere.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Contract Administrator.

.6 Bear costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Contract Administrator.

3.12 Existing Systems

.1 Connect into existing piping systems at times approved by Contract Administrator.

.2 Request written approval 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

.4 Ensure daily clean-up of existing areas.

END OF SECTION

Part 1 General

1.1 General Conditions

.1 Mechanical General Conditions 15010 shall be part of this Section.

1.2 Scope

.1 Valves and strainers for domestic water service.

.2 Valves and strainers for the hydronic heating systems.

.3 Valves for natural gas service.

1.3 Manufacturer

.1 Provide valves of the same type by the same manufacturer throughout.

.2 Provide valves with manufacturer's name and pressure rating clearly marked on the outside of the body.

1.4 Shop Drawings

.1 Submit detailed shop drawings clearly indicating make, model, size, pressure rating, materials of constructed and intended applications.

Part 2 Products

2.1 Hot and Cold Domestic Water Service

.1 Gate valves up to 50 mm (2") (solder joint)

- .1 Solder joint bronze body, solid wedge disc, bronze trim, rising stem.
- .2 860 kPa (125 psig) rating.
- .3 Acceptable material: Crane #1334, Toyo #299 or Kitz #44.

.2 Gate valves up to 50 mm (2") (screwed ends)

- .1 Screwed bronze body, solid wedge disc, bronze trim, rising stem.
- .2 860 kPa (125 psig) rating.
- .3 Acceptable material: Crane #428 solid disc, Toyo #293 or Kitz #24.

.3 Gate valves 65 mm (2 ½") and larger

.1 Flanged cast iron body, solid wedge disc, bronze trim.
.2 Rising stem, outside screw and yoke.
.3 860 kPa (125 psig) rating.
.4 Acceptable material: Crane #465 ½, Toyo #421A or Kitz #72.

.4 Ball valves up to 50 mm (2") (solder joint)

.1 Solder joint brass 2 piece body, blow-out proof stem, PTFE seats, brass chrome plated ball, lever handle operator.
.2 1034 kPa (150 psig) rating.
.3 Acceptable material: Crane #F9222, Toyo #5049A or Kitz #69.

.5 Ball valves up to 50 mm (2") (screwed ends)

.1 Screwed brass 2 piece body, blow out proof stem, PTFE seats, brass chrome plated ball lever handle operator.
.2 1034 kPa (150 psig) rating.
.3 Acceptable material: Crane #F9202, Toyo #5044A or Kitz #68.

.6 Check valves (horizontal) up to 50 mm (2") (solder joint)

.1 Solder joint bronze body, bronze swing disc.
.2 860 kPa (125 psig) rating.
.3 Acceptable material: Crane #1342, Toyo #237 or Kitz #23.

.7 Check valves (horizontal) up to 50 mm (2") (screwed joint)

.1 Screwed bronze body, bronze swing disc.
.2 860 kPa (125 psig) rating.
.3 Acceptable material: Crane #37, Toyo #236 or Kitz #22.

.8 Check valves (horizontal) 65 mm (2 ½") and larger

.1 Flanged cast iron body, bronze or cast iron swing disc, bronze trim.
.2 860 kPa (125 psig) rating.
.3 Acceptable material: Crane #373, Toyo #435A or Kitz #78.

.9 Check valves (vertical upward flow) up to 50 mm (2")

.1 Solder joint bronze, bronze disc.
.2 860 kPa (125 psig) rating.
.3 Acceptable material: Kitz #26.

.10 Check valves (vertical upward flow) 65 mm (2 ½") and larger

.1 Wafer style cast iron body, viton "A" body seat, 304SS clapper, arm and pin, 304SS spring.

.2 PTFE thrust washer.

.3 860 kPa (125 psig) rating.

.4 Acceptable material: Moyes & Groves W12A-16V, or Center Line Series #800.

.11 Butterfly valves 65 mm (2 ½") and larger

.1 Threaded lug style cast iron body

.2 EPDM seat liner

.3 S.S. disc

.4 403SS Stem

.5 10 position lever lock handle operator 150 mm and smaller

.6 1380 kPa (200 psig) rating

.7 Acceptable material: Keystone Fig. #AR2-805 or approved equal in accordance with B6, Bray Series #31 or Center Line L200L/G200L (EPDM) or approved equal in accordance with B6.

.12 Drain valves: shut off 20 mm (3/4") and 25 mm (1")

.1 Screwed brass 2 piece body ball valve, blow-out proof stem, PTFE seats, brass chrome plated ball, hose end connection with cap and chain

.2 1034 kPa (150 psig) rating

.3 Acceptable material: Toyo #5046 or Kitz Fig. 58CC

.13 Strainers: up to 50 mm (2")

.1 Screwed bronze "Y" pattern body, 304SS screen

.2 1034 kPa (150 psig) rating

.3 Acceptable material: Watts #777S, Toyo #380 or Kitz #15

.14 Strainers: 65 mm (2 ½") and larger

.1 Flanged cast iron "Y" pattern body, 304SS screen

.2 860 kPa (125 psig) rating

.3 Acceptable material: Toyo #318A or Kitz Fig. 80

2.2 Heating, Ventilation and Air Conditioning Service

.1 Gate valves: up to 50 mm (2")

.1 Screwed bronze body, solid wedge disc, bronze trim, rising stem

.2 860 kPa (125 psig) rating

.3 Acceptable material: Crane #428, Toyo #293 or Kitz Fig. 24

.4 Acceptable material: Crane #438, Toyo #280A or Kitz Fig. 40

.2 Gate valves: 65 mm (2 ½") and larger

.1 Cast iron body, bronze trim, rising stem, solid wedge, flanged ends.

.2 860 kPa (125 psig) rating

.3 Acceptable material: Crane #465 ½, Toyo #421A or Kitz Fig. 72.

Note: If there is insufficient clearance for a rising stem valve, use a non-rising stem valve.

.4 Acceptable material: Crane #461, Toyo 415A or Kitz Fig. 75

.3 Check valves (horizontal): up to 50 mm (2")

.1 Screwed bronze body, bronze swing disc

.2 860 kPa (125 psig) rating

.3 Acceptable material: Crane #37, Toyo #236 or Kitz Fig. 22

.4 Check valves (horizontal): 65 mm (2 ½") and larger

.1 Flanged cast iron body, bronze or cast iron swing disc, bronze trim

.2 860 kPa (125 psig) rating

.3 Acceptable material: Crane #373, Toyo #435A or Kitz Fig. 78

.5 Check valves (vertical upward flow): up to 50 mm (2")

.1 Screwed bronze body, bronze disc

.2 860 kPa (125 psig) rating

.3 Acceptable material: Crane #29, Toyo #231 or Kitz Fig. 36

.6 Check valves (vertical upward flow): 65 mm (2 ½") and larger

.1 Wafer style cast iron body, viton "A" body seat, 304SS clapper, arm and pin, 302SS spring

.2 PTFE thrust washer

.3 860 kPa (125 psig) rating

.4 Acceptable material: Moyes and Groves Fig. W12A-16V or Center Line Series #800.

.7 Butterfly valves: 65 mm (2 ½") and larger

.1 Wafer style or threaded lug style cast iron body

.2 EPDM seat liner

.3 Bronze disc

.4 403SS stem

.5 10 position lever-lock handle operator 150 mm and smaller

.6 For installation between Class 125/150 flanges

.7 1380 kPa (200 psig) rating

.8 Acceptable material: Keystone Fig. #AR2-805, Bray Series #31 or Center Line L200L/G200L (EPDM) (Lug style)

.8 Balance fittings and valves: up to 30 mm (1 ¼"): return side of heating elements

.1 Female by male union bronze body, Teflon disc
.2 Internal adjustable balancing stem
.3 Globe type
.4 (LS) Lockshield
.5 690 kPa (100 psig) rating
.6 Straight pattern or angle pattern
.7 Acceptable material: Toyo Fig. 250 or 251 or Kitz Fig. 100, 101, 102, 103

.9 Drain valves and hose bibs: up to 50 mm (2")

.1 Screwed brass 2 piece body ball valve, blow-out proof stem, PTFE seats, brass chrome-plated ball hose end connection with cap and chain
.2 1034 kPa (150 psig) rating
.3 Acceptable material: Toyo #5046 or approved equal in accordance with B6, Kitz Fig. 58CC

.10 Strainers: up to 50 mm (2")

.1 Screwed bronze "Y" pattern body, 304SS screen
.2 1034 kPa (150 psig) rating
.3 Acceptable material: Watts #777S, Toyo #380 or Kitz Fig. 15

.11 Strainers: 65 mm (2 ½") and larger

.1 Flanged cast iron "Y" pattern body, 304SS screen
.2 860 kPa (125 psig) rating
.3 Acceptable material: Sarco, Toyo #318A or Kitz Fig. 80

.12 Suction diffuser

.1 For base mounted or floor mounted vertical inline pumps.
.2 Cast iron construction, NPT connections up to 50 mm: flanged connections.
.3 Over 65 mm: cast iron straightening fitting, stainless steel combination diffuser – strainer – orifice cylinder with 4.8 mm perforations, and permanent magnet. Provide complete with a 16 mesh bronze strainer.

2.3 Valves for Natural Gas

.1 Ball valves: 12 mm (1/2") to 50 mm (2")

.1 Brass body, nickel chrome plated ball, threaded ends, quarter turn operation.
.2 CGA approved for natural gas.
.3 860 kPa (125 psi) rated.

.4 Acceptable material: Newman Hattersly Fig. 1969 CGA.

.2 Plug valves: 50 mm (2") and larger

.1 Cast iron body, lubricated plug valve, full bore, Class 125, flanged to ANSI B16.1

.2 CGA approved for natural gas.

.3 100 mm (4") and smaller: wrench operated.

.4 150 mm (6") and larger: gear operated.

.5 Acceptable material: Newman Hattersby, Figure 201M wrench operated and Figure 201 MG gear operated.

Part 3 Execution

3.1 Installation and Application Valves

.1 Install valves with stem upright or horizontal, not inverted.

.2 Provide valves for isolation of all equipment and as shown. Valve type to suit line size.

.3 Provide threaded lug type butterfly valves for equipment isolation service. Provide wafer or threaded lug type valves for zone shut-off service.

.4 Where permitted by codes, butterfly valves may be used in fire protection systems.

.5 Use ball valves in water systems for throttling/balancing service.

.6 For radiant panels and water and glycol system terminal heat transfer units, provide "circuit setter" valves on return line for each zone; and a ball valve for shut-off service.

.7 Provide drain valves at main shut-off valves, low points of piping and apparatus and terminal units.

.8 Size drain lines and drain valves equal to size of apparatus drain connection.

.9 For pipe sizes 20 mm and over, minimum drain size to be 20 mm.

.10 Provide hose thread connection with cap and chain for 20 mm drain valves located in ceiling and public areas.

.11 Provide male NPT nipples with threaded pipe cap for drain sizes over 20 mm where not piped directly to floor drains.

.12 Provide valved drain and hose connections off the bottom of all strainers.

3.2 Installation and Application Strainers

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve and as indicated.

END OF SECTION

Part 1 General

1.1 Description

.1 Comply with requirements of Division 1 and Section 15010.

.2 All drawings and all sections of the specifications shall apply to and form an integral part of this section.

.3 Contract documents of this section are diagrammatic and approximate to scale. The drawings and specifications establish scope for material and installation quality and are **not** detailed installation instructions. Follow Manufacturer's recommendations for installation supplemented by contract documents.

1.2 Work Performed By This Section

.1 Labour, material, plant, tools, equipment and services for the supply and installation of piping, ductwork, and equipment insulation.

1.3 Quality Assurance

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

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

1.4 Definitions

.1 The word "exposed", where used in this Section, means any work, which is not concealed in wall, shaft, or ceiling cavities or spaces. Work behind doors in closets or cupboards or under counters is considered exposed.

Part 2 Products

2.1 Materials

.1 All insulation systems shall have composite (insulation, jacket and adhesive used to adhere the jacket to the insulation) Fire and Smoke Hazard ratings as tested under procedure ASTM E 84, NFPA 225, or UL 723.

.2 Never is asbestos in any form to be used for any type of insulation work. All products must be certified "asbestos free".

.3 All final pipe and duct installations including insulation, covering and adhesive shall have a flame spread rating of not greater than 25.

.4 All canvas shall be treated to be fire retardant in accordance with ULC standards.

.5 Wire to be 1.2mm (18 ga.) soft annealed, type 304 stainless steel,.

.6 U.L.C. label or satisfactory certified report from approved testing laboratory is required to demonstrate that the fire hazard ratings for materials proposed for use do not exceed those specified.

.7 Flame proofing treatments subject to deterioration due to effects of high humidity are not acceptable.

.8 The Contract Administrator reserves the right to demand test samples of components of insulation systems for fire and smoke hazard ratings.

.9 In general, piping systems shall be insulated with fibreglass piping insulation with an all-purpose jacket. Fittings, flanges, and valves shall be insulated with fibreglass inserts and pre-molded polyvinyl or PVC jackets.

.10 Duct systems to be insulated with fibreglass duct insulation with an all-purpose jacket.

.11 Refrigerant piping systems shall be insulated with elastomeric pipe insulation.

.12 Special insulation protection shall be considered for areas subject to abuse and moisture, as indicated.

2.2 Compatibility of Components

.1 All adhesives, sealers, vapour coating, mastics, laggings and bedding compounds, shall be compatible with materials to which they are applied. They shall not soften, corrode, or otherwise attack such material in either wet or dry state. Materials shall only be those recommended by manufacturer or insulation as suitable for application proposed and be applied within ambient temperature range recommended by the manufacturer.

2.3 Insulation

.1 Premolded fibreglass pipe insulation

.1 ULC Listed sectional fibreglass pipe insulation in compliance with ASTM C547 in pre-moulded sections 900 mm (36") long, split and ready for application with a minimum Thermal Conductivity of 0.033 W/m°C (0.23 Btu.in/h.ft^2°F) at 24°C (75°F) mean temperature and be capable of use on service from -18°C to 454°C

(0°F to 850°F) and with factory applied vapour seal jacket of vinyl coated foil Kraft laminate with reinforcing of open mesh glass fibre. Jacketing with factory applied double pressure sensitive adhesive system.

.2 Acceptable material: Owens Corning Fiberglas SSL-II.

.2 Pipe and tank insulation

.1 ULC listed fibreglass semi-rigid board, factory jacketed with a laminated kraft-aluminum foil all service jacket. A minimum thermal conductivity of 0.039 W/m°C (0.27 Btu.in/h.ft^2°F) at 24°C (75°F) mean temperature. Suitable for an operating range of -18°C to 343°C (0°F to 650°F).

.2 Acceptable material: Owens Corning Fibreglass Pipe and Tank Insulation.

.3 Vapourwick pipe insulation

.1 ULC listed sectional fibreglass pipe insulation in compliance with ASTM C547 in pre-moulded sections 900 mm (36") long, split and ready for installation. Minimum thermal conductivity of 0.034 W/m°C (0.24 Btu in/h.ft^2°F) at 25°C (75°F) mean temperature. Operating temperature range of 0°C to 104°C (32°F to 220°F). Synthetic wicking material on inner surface of insulation to assist in transporting moisture to the outside of the system. Factory jacketed with a polymer facing. Insulation to be provided as a system including wick material for use on valves and fittings and matching butt joint sealing tape.

.2 Acceptable material: Owens Corning Vapourwick.

.4 High temperature pipe insulation:

.1 ULC listed pre-moulded mineral fibre (non-asbestos) insulation in compliance with ASTM C547. 900 mm (36") long, split and hinged. Minimum thermal conductivity of 0.059 W/m°C (0.41 Btu.in/h.ft^2°F) at a mean temperature of 204°C (400°F). Service temperature of -84°C to 649°C (-120°F to 1200°F)

.2 Acceptable material: Fibrex Coreplus 1200.

.5 Elastomeric pipe insulation:

.1 ULC listed, flexible elastomeric insulation, pre-slit with factory applied sealing system. Minimum thermal conductivity of 0.039 W/m°C (0.27 Btu.in/h.ft^2°F) at 25°C (75°F) mean temperature. Operating temperature range of -57°C to 104°C (-70°F to 220°F).

.2 Acceptable material: AP Armaflex SS.

.6 Duct insulation: board

.1 ULC listed semi-rigid board, nominal density 48 kg/m^3 (3 pcf). Minimal thermal conductivity of 0.036 W/m°C (0.25 Btu.n/h.ft^2°F) at 25°C (75°F) mean temperature. Operating temperature to 232°C (450°F). Factory applied foil reinforced kraft (FRK).

.2 Acceptable material: Owens Corning Fibreglass 703.

.7 Duct insulation: flexible

.1 ULC listed, flexible blanket of glass fibre insulation, factory laminated to foil reinforced kraft (FRK). Operating temperatures to 121°C (250°F). Minimum thermal conductivity of 0.039 W/m°C (0.27 Btu.in/h.ft^2°F) at mean temperature of 25°C (75°F). Nominal density of 16 kg/m^3 (1.0 pcf).

.2 Acceptable material: Owens Corning All Service Duct Wrap Type 100.

.8 Elastomeric: sheet

.1 ULC listed, flexible, elastomeric, thermal insulation. Expanded closed cell. Minimum thermal conductivity of 0.039 W/m°C (0.27 Btu.in/h.ft^2°F) at a mean temperature of 25°C (75°F). Operating temperature range of -57°C to 104°C (-70°F to 220°F). Self-adhering.

.2 Acceptable material: AP Armaflex SA.

2.4 Finishes and Protective Coverings

.1 Canvas: 170 g/m^2 w (0.6 ounces/ft^2) with lagging adhesive, ULC labelled.

.2 Aluminum: Protective covering to be 0.5 mm (0.020") thick Childers aluminium pre-formed covering complete with matching strapping and seals. The texture of both the lagging and fittings shall be stucco embossed.

.3 Trowelled-on weather protective coating: Bakor 110-14 asphalt mastic vapour barrier coating.

2.5 Insulation Protection Shields

.1 Insulation protection shields shall be installed at all pipe hangers and supports. Shields shall span an arc of 180°.

.2 A 1.2 mm thick (18 gauge) stainless steel shield shall be installed fully over all insulated piping located on the roof. The shield shall be a minimum length of 900 mm (36") and field located to prevent damage to the insulation while walking over the piping.

Part 3 Execution

3.1 Installation

.1 Insulation shall be applied on clean, dry surfaces and only after tests and approvals required by the specifications have been completed.

.2 All pipe insulation on piping operating below ambient temperature shall be continuous through wall and ceiling openings and sleeves.

.3 Insulation on all cold surfaces must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces shall be adequately insulated and vapor sealed to prevent condensation.

.4 Specified adhesives, mastics, and coatings shall be applied at the manufacturer's recommended minimum coverage per gallon.

.5 Edges of vapor barrier insulation at valve stems, instrument wells, unions, and other raw edges shall be sealed adequately to prevent moisture from penetrating the insulation.

3.2 Workmanship

.1 Work shall be performed by licensed journeymen.

.2 Apply insulation materials, accessories and finishes in accordance with Manufacturer's recommendations.

.3 Do not apply coverings until hydrostatic tests have been completed, surfaces are free of grease, scale, moisture, and heat tracing where required has been installed. Insulation shall be clean and dry when installed and during application of any finish.

.4 Cold surfaces to be dry and ferrous surfaces to be coated with rust penetrating protective paint before applying insulation and vapour barriers.

.5 Vapour barriers and insulation to be complete over full length of pipe or surface, without penetration for hangers, duct or seams, and without interruption at sleeves, pipe and fittings.

.6 Install insulation with smooth and even surfaces, with round shapes laid to true circular and concentric shape, shaped to blend with fitting insulation and adjacent covering; with full length section and tight to insulated object.

.7 Pack solid around all pipes where they pass through sleeves in walls, floor slabs, etc. for full thickness of floor with fibreglass or rockwool. Insulated pipes having vapour barrier jacket to pass through wall, floors, etc. to accommodate full insulation thickness. Protect insulation of exposed pipes passing through floors with 1.2mm (18 ga.) galvanized iron 150mm (6") from finished floor.

.8 On piping, gouge out insulation for proper fit where there is interference between weld bead and insulation. Bevel insulation away from studs and nuts to permit their removal without damage to insulation. Closely and neatly trim around extending parts of pipe saddles, supports, hangers and clamp guides. Seal with insulating cement.

.9 Use pipe covering protection saddles with roll type hangers unless otherwise indicated.

.10 Butt joints

.1 Place joints on top of duct wherever practical. Butt joints on side of duct for flexible duct insulation.

.2 Adhere and seal laps of vapour barrier cover or vapour barrier strip of 100mm (4") minimum width furnished with insulation, using vapour seal adhesives.

.11 Sagging of duct insulation will not be acceptable.

.12 Stagger both longitudinal and horizontal joints, on duct insulation of multi-layered construction.

.13 Duct insulation with vapour barrier shall be continuous, except at fire dampers.

.14 Ducts acoustically lined need no external insulation, unless specifically noted otherwise.

.15 Existing duct and pipe covering damaged or cut back during installation work to be made good with same insulation as specified for new work.

.16 Protect insulation against elements during all stages of application.

.17 Do not cover Manufacturer's nameplates on equipment. Cut insulation on 45 deg. angle to nameplate edge and seal.

.18 Covering to be uniform in diameter, smooth in finish. Place longitudinal seams so as to be invisible.

3.3 Pipe Insulation

.1 Fibreglass

.1 Insulate all piping flanges, fittings and valve bodies, etc. Insulate valve bonnets on chilled water systems.

.2 Fasten longitudinal laps with staples and seal with Swifts Adhesive #3218.

.3 Butt joints wrapped with a 100mm (4") strip of ASJ. Stagger joints on multiple layers.

.4 Refinish exposed piping with brush coat of Flintguard No. 120 white fire retardant lagging adhesive.

.5 45° and 90° to be insulated with Aercore, lagged on both sides, mudded then canvassed and lagged. Surface shall be wrapped with Friction Tape and sealed with an asphaltic sealing compound. Over this to be applied a smooth coating of insulating cement. Recover fittings with ASJ vapour seal jacket and brush coat with fire retardant white lagging adhesive.

.2 Elastomeric

.1 Insulate all piping, flanges, fittings and valve bodies.

.2 Apply to clean dry pipe.

.3 Snap pre-slit tubing over piping. Remove the release paper and the protective strip from the adhesive film. Apply firm pressure along the joint.

.4 Secure butt joints with manufacturer's approved adhesive.

.5 Use larger insulation sizes at flange, etc. to suit.

.6 Do not install at temperatures below 10°C (50°F) or above 35°C (95°F).

.7 Install manufacturer's approved finish when installed outside.

3.4 Vapour Barrier Flexible Duct Insulation

.1 Rectangular Ductwork

.1 On ducts 600mm (24") wide and wider apply welded pin fasteners to bottom surface of duct by impaling on welded pins on 300mm (12") centres. Spot adhesive on 300mm (12") centres on all sides of duct. Apply insulation with edges tightly butted together and secured with 100% coverage of 3-M No. 17 or approved alternate. Staple joints and seal with 100mm (4") strips of vapor barrier foil of same quality as duct insulation membrane sealed with BF 85-15.

.2 After installation of fasteners, cut pins and apply foil tape to cover completely.

.3 On ducts 575mm (23") wide or less insulation applied as above but welded pins may be omitted.

.2 Round Ducts

.1 Adhere to duct surface applied in strips 150mm (6") wide, 300mm (12") o.c. Butt all edges of insulation, staple and seal all joints with tape adhered over the joint. Seal all breaks with vapor barrier type.

.3 Exposed Ducts Indoors

.1 Recover ducts exposed to view with 170 g. (6 oz.) canvas secured with Flintguard No. 120 white fire retardant lagging adhesive. Finish with brush coat of same adhesive.

3.5 Vapour Barrier Rigid Insulation

.1 Insulation applied with edges tightly butted and secured by impaling on pins welded to duct. Pins to be staggered, minimum 300mm (12") o.c. in every direction. This applies to all sides. Secure insulation to pins with metal fasteners. Pins shall be long enough to bend after fasteners have been applied. Install two fasteners to all insulation on roof. Dab adhesive over pins and fasteners. After installation of fasteners, cut pins and apply foil tape to cover completely. Seal all joints, edges and breaks in vapor seal jacket with vapor barrier foil of the same quality as that of duct membrane 100mm (4") wide with BF 85-15 lagging adhesive.

.2 Wrap exposed ducts with fire retardant paper recovered with 170 g. (6 oz.) canvas secured with Flintguard No. 120 white fire retardant lagging. Brush coat with same adhesive. Do not use staples.

3.6 Finishes

.1 Canvas over insulated items where exposed indoors and cover with 2 coats of lagging installed to manufacturer's specifications.

.2 Weatherproof mastic, two 3 mm (1/8") thick coats trowelled smooth over mesh screen on all ductwork insulation where exposed outdoors.

3.7 Application Schedule

.1 Ductwork:

	Location/Service	Insulation Thickness	Type
.1	Supply ductwork in unconditioned spaces and where indicated on drawings	25 mm (1")	See Note 1
.2	All ductwork conveying unheated outside air in a heated building space	50 mm (2")	See Note 1
.4	All ductwork conveying heated air in an unheated building area or outside a building	50 mm (2")	See Note 1
.5	Ducts penetrating an exterior building surface (last 3 m (10 feet))	25 mm (1")	See Note 1
.6	Relief air ducts	25 mm (1")	See Note 1
.7	Drip pans	25 mm (1")	Elastomeric

Notes:

1. Utilize duct blanket insulation on all round ductwork and all rectangular supply ductwork less than 1200 mm wide (48").

.2 Piping:

	Location/Service	Insulation Thickness	Type
.1	Heating supply and return (water or glycol)		
	20 mm (¾") and smaller piping	25 mm (1")	Fibreglass pipe
	25 mm to 37 mm (1" to 1 ½") piping	37 mm (1 ½")	Fibreglass pipe
	over 50 mm (2")	50 mm (2")	Fibreglass pipe
.2	Domestic cold water	25 mm (1")	Vapourwick
.3	Domestic hot and recirculation	25 mm (1")	Fibreglass pipe

END OF SECTION

Part 1 General

1.1 General Conditions

.1 Mechanical General Conditions 15010 shall be part of this Section.

1.2 References

.1 ANSI/ASME B16.3-1992 Malleable Iron Threaded Fittings, Class 150 and 300

.2 ANSI/ASME B16.5-1988, Pipe Flanges and Flanged Fittings.

.3 ANSI B16.18-1984, Cast Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.22-1989, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.5 ANSI B18.2.1-1981, Square and Hex Bolts and Screws.

.6 ASTM A 47M-90, Specification for Ferritic Malleable Iron Castings.

.7 ASTM A 53-98, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.8 CAN/CGA B149.1-2000, Natural Gas and Propane Installation Code.

.9 The National Plumbing Code of Canada.

1.3 Product Data

.1 Submit product data in accordance with Section 01330 - Submittal Procedures.

.2 Indicate on manufacturers catalogue literature following:

.1 valves

.2 pressure reducing valves

1.4 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01780 - Closeout Submittals.

Part 2 Products

2.1 Pipe

.1 Steel pipe: to ASTM A 53, Grade B, seamless as follows:

.1 50 mm (2") and below: Schedule 40, threaded ends.

.2 65 mm (2 ½") to 250 mm (10"): Schedule 40, beveled ends.

2.2 Fittings

.1 50 mm (2") and below: Class 150 lb malleable iron ASTM A197, screwed to ANSI/ASME B16.3.

.2 65 mm (2 ½") to 250 mm (10"): Schedule 40 carbon steel ASTM A234 WPB, butt weld to ANSI/ASME B16.9.

2.3 Flanges

.1 50 mm (2") and below: Class 150 lb, raised face, screwed, forged carbon steel ASTM A105, to ANSI/ASME B16.5. Note: Use flanges 50 mm (2") and below only for connections to flanged equipment.

.2 65 mm (2 ½") and larger: Class 150 lb, slip-on or weld neck, raised face, forged steel ASTM A105, ANSI/ASME B16.5. Bore of welding neck flanges to suit pipe inner diameter.

.3 Flat faced flanges required at cast iron valves and equipment flanges for all sizes.

2.4 Unions

.1 50 mm (2") and below: Class 150 lb, malleable iron union, ASTM A197, brass to brass seats, ground joint.

2.5 Flange Bolting

.1 Carbon steel bolts to ASTM A307 Grade B with hex nuts to ASTM A563 Grade A. Dimensions to ANSI B18.2.1 and ANSI/ASME B18.2.2.

2.6 Thread Sealant

.1 To ULC Standard CAN/ULC-S642.

2.7 Gaskets

.1 Neoprene or other material resistant to any action of natural gas.

.2 Natural rubber shall not be used.

2.8 Valves

.1 Refer to Section 15111, Valves and Strainers.

Part 3 Execution

3.1 Piping

.1 Install in accordance with applicable Provincial/Territorial Codes.

.2 Install in accordance with CAN/CGA B149.1.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.5 Slope piping down in direction of flow to low points.

.6 Install drip points:

.1 At low points in piping system.

.2 At each connection to equipment.

.7 Use eccentric reducers at pipe size change installed to provide positive drainage.

.8 Provide clearance for access and for maintenance.

.9 Ream pipes, clean scale and dirt, inside and out.

.10 Install piping to minimize pipe dismantling for equipment removal.

3.2 Valves

.1 Install valves with stems upright or horizontal unless otherwise approved by Contract Administrator.

.2 Install valves at branch take-offs to isolate each piece of equipment, and as indicated.

3.3 Field Quality Control

.1 Test system in accordance with CAN/CGA B149.1 and requirements of authorities having jurisdiction.

3.4 Purging

.1 Purge after pressure test in accordance with CAN/CGA B149.1.

3.5 Pressure Reducing Valve

.1 Terminate vent in accordance with CAN/CGA B149.1.

END OF SECTION

Part 1 General

1.1 References

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)

.1 ANSI/NFPA 13-2002, Installation of Sprinkler Systems

.2 Underwriters Laboratories of Canada (ULC)

.1 ULC S543-1984, Internal Lug Quick Connect Couplings for Fire Hose.

1.2 Related Sections

.1 Section 15122 – Thermometers and Gauges.

1.3 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01330 – Submittal Procedures and in accordance with ANSI/NFPA 13, working plans and design requirements.

1.4 Samples

.1 Submit samples in accordance with Section 01330 – Submittal Procedures.

.2 Submit samples of following:

.1 Each type of sprinkler head.

.2 Signs.

1.5 Engineering Design Criteria

.1 Design system in accordance with ANSI/NFPA 13, using following parameters:

.1 Hazard:

.1 To suit occupancy as indicated.

.2 Pipe size and layout:

.1 Hydraulic design.

.2 Sprinkler head layout: to ANSI/NFPA 13 and as directed by authorities having jurisdiction.

.3 Water supply:

.1 Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for bases of design in accordance with ANSI/NFPA 13.

.4 Zoning:

.1 System zoning as indicated.

1.6 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01780 – Closeout Submittals.

1.7 Extra Materials

.1 Provide maintenance materials in accordance with Section 01780 – Closeout Submittals.

Part 2 Products

2.1 Pipe, Fittings and Valves

.1 Pipe

.1 Ferrous: to ANSI/NFPA 13.

.2 Copper tube: to ANSI/NFPA 13.

.2 Fittings and joints to ANSI/NFPA 13:

.1 Ferrous: screwed, welded, flanged or roll grooved.

.2 Copper tube: screwed, soldered, brazed.

.3 Valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2: bronze, screwed ends, OS& Y; gate.

.3 NPS 2 ½ and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.

.4 Swing check valves.

.5 Ball drip.

.4 Pipe hangers:

.1 ULC listed for fire protection services.

2.2 Sprinkler Heads

.1 General: to ANSI/NFPA 13 and ULC listed for fire services.

2.3 Sprinkler Head Type A

.1 Upright bronze.

2.4 Sprinkler Head Type B

.1 Pendant chrome link and lever type.

2.5 Sprinkler Head Type C

.1 Pendant chrome glass bulb type.

2.6 Sprinkler Head Type D

.1 Recessed chrome, glass bulb type with ring and cup.

2.7 Sprinkler Head Type E

.1 Flush chrome, link and lever type.

2.8 Sprinkler Head Type F

.1 Side wall chrome, link and lever type.

2.9 Alarm Check Valve

.1 Alarm check valve with retard chamber to ANSI/NFPA 13 and ULC listed for fire service.

2.10 Supervisory Switches

.1 General: to ANSI/NFPA 13 and ULC listed for fire service.

.2 Valves:

.1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.

.3 Flow switch type:

.1 With normally open and normally closed contacts and supervisory capability.

.4 Pressure alarm switch:

.1 With normally open and normally closed contacts and supervisory capability.

2.11 Water Gong

.1 To ANSI/NFPA 13 and ULC listed for fire service. Location as indicated.

2.12 Fire Department Connection

.1 To ANSI/NFPA 13 and ULC S543 listed, Siamese type, location as indicated. Thread specifications to be compatible with local fire department.

.2 Polished bronze, chrome plated exposed, with identifying sign cast on plate. Threaded metal caps and chains.

2.13 Excess Pressure Pump

.1 Pumps: double acting displacement type, open cylinder design, direct drive, ULC listed, complete with relief valve.

.2 Motor: EEMAC Class B squirrel cage induction 1725 rpm, continuous duty, drop proof, ball bearing, maximum temperature rise 50°C (90°F), 0.25kW (1/3 hp), 120/1/60.

.3 Capacity: 7.6 L/min. (120 USgpm).

.4 Pump operation switch: to operate excess pressure pump with pressure differential of 103 kPa (15 psi).

.5 Electrical wiring by Division 16.

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

2.14 Pressure Gauges

.1 ULC listed.

.2 Shall have maximum limit of not less than twice normal working pressure at point where installed.

2.15 Signs

.1 Signs for controls drain and test valves: to ANSI/NFPA 13.

2.16 Anitfreeze

.1 Anitfreeze loops to ANSI/NFPA 13, locations as indicated.

2.17 Spare Parts Cabinet

.1 For storage of maintenance materials, spare sprinkler heads and special tools.

.2 Construct to sprinkler head manufacturer's standard.

Part 3 Execution

3.1 Installation

.1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13.

.2 Install excess pressure pump across alarm valve in accordance with manufacturer's instructions.

.3 Testing to be witnessed by the Engineer and the authority having jurisdiction.

.4 Install water gong as indicated.

END OF SECTION

Part 1 General

1.1 Scope of Work

.1 The following generally describes the scope of work covered under this Section:

.1 Provision of all portable fire extinguishers, wall clips, identification, service tags and their related mounting accessories as required by codes, the authorities having jurisdiction, the work shown on the Contract Documents and as specified herein.

1.2 Related Sections

.1 Mechanical General Conditions – Section 15010.

.2 Mechanical Identification – Section 15075.

1.3 References

.1 NFPA 10-1998, "Portable Fire Extinguishers".

.2 CAN/ULC-S508-M90, "Rating and Fire Testing of Fire Extinguishers and Class "D" Extinguishing Media".

.3 CAN/ULC-S504-M86 "Dry Chemical and Dry Powder Hand and Wheeled Fire Extinguishers".

.4 National Fire Code 1995.

1.4 Shop Drawings and Product Data

.1 Submit shop drawings and product data for the following:

.1 Fire extinguishers and hangers.

Part 2 Products

2.1 Multi-Purpose Dry Chemical Extinguishers

.1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for A, B and C class protection.

.2 Minimum rating of extinguishers to meet or exceed both the A and combination BC values noted on drawings for each extinguisher.

.3 Construction: Metallic tank, handle and valve assemblies, reinforced rubber hose with non-conductive nozzle, hose stay and pressure gauge.

.4 Extinguishing Agent: Free-flowing, non-toxic, non-conductive, foam compatible dry chemical extinguishing powder approved for operation to -47.2°C (-53°F).

.5 Five year warranty.

2.2 Extinguisher Brackets

.1 Type 1 Mounting: Wall hook and masonry anchor or wood screw.

2.3 Identification

.1 Identify extinguishers in accordance with recommendations of NFPA 10 and CAN/ULC-S508.

.2 Attach bilingual tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

Part 3 Execution

3.1 Installation

.1 Install or mount extinguishers on brackets as indicated.

.2 Mount identification/location signage with permanent means of fastening, where required.

.3 Provide MSDS sheet(s) on extinguishing agent(s) for inclusion in operations and maintenance manual.

END OF SECTION

Part 1 General

1.1 Scope of Work

.1 Domestic water supply piping and fittings

.2 Drain, waste and vent

.3 Roof drainage

.4 Fixtures and trim

.5 Plumbing specialties and accessories

1.2 Related Work

.1 This Section does not contain all materials, equipment and requirements that may be required on this project. Read this Section in conjunction with the remaining Sections of Division 15 for related work.

.2 Division 1 forms an integral part of Division 15.

.3 Refer to Division 16 for electrical requirements.

1.3 Codes and Standards

.1 Refer to Section 15010, "General Mechanical Requirements" for the codes and standards that apply to this project.

1.4 Shop Drawings and Product Data

.1 Refer to Section 15010, "General Mechanical Requirements" and Section 01330, "Submittal Procedures " for submission requirements.

.2 Submit shop drawings and product data on the following:

.1 Valves
.2 Fixtures and trim
.3 Specialties and accessories

1.5 Operation and Maintenance Data

.1 Refer to Section 15010, "General Mechanical Requirements" and Section 01330, "Submittal Procedures " for submission requirements.

1.6 Pressure Testing

.1 Test all piping systems in accordance with code and Section 15010, Mechanical General Requirements.

1.7 Start-Up and Commissioning

.1 Potable water system disinfection tests

.2 Flushing

.3 Venting

.4 Flow rate adjustment and balancing of valves and fixtures.

Part 2 Products

2.1 General

.1 Code conformance: All fixtures, equipment, pipe, fittings and valves are to comply with the requirements of The National Plumbing Code of Canada, CSA Standards, ANSI Standards and ASTM Standards as referenced in these Specifications, listed in Section 15010, "General Mechanical Requirements" or as applicable by their scope.

.2 Colour: Fixture colour will be white, unless otherwise noted. Stainless steel fixtures will be a natural brushed or polished finish. All exposed plumbing brass and piping is to be bright chrome finish. Caulking compounds are to match the colour of the fixture or the surface to which the fixture is being sealed. Clear caulking materials may be used for chrome and stainless steel finishes.

.3 All fixtures in the same room are to be from the same manufacturer. Stainless steel products are to be from the same manufacturer unless specified as custom made. Brass and faucets are to be from the same manufacturer, and style when in the same room.

.4 Barrier free design requirements are to be observed where noted, fixtures, trim and accessories are to be compliant with the dimensions, capacities, operating forces, weights and clearances as specified by codes and standards referenced.

2.2 Pipe, Tube, Fittings and Joints

.1 Cast Iron Pressure Pipe, Non-Potable: centrifugally cast, bituminous tar coated ductile iron pipe, cast fittings, sizes 75 mm (3") to 1200 mm (48") diameter. Pipe end conditions to be as follows:

.1 Plain end for site applied mechanical joint system connections, where indicated.

.1 Ductile iron sleeve and cast steel end frames with lugs, all epoxy coated. Neoprene or EPDM elastomeric seal rings and T304 stainless steel fasteners.

.1 Acceptable material: Robar, Romac or Rockwell couplings.

.2 Ductile iron flange c/w elastomeric seal and setscrew locating fasteners. holes for fasteners and quantity to match Class 125 flange pattern.

.1 Acceptable material: Uniflange.

.2 Integrally cast Class 125 full face flanges c/w bolt holes conforming to ANSI/ASA standards.

.3 Use for buried forcemains and fluid systems where non-potable fluids are involved.

.2 Cast Iron Pressure Pipe, Potable, Cement Lined: Pipe and fittings as for non-potable service, c/w cement mortar lining to ANSI/AWWA standards.

.1 Use for potable water supplies to buildings on fire protection system water supplies, and where plastic and copper lines are not acceptable to the authority having jurisdiction.

.3 Cast Iron Drain, Waste and Vent (DWV) Pipe: Sizes 50 mm (2") and larger, centrifugally cast bituminous tar coated cast iron pipe and mold cast fittings. Uses and end conditions to be as follows:

.1 Plain or beaded and for mechanical joint (MJ) couplings to be used for above ground DWV pipe and Rainwater Leaders.

.1 Mechanical joint couplings are to be constructed of a neoprene gasket sleeve, stainless steel shear sleeve and stainless steel gear clamps.

.1 Acceptable material: Clamp All Corp, Bibby Ste. Croix.

.4 Copper Tube and Fittings: Sizes up to and including 75 mm (3") diameter, seamless copper water tube.

.1 Pressure piping, potable water systems:

.1 Below ground: Type K soft temper.

.1 Connectors: bronze flare unions, and threaded adapters to AWWA standards.

.2 Bends: Formed bends in tubing to comply with manufacturer's tube bending recommendations.

.2 Above ground: Type K or L, hard temper.

.1 Socket solder brass, bronze or wrought copper fittings, 50 mm (2") and under.

.1 Solder to be 95% tin and 5% antimony, lead free.

.2 Brazing flanges, Class 125 pattern, full face for lines of 63 mm (2 ½") and 75 mm (3") size.

.1 Silver solder brazing using Silfos or equivalent brazing filter metal, lead free.

.2 Silver solder all fittings on 63 mm (2 ½") and 75 mm (3") lines.

.2 Atmospheric Equipment Drains, non-potable service: Type M copper water tube, above ground only.

.1 Socket solder brass, bronze or wrought copper fittings, 50 mm (2") and under.

.1 50/50 lead/tin solder.

.3 Drain, Waste and Vent Piping: Sizes 50 mm (2") and under, above ground sanitary and indirect waste piping and vents.

.1 Socket solder brass, bronze or wrought copper fittings and threaded cleanouts.

.1 50/50 lead/tin solder.

.5 Plastic Piping:

.1 Drain, Waste and Vent (DWV): Sanitary, indirect waste and storm drainage piping:

.1 PVC (Polyvinyl Chloride): Schedule 40 pipe, all sizes, socket solvent welded DWV fittings of molded PVC.

.1 For use in combustible and non-combustible construction, and buried applications.

.2 Provide plastic pipe device firestopping and smoke sealing at the penetration of all fire rated assemblies.

2.3 Gaskets

.1 For flanged joints: 3 mm (1/8") thick type SBR red rubber, die cut to ASA Class 125 flange pattern (or ANSI Class 150).

.1 Acceptable material: Garlock No. 22, Polar Bear Rubber Model S012RRS or Argus Industries.

.2 Fasteners: T304 stainless steel studs, plate washers and heavy hex nuts.

2.4 Valves

.1 For valves, refer to Section 15111 – Valves and Strainers.

2.5 Plumbing Specialties and Accessories

.1 Cleanouts:

.1 Flush mounted:

.1 Floor access: round epoxy coated cast iron body and frame with adjustable secured heavy duty nickel bronze top and no-hub outlet:

.1 Plugs: Taper threaded bronze.

.2 Acceptable material: Zurn Model ZN-1400-HD-BP-NH, or Ancon Model CO-200-R-1-NH-34B.

.2 Wall access:

.1 Sizes 50 mm (2") and under: Neoprene expansion plug with 100 mm (4") round stainless steel access cover and centre securing screw.

.1 Acceptable material: Ancon Model CO-440-RD-3 or Zurn Model ZSS-1666-1.

.2 Sizes 75 mm (3") and larger: Threaded plug in tee or wye of parent pipe material, metallic plugs are to be brass. Install in wall with access door positioned for optimum accessibility. Also suitable for ceiling spaces.

.1 Provide access door in drywall ceilings to permit cleanout use.

.2 Exposed:

.1 In finished areas: Exposed metallic portions are to be chrome plated, provide cap and escutcheon.

.2 In unfinished areas: Threaded plug in ferule of parent pipe material, metallic plugs are to be brass.

.2 Access Doors: Satin coat galvanized steel construction, hinged one side, c/w vandal resistant cam or screw fastener closures. Flanged frame to suit thickness of finish or assembly in which it is installed. No sharp edges.

.1 Provide ULC listed access doors for all penetrations of rated assemblies.

.2 Sizes:

.1 Hand entry: Minimum 203 x 203 mm (8" x 8").

.2 Arm entry (more than 305 mm (12") reach required): minimum 305 x 305 mm (12" x 12").

.3 Head and one arm (more than 610 mm (24 reach required): minimum 457 x 457 mm (18" x 18").

Part 3 Execution

3.1 General

.1 Perform all work in full compliance with all codes, standards, bylaws and recommended practices referenced.

.2 Only first quality workmanship will be accepted, all deficient and inferior work will be corrected at no additional cost to the City.

.3 Codes, standards and bylaws are minimum requirements, and additional work shown or specified in excess of these minimum requirements will be provided as if required by codes, etc.

.4 Layout and installation is to consider access for maintenance, repair, inspection and replacement. Provide sufficient clearances from the building structure, access through finishes, clearance from electrical cables and communication wiring as will be required for these tasks.

.5 Provide all sketches, drawings and product information required for permit applications and pay all fees levied for the issuance of permits, inspections, reports, testing and penalties.

.6 Install fixtures and equipment in accordance with manufacturer's recommendations.

3.2 Piping and Fittings

.1 All references to tubing are to include pipe, tube, hose and conduits of other shapes and descriptions.

.2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.

.3 Assemble all piping using fittings manufactured to ANSI standards.

.4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.

.5 Connect to fixtures and equipment in accordance with manufacturer's instructions unless otherwise indicated.

.6 Buried tubing:

.1 Bend tubing without crimping or constriction. Minimize use of fittings.

.2 Install buried pipe on a minimum 100 mm (4") bed of washed clean sand, shaped to accommodate fittings, to line and grade as indicated. Backfill with washed clean sand. Compact as specified in Section 02315 - Excavating, Trenching and Backfilling.

.7 Install piping with slopes and grades to promote effective venting and drainage.

.8 Provide unions, flanges or other means of quick disconnection of piping from connections at pumps, equipment and fixtures.

.9 Support piping at intervals as specified in Section 15061, "Pipe Hangers and Supports".

.10 Provide the means to accommodate piping expansion, contraction and shock loadings without damage to the piping system, equipment or fixtures.

.11 Provide drain valves at the low points in all pressure piping systems.

.12 Provide the cleanouts necessary to facilitate system maintenance of all gravity drainage lines.

.13 Provide expansion compensators for vertical piping passing through floor slab and roof.

.14 Provide suitable transition couplings when joining pipe of differing materials.

.15 Provide deep seal P-traps for all floor drains directly connected to the building drainage system.

.16 Provide cleanouts on all P-traps for fixtures installed above the floor, or accessible from the crawlspace or lower storey.

3.3 Valves

.1 Isolate water meter and provide bypass valve using ball valves.

.2 Use gate valves to isolate equipment or systems where no modulation, throttling or adjustments are required.

.3 Use globe valves or ball valves to provide combination throttling/shut-off capability.

.1 Indelibly mark the position of the operator after setting in a throttling position.

.2 Where valves are required to be closed more than once per year for service or operating reasons, provide a memory stop feature to allow the reliable repositioning of the valve to its design position.

.4 Install check valves in lines where reverse flow would have a detrimental effect on system safety, function or performance.

.1 Swing check valves are to be installed with the hinge pin level and the body in horizontal or up-flow position.

.2 Use spring or counterweight assisted check valves for down flow positions.

.5 Valve stems are to be oriented in the vertical "upright" position where possible. Position above horizontal to full upright will be acceptable in vertical lines and horizontal lines where space is limited.

.6 Provide drain valves per Section 15010, Mechanical General Requirements at all low points and in trapped sections of pressure piping systems.

3.4 Fixtures

.1 Floor drains: Remove strainers, clean traps, fill with clean water and reinstall strainers.

.2 Roof drains: Remove any rocks, ballast or debris from line, install strainer.

.3 Escutcheons: Remove masking, paint splatter and set in place against finished wall.

.4 Caulking to be a uniform bead profile as recommended by manufacturer, continuous and firmly adhering to both surfaces. Minimize post-application tooling.

3.5 Flushing and Disinfection

.1 Prior to disinfection, conduct all pressure tests, test all backflow preventors, and flush all lines to remove foreign objects and all loose materials.

.2 Apply sodium hypochlorite (bleach) to the water and circulate to distribute evenly. Let stand for 24 hours.

.3 Drain and flush the piping until the sodium hypochlorite residual is 0.5 ppm or less.

.4 Draw a sample and have it analyzed at the Cadham Provincial Labs for contaminant levels.

.5 When an acceptable water quality result is confirmed, proceed with venting, balancing and adjustment of fixture performance.

.1 If an unacceptable water quality test result is reported, repeat the flushing and disinfection process, then retest.

END OF SECTION

Part 1 General

1.1 Scope of Work

.1 The following generally describes the scope of work covered under this Section:

.1 Provision of water supply and drainage system accessories required by; codes, the authorities having jurisdiction, the work shown on the contract documents and as specified herein. They are to include, but not be limited to:

.1 General use floor drains.

.2 Cleanouts.

.3 Water hammer arrestors.

.4 Trap primers.

1.2 References

.1 CAN3-B79-M79, Floor Drains and Trench Drains.

.2 PDI-WH201-77, Water Hammer Arrestors.

1.3 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with 01330 – Submittal Procedures.

.2 Indicate dimensions, construction details, capacities and materials for following:

.1 Floor drains

.2 Cleanouts

.3 Water hammer arrestors

.4 Trap primers

1.4 Maintenance Data

.1 Provide maintenance data for incorporation into manual.

.2 Data to include:

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

Part 2 Products

2.1 Floor Drains

.1 Floor drains and trench drains: to CAN3-B79.

.2 FD-1: Floor and shower drain: epoxy coated cast iron body, 152 mm dia. round, nickel bronze adjustable strainer, no-hub outlet.

.1 Acceptable material: Zurn Model ZN-211-B6, Ancon Model FD-200-A.

2.2 Cleanouts

.1 Exposed cleanout plugs: heavy PVC male ferrule with threaded plug. Sealing neoprene gasket.

.1 Acceptable material: Ipex, Bow or Canplas.

.2 Concealed:

.1 Wall access: face or wall type, polished nickel bronze square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.1 Acceptable material: Zurn Model ZANB-1460.

.2 Floor access: round epoxy coated cast iron body and frame with adjustable secured heavy duty nickel bronze top and no-hub outlet:

.1 Plugs: Taper threaded bronze.

.2 Acceptable Material: Zurn Model ZN-1400-HD-BP-NH.

.3 Stack base cleanout: PVC DWV in-line tee fitting with NPT plug.

.1 Acceptable material: Ipex, Bow or Canplas.

.4 Urinal cleanout: Neoprene rubber expansion stop with stainless steel compression caps, wing nut operated compression screw, stainless steel access cover and centre securing screw.

.1 Acceptable material: Zurn Z-1666-1.

2.3 Water Hammer Arrestors

.1 Stainless steel construction, bellows type: to PDI-WH 201.

.2 Acceptable material: Zurn Z-1700.

2.4 Strainers

.1 125 psi, Y type with 40 mesh, stainless steel removable screen.

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

.1 Acceptable material: Spirax BT.

Part 3 Execution

3.1 Installation

.1 Install in accordance with most recent version of Manitoba Plumbing Code 1992 and local authority having jurisdiction except where specified otherwise.

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

3.2 Cleanouts

.1 In addition to those required by code, install at base of all soil and waste stacks, and rainwater leaders and where indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum 100 mm dia. (NPS 4).

3.3 Water Hammer Arrestors

.1 Install on branch supplies to each fixture or group of fixtures where such fixtures or groups of fixtures include urinals or water closets and at the dishwasher.

.2 Provide schedule of proposed sizes and locations as part of shop drawing submission.

3.4 Floor Drains

.1 Protect the threads and provide void form below strainer rim of all floor drains to allow adjustment after installation.

.2 Set and seal strainer into concrete or floor system to promote complete drainage of all liquids on floors.

.3 Refer to structural drawings for floor slopes.

.4 Refer to architectural drawings for locations of floor drains.

3.5 Commissioning

.1 After start-up, test, adjust and prove operation as indicated, to suit site conditions such as: clean out and prime all floor drain traps using means acceptable to the Manitoba Plumbing Code and Authority having Jurisdiction.

END OF SECTION

Part 1 General

1.1 Scope

.1 The following generally describes the scope of the work covered by this Section:

.1 Provision of packaged HVAC units with controls and accessories as required by the work shown in the Contract Documents and as specified.

.2 Co-ordinate the installation with Section 15900 and all other trades.

1.2 Related Sections

.1 Ductwork and Accessories - Section 15800

.2 Controls - Section 15900

1.3 References

.1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

.1 ANSI/ARI 430- 89, Central Station Air Handling Units.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181- 92, Ready-Mixed Organic Zinc-Rich Coating.

1.4 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01330 – Submittal Procedures.

.2 The shop drawings shall indicate the following: fan size and configuration, fan curves showing point of operation, motor drive bearings filters, mixing box, dampers, coil, plus all performance data.

1.5 Waste Management and Disposal

.1 Separate and recycle waste materials.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.6 Extra Materials

.1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Engineer, supply one (1) complete set of air filters for each filter bank.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

Part 2 Products

2.1 Packaged Direct Gas Fired Make-Up Air Unit (MUA-1)

.1 General:

.1 Supply direct gas fired make-up unit designed for indoor installation. The capacity and configuration shall be as detailed on the drawings. The unit shall be CGA and ETL certified and listed to be in compliance with the current ANSI Z83.18 standard.

.2 The line burner, gas train and controls are to be in accordance with FM and IRI requirements. Both burner and blower shall be compensated for an altitude of 230 metres above sea level.

.3 The unit is to be completely factory test fired to verify proper operation. The unit capacity is to be validated with an instantaneous flow meter. A complete electrical circuit analysis is to be conducted and all systems operated and measured. A combustion analyzer is to be employed while unit is operating at full capacity to verify combustion emissions. Burner combustion must be clean and odorless and no aliphatic aldahydes are to be detectable. Combustion efficiency must limit the products of combustion to a maximum of 5 ppm carbon monoxide and 0.5 ppm nitrogen dioxide.

.2 Unit Casing:

.1 Unit construction is to be of industrial quality heavy gauge bonderized G90 steel. The unit design shall incorporate a full base pan supported by an integral welded channel iron base. Bases are to be of industrial welded structural iron integrity, formed sheet metal bases are unacceptable. All structural iron base supports are to be treated with an industrial epoxy primer enriched with a rust inhibitor.

.2 To ensure the casings are airtight and weatherproof, all panels are to be caulked during assembly. All casings are to be hand fitted and secured with gasketed self-tapping Tek screws. Roof casing are to feature three-break standing seam panel design.

.3 Entire unit casing and accessories are to be insulated with fiberglass insulation with hard neoprene facing. 25 mm thick 0.7 kg insulation is to be secured with industrial glue and welded pin spots. Insulation is to be certified to fire and

flamespread ratings as outlined by the ANSI code. The entire floor of the unit is to feature a steel liner sandwiching the insulation.

.4 Units are to be equipped with access doors to all serviceable components. Access doors are to have full-length stainless steel piano hinges. All access doors are to be equipped with an insulation liner, positive seal latches and gasketing . Access doors are to open outward on negative pressure sections and inward on positive pressure sections.

.5 Units are to be finished with an industrial grade chain stop alkyd enamel paint. The medium grey finish coat is to be a mimum of 3 mils thick and provide 100% coverage.

.3 Blower and Motor Section

.1 Unit shall be supplied with AMCA rated centrifugal forward curve DWDI statically and dynamically balanced blower. The fan shall be mounted on a heavy duty machined and polished shaft. The shafts maximum operating speed is not to exceed 75% of its first critical speed. The bearings and motor shall be mounted in the airstream. The T-frame motor shall be mounted in a motor compartment on a fully adjustable base. The bearings are to be industrial pillow block type supplied with extended grease lines. The blower is to be driven with a fixed 1.25 s.f. V-belt drive package concealed in a belt guard.

.4 Burner Section

.1 The unit shall be equipped with a wide range fully modulating direct gas-fired burner capable of 30:1 turndown. The burner shall have stainless steel combustion baffles, non-clogging gas ports, spark-ignited intermittent pilot and flame safeguard system. Burner combustion must be clean and odorless. Combustion efficiency must limit the products of combustion to a maximum of 5 ppm carbon monoxide and 0.5 ppm nitrogen dioxide. The burner profile is to be equipped with adjustable profile plates. A heat treated glass observation port shall provide a full view of flame. Hinged access door(s) are to be provided to allow easy maintaince and inspection for burner, ignitor and flamerod.

.5 Control and Manifold Compartments

.1 Unit control enclosure to have hinged access. Terminal strip and all wiring shall be numbered. The controls for the heater shall include:

.1 Blower motor starter w/ambient compensated overloads and auxiliary contact(s),

.2 Primary to 120v control transformer,

.3 6,000 volt ignition transformer,

.4 Control circuit breaker and service switch,

.5 Manual reset temperature high limit,

.6 Flamesafeguard relay w/ LED status and flamerod,

.7 Discharge temperature control sensor,

.8 Differential air proving safety switch, and

.9 Automatic low temperature limit.

.2 All wiring external to control enclosure shall be run in conduit. The gas manifold shall include:

.1 Main gas pressure regulator,

.2 Manual shutoff & test firing valve,

.3 Main gas automatic shutoff valve,

.4 Auxiliary main gas automatic shutoff valve,

.5 Modulating control system,

.6 Pilot pressure regulator,

.7 Pilot automatic shutoff valve,

.8 Pilot manual shutoff valve,

.9 Pilot needle valve, and

.10 Multiple test ports.

.6 Unit shall be pre-wired; factory tested and shall bear the CSA and CGA approval as a complete unit.

.7 The unit shall be provided with a filter section. Filter access shall be through latched and gasketed access doors located on both sides of the unit.

.1 Acceptable Material: Farr 30/30.

.8 Acceptable Material: ICE, Engineered Air.

2.2 Packaged Indirect Gas Fired Make-Up Air Unit (MUA-3)

.1 Furnish outdoor, indirect gas fired heat units. Units shall be sectionalized, factory assembled and consist of a blower section, gas heating section, flat filter section and an inlet section with low temperature, low-leakage dampers.

.2 Units shall be pre-wired; factory tested and shall bear the CSA and CGA approval as a complete unit.

.3 Unit shall be a single package, piped and wired at the factory. All shall be integral to the unit. Unit shall be equipped with low limit freeze protection with by-pass timer.

.4 Unit casing shall be heavy gauge G90 rated steel. Unit roof shall be sloped for water drain off and feature standing seam construction. The entire unit casing shall be insulated with 25 mm (1") thick 0.7 kg (1 ½ lb) fiberglass insulation with hard neoprene backing.

.5 The gas fired heating section shall be four pass design with a primary combustion chamber and multi-tube secondary heat exchanger. Internal turbulators or other flue restrictors to boost efficiency are unacceptable.

.1 Construct entire primary and secondary heat transfer surfaces from Type 409 Series stainless steel.

.2 Type 409 stainless steel burner shall feature an integral combustion air blower and motor; combustion air proving switch, removable pilot assembly and positive pilot combustion air supply.

.3 The combustion air damper shall be interlocked with the main gas valve to insure proper air/gas mixture.

.4 The unit shall be suitable for natural gas and designed and certified by ETL and CGA to provide full gas modulation. The minimum turndown ratio shall be 10:1.

.6 The air inlet section with outdoor air damper shall be provided. The dampers shall be aluminum airfoil low leak type with seals inset into (22 gauge) steel mix box liners.

.1 The dampers shall be equipped with actuators.

.7 The unit shall be provided with a flat filter section. Filter access shall be through latched and gasketed access doors located on both sides of the unit.

.1 Acceptable Material: Farr 30/30.

.8 Units shall be supplied with a factory fabricated base rail.

.9 Units shall be served by a single point power connection, all motor starters and internal controls shall be factory wired.

.10 Units shall be supplied with a non-fused disconnect for installation by Division 16.

.11 Acceptable Material: ICE, Engineered Air.

2.3 Vibration Isolation

.1 Provide flexible connections at the supply and return inlets as noted in Section 15800.

.2 Factory installed vibration isolators shall be provided on the fan section.

Part 3 Execution

3.1 Packaged Make-Up Air Units (MUA-1, MUA-2)

.1 Provide appropriate protection apparatus.

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

.3 Ensure adequate clearance for servicing and maintenance.

.4 Units to be mounted on factory supplied roof curbs.

END OF SECTION

Part 1 General

1.1 Shop Drawings

.1 Submit shop drawings in accordance with Section 01330 - Submittal Procedures.

.2 Indicate:

.1 Equipment, capacity, piping, and connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

.3 Special enclosures.

1.2 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 01780 - Closeout Submittals.

Part 2 Products

2.1 Finned Tube Radiation

.1 Reuse existing.

2.2 Cabinet Unit Heaters

.1 Reuse existing.

Part 3 Execution

3.1 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Install in accordance with piping layout and reviewed shop drawings.

.3 Provide for pipe movement during normal operation.

.4 Maintain sufficient clearance to permit performance of service maintenance.

.5 Check final location with Contract Administrator if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Contract Administrator's directive.

.6 Valves

.1 Install valves with stems upright or horizontal unless approved otherwise.

.2 Install isolating gate valves on inlet and lockshield balancing valves on outlet of each unit.

.7 Venting:

.1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.

.2 Install standard air vent with cock on continuous finned tube radiation.

.8 Clean finned tubes and comb straight.

.9 Install flexible expansion compensators as indicated.

.10 Provide double swing pipe joints as indicated.

.11 Provide supplementary suspension steel as required.

END OF SECTION

Part 1 General

1.1 General

.1 For additional information, refer to Section 15010 - Mechanical General Requirements and the General Conditions of the Contract.

.2 For a list of applicable codes and standards, refer to Section 15010 - Mechanical General Requirements.

.3 The mechanical contractor shall be responsible for coordinating all aspects of this work.

1.2 Scope of Work

.1 The scope of work for this section includes, but is not limited to, the following:

- .1 Provision of low, medium, and high pressure ductwork and plenums as indicated.
- .2 Provision of flexible ducts.
- .3 Provision of duct access doors, hangers, supports, bracing, balancing dampers, splitter dampers, backdraft dampers, fire dampers, flexible connections, turning vanes and instrument test ports.
- .4 Provision of duct sealants, tapes, reinforcing fabric and gaskets.
- .5 Duct cleaning.

1.3 Shop Drawings

.1 Shop drawings shall be submitted for the following items:

- .1 Flexible ductwork.
- .2 Sealant, tape, hangars and supports and fittings.

.2 Shop drawings of high pressure duct fittings shall indicate the following:

- .1 Thicknesses.
- .2 Welds and configurations.
- .3 Sealants.
- .4 Tape
- .5 Proprietary joints.

1.4 Alternatives

.1 Size round ducts installed in place of rectangular ducts indicated from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration, shape or sizes is permitted except with prior authorization in writing from the Contract Administrator.

1.5 Definitions

.1 Low Pressure: Static pressure in ducts less than 500 Pa (2") and velocities less than 10 m/s (2000 FPM).

.2 Medium Pressure: Static pressure in duct of greater than 500 Pa (2"), but less than 1500 Pa (6"), or velocities greater than 10 m/s (2000 FPM).

.3 High Pressure: Static pressure in duct over 1500 Pa (6") and less than 2500 Pa (10") and velocities greater than 10 m/s (2000 FPM).

.4 Duct Sizes: Inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes indicated as clear inside duct liner or insulation.

Part 2 Products

2.1 Ductwork

.1 Provide galvanized steel low, medium and high pressure distribution ductwork for building supply, return and exhaust air systems as indicated.

	Pressure Class (Maximum Pressure) (Pa)						
Duct System or Location	125 (0.5")	250 (1")	500 (2")	750 (3")	1000 (4")	1500 (6")	2500 (10")
Supply Air			X				
Return Air			X				
Exhaust Air		X					
Receiver Air		X					
Combustion	X						

.2 Construct ducts of galvanized steel, of lock forming quality and having zinc coating to ASTM A653/A653M designation for both sides.

.3 Use rivets or bolts for fastening medium velocity ducts; sheet metal screws are acceptable on low pressure ducts only.

.4 Use water resistant, fire resistive duct sealant which is compatible with mating materials.

2.2 Seal Classification

.1 Classification as follows:

Maximum Pressure Pa (inch)	SMACNA Seal Class
2500 (10")	A
1500 (6")	A
1000 (4")	A

750 (3")	B
500 and lower (2")	B

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with gaskets, sealant, tape, or combination thereof.

2.3 Flexible Ductwork

.1 Comply with requirements of ULC "Standards for Safety, Air Ducts", ULC-181 Class I, and NFPA 90A.

.2 Provide at inlet to air control boxes and at diffusers. Length shall not exceed 1500 mm (5') or as shown. Unit must withstand 2500 Pa (10") internal pressure and external pressure.

.3 Ductwork shall be of non-collapsible coated mineral base fabric type, helically supported either by steel wire or flat steel strips.

.4 Provide 25 mm (1") mineral fibre insulation with factory applied vapour barrier on ducting systems which require insulation.

2.4 Fabrication

.1 Fabricate metal ducts complete with no single partition between ducts. Where any dimension of duct exceeds 450 mm (18"), cross break all sides for rigidity. Open corners are not acceptable.

.2 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.3 Construct tees, bends, and elbows with centreline radius of not less than 1 1/2 times width of duct in plane of rotation. Where not possible, and where square turn elbows are used, provide air foil turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with internal mineral fibre cores.

.4 Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible. Maximum divergence upstream of equipment to be 30 degree and 45 degree convergence downstream. Angles are measured as total included angle (both sides).

.5 Rigidly construct low pressure metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with approved duct sealant during duct assembly.

.6 Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10% of duct area, split into two ducts maintaining original duct area.

.7 Provide necessary baffling in mixed air plenums to ensure good mixed air temperature with cross sectional variations of not more than 5°C (9°F) under all operating conditions.

.8 Fabricate continuously welded medium pressure round and oval duct fittings of one gauge heavier than gauges indicated for duct size. Joints shall be 100 mm (4") cemented slip joint, brazed or electric welded. Prime coat welded joints. Fabricate elbows of five piece construction. Provide standard conical 45° takeoffs unless otherwise indicated where conical 90° tee takeoff connections may be used. Adequately brace with truss couplings or companion angle flanges with gaskets bolted at 150 mm (6") centres.

.9 Fabricate plenums and casings to configurations shown on drawings. Construct plenums of galvanized panels joined with standing seams on outside of casing riveted or bolted on approximately 300 mm (12") centres. Reinforce with suitable angles and provide diagonal bracing as required. Tightly fit at apparatus and caulk with sealant.

.10 Reinforce door frames with angle iron tied to horizontal and vertical plenum supporting angles. Install hinged access doors where shown, specified or where required for access to equipment for cleaning and inspection.

2.5 Sealant

.1 Sealant: Oil resistant, polymer type flame resistant duct sealant. Temperature range of -35°C (-31°F) to 93°C (200°F).

.1 Acceptable Material: Duro Dyne S-2.

2.6 Tape

.1 Tape: Polyvinyl treated, open weave fiberglass tape, 50 mm (2") wide.

.1 Acceptable Material: Duro Dyne FT-2.

2.7 Fittings

.1 Fabrication: to SMACNA.

.2 Mitred Elbows:

.1 To 400 mm (16"): with single thickness turning vanes.

.2 Over 400 mm (16"): with double thickness turning vanes.

2.8 Hangers and Supports

.1 Strap Hangers: Of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 800 mm (32").

.2 Hanger Configuration: to SMACNA.

.3 Hangers: Galvanized steel angle with galvanized steel rods to SMACNA.

.4 Upper hanger rod attachments:

.1 For steel joist: manufactured joist clamp or steel plate washer.

.2 For steel beams: manufactured top chord beam clamps.

.3 Acceptable Material: Figure 93 as manufactured by Grinnell.

2.9 Access Doors

.1 Coordinate with Section 15010 for access to concealed areas.

.2 Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices. Install minimum 25 mm (1") thick insulation with suitable sheet metal cover frame for insulated ductwork. Doors shall be minimum 300 mm (12") square, unless indicated otherwise on drawings, of same gauge as duct, and larger doors 2 gauges heavier than duct.

.3 Fabricate with two butt hinges fastened with two sash locks and outside handle for sizes up to 450 mm (18"), two hinges and two compression latches with outside and inside handles for sizes up to 600 x 1200 mm (24" x 48") and an additional hinge for larger sizes. For full body entry, handles that operate door locks are required on the interior as well.

2.10 Fire Dampers

.1 Fire dampers: arrangement Type A, B, C, listed and bear label of ULC, meet requirements of provincial fire authority and authorities having jurisdiction. Fire damper assemblies to be fire tested in accordance with CAN4-S112.

Utilization Schedule

Location	Type
Behind grilles and louvers	A
Rectangular duct penetrating a rated assembly	B
Round duct penetrating a rated assembly	C

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.3 Top hinged: offset, single damper, round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section or as indicated.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 40 x 40 x 3 mm (1 5/8" x 1 5/8" x 1/8") retaining angle frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

2.11 Fire Stop Flaps

.1 To be ULC listed and labelled and fire tested in accordance with CAN4-S112.2.

.2 Construct of minimum 1.5 mm (0.06") thick sheet steel with 1.6 mm (16 gauge) thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.

.3 Flaps to be held open with fusible link conforming to ULC-S505 and close at 74°C (165°F).

2.12 Single Blade Volume Dampers

.1 Low velocity system single blade volume dampers shall be limited to maximum duct depths of 300 mm (12") and maximum duct widths of 1.2 metres (4').

.2 Volume dampers shall be minimum 0.76 mm (22 gauge) thick steel for duct widths up to 450 mm (18"), and 1.52 mm (0.06") thick steel for widths in excess of 450 mm (18"). Ducts 450 mm (18") maximum width shall utilize 10 mm (3/8") diameter axle pins, and ducts in excess of 450 mm (18") widths shall utilize 12 mm (1/2") axle rod. Pins and rods shall be cold rolled steel.

.3 Damper blades shall be die formed for reinforcement, with centre grooved and edges bent. Centre groove shall hold mounting pins and rod. Damper frame shall be mild steel channel with back stops at top and bottom. Bearings shall be oilite bronze press-fit into frame.

.4 Manual dampers shall have a locking quadrant to hold dampers in fixed position without vibration. Complete assembly shall be galvanized finish.

2.13 Multiple Blade Volume Dampers

.1 Use multi-blade dampers where damper width exceeds 300 mm (12"). Dampers to be Tamco Series 1000 except for exhaust/outdoor air intake and relief dampers, which are to be insulated Tamco series, 9000 BF.

.2 Frames shall be welded construction mild steel or aluminum channels, maximum size 1.2 metres (4') by 1.8 metres (6'). Larger sizes shall be made up of damper sections connected together vertically and horizontally. Frame net area shall equal duct area.

.3 Blades shall be 2.0 mm (14 gauge) thick extruded aluminum, with widths varying from 150 to 200 mm (6" to 8"). Blade edges shall be formed 12 mm x 12 mm (1/2" x ½") channel. Blades shall be centre reinforced to take axle rods.

.4 Synthetic bearings for each damper axle shall be press fitted into frame. Centre bar linkage shall be fitted with bearings interconnecting the blades with 8 mm (5/16") tie-rods to provide opposed blade action.

.5 Each damper section shall have side, top and bottom stops welded to frame.

.6 Fit extruded silicone rubber seals to damper sections used for total shut-off application, and face and bypass applications. Opposed blade arrangement to be rated at 0.6% leakage at 2500 Pa (10") static. Operating temperature range to be -40°C (-40°F) to 90°C (195°F).

.7 Manual dampers shall have a locking quadrant control. Motorized dampers shall operate external linkage on single section dampers and centre bar linkage on multiple sections. All steel components to be cadmium plated.

2.14 Backdraft Dampers

.1 Fabricate multi-blade, parallel action gravity balanced backdraft dampers with blades a maximum of 150 mm (6") width having felt or flexible vinyl sealing edges, linked together in rattle-free manner and with balance adjustment device to permit setting for varying differential static pressure.

2.15 Flexible Connections

.1 General HVAC System: Provide where indicated, at fans and at air handling units, neoprene coated flame proof fabric, minimum density 1.22 kg/m^2 (0.25 lb/ft^2), factory fabricated, not more than 150 mm (6") long between metal parts and installed with just sufficient slack to prevent vibration transmission. Allow 100 mm (4") movement to medium pressure fans and 50 mm (2") movement to low pressure fans.

2.16 Turning Vanes

.1 Provide small arc air foil hollow vanes for square elbows. Where acoustical lining is provided, provide turning vanes of perforated metal type with fibreglass core. Where centreline radius is less than 1-1/2 times turning dimension of duct, provide splitter vanes constructed and spaced according to the latest SMACNA Manuals.

2.17 Instrument Test Ports

.1 Zinc plated steel.

.2 Camlock handles with neoprene expansion plug and handle chain.

.3 28 mm (1 1/8") minimum inside diameter.

Part 3 Execution

3.1 Installation

.1 Provide openings in ductwork where required to accommodate thermometers, controllers and test openings. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.2 Clean duct systems and force air at high velocity through ducts to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect with filters, equipment which may be harmed by excessive dirt, or bypass during cleaning. Alternatively, clean duct systems with high power vacuum machines. Protect with filters, equipment which may be harmed by excessive dirt, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

.3 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.4 Provide 0.5% slope underground ducts to low pumpout points. Provide access doors for inspection. Encase ducts in 80 mm (3.2") minimum of concrete. Provide adequate tie-down points to prevent ducts from floating during concrete pour. Introduce no heat into ducts until 20 days after pouring of concrete.

.5 Set plenum doors 150 mm to 300 mm (6" to 12") above floor.

.6 Connect terminal units to medium or high pressure ducts with 300 mm (12") maximum length of flexible duct. Do not use flexible duct to change direction.

.7 Connect diffusers or troffer boots to low pressure ducts with 1500 mm (5') maximum length of flexible duct. Hold in place with caulking compound, screws and strap or clamp.

.8 Install balancing dampers at all branch ducts and as indicated.

.9 Anchor all risers.

.10 Install fire dampers in accordance with NFPA 90A and the requirements of the damper listing.

.11 Install airtight access door and clean outs on upstream side of all reheat coils.

.12 Support flexible ducts at 1200 mm (4') centres. Ensure bends are not tighter radius than standard 1 1/2 times duct width. Use pipe shields to support duct at hanger without sagging or compression.

.13 Do not break continuity of insulation vapour barrier with hangers or rods.

3.2 Watertight Duct

.1 Provide watertight ductwork for "Wet" air exhaust, humidifiers for 3000 mm (10') in all directions, fresh air intake and relief ducts under roof hoods, goosenecks or louvred penthouses.

.2 Form bottom of duct without longitudinal seams. Solder or weld joints of bottom sheets and sides. Solder or weld transverse joints and caulk.

.3 Fit base of risers with 150 mm (6") deep drain sump, 32 mm (1 ¼") drain connection, with deep seal trap and valved drain line to open funnel drain. Where ducts convey freezing air, provide remote trap.

3.3 Plenum Gauges

.1 Fabricate fan plenums and plenums downstream of fan in accordance with duct gauges.

.2 Fabricate plenums upstream of fan between apparatus of 1.6 mm thick (16 gauge) sheet metal.

.3 Fabricate plenums upstream of filters of 1.2 mm thick (18 gauge) sheet metal.

3.4 Hangers

.1 Strap hangers: install in accordance to SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA.

3.5 Sealing and Taping

.1 Apply sealant to outside of joint to manufacturer's recommendations and specified pressure and seal class.

.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturer's recommendations and specified pressure and seal class.

3.6 Application

.1 Provide adequately sized access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Review locations prior to fabrication.

.2 Provide 100 x 100 mm (4" x 4") quick opening access doors for inspection at balancing dampers on all rectangular ducts and on all round ducts over 250 mm (8") diameter.

.3 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated building components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges. Apply firestop and smoke seal products to seal all joints to the wall and sleeve.

.4 At each point where ducts pass through partitions, the joints around the duct shall be sealed with non-combustible material.

.5 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger duct and as required for proper air balancing.

.6 Provide balancing dampers on medium pressure systems where indicated. Splitter dampers shall only be used where indicated on the drawings.

.7 Install flexible connections in ducts connected to fans and equipment subject to forced vibration, immediately adjacent to equipment and where indicated on the drawings.

.8 For connection to medium pressure fans, install 12 mm (1/2") thick neoprene pad over fabric and hold in place with additional metal straps.

.9 Install all accessories in accordance with manufacturers recommendations.

END OF SECTION

Part 1 General

1.1 References

.1 AMCA 99-1986, Standards Handbook.

.2 ANSI/AMCA 210-1985, Laboratory Methods of Testing Fans for Rating.

.3 AMCA 300-1985 Revised 1987, Reverberant Room Method for Sound Testing of Fans.

.4 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.5 ANSI/ASHRAE 51- 1985, Laboratory Methods of Testing Fans for Rating.

.6 CGSB 1-GP-181M-77, Coating, Zinc Rich, Organic, Ready Mixed.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01330 - Submittal Procedures.

.2 Provide:

- .1 Fan performance curves showing point of operation, kW (BHP) and efficiency.
- .2 Sound rating data at point of operation.

.3 Indicate:

- .1 Motors, sheaves, bearings, shaft details.
- .2 Minimum performance achievable with variable frequency drives or variable inlet vanes as appropriate.

1.3 Closeout Submittals

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01780 - Closeout Submittals.

1.4 Extra Materials

.1 Provide maintenance materials in accordance with Section 01780 - Closeout Submittals.

- .1 Spare parts to include:
  - .1 One matched set of belts for each fan.

1.5 Manufactured Items

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

Part 2 Products

2.1 Fans General

.1 Capacity: flow rate, static pressure, bhp (W), revolutions per minute, power, model, size, and as indicated on schedule.

.2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.3 Sound ratings: comply with AMCA 301, tested to AMCA 300.

.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm (12") diameter.

.5 Motors:

.1 In accordance with Section 15010, supplemented as specified herein.

.2 For use with variable frequency drives (VFDs) where indicated.

.3 Sizes as indicated.

.6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and/or outlet safety screens as indicated. Inlet or outlet dampers and vanes and as indicated.

.7 Factory primed before assembly in colour standard to manufacturer.

.8 Scroll casing drains: as indicated.

.9 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.10 Vibration isolation: to Section 15072 - Vibration Isolation.

.11 Flexible connections: to Section 15800 - Ductwork.

2.2 Vaneaxial Fans

.1 Housing:

.1 Welded heavy gauge steel.

.2 Flanges to be integrally rolled mechanically from the housing sheet steel.

.3 Vertical mounted lugs shall be welded to the fan casing at 90° intervals.

.2 Guide Vanes: welded to both the inner cylinder and fan housing interior.

.3 Wheel: formed steel airfoil shaped blades welded to a spun steel central hub.

.4 Shaft:

.1 Turned, ground, polished and ring gauged for accuaracy.

.2 Sized for the first critical speed of at least 1.43 times the maximum speed.

.5 Bearings:

.1 Heavy-duty, grease-lubricated, anti-friction flange ball or roller, self-aligning, pillow block type.

.2 Selected for a minimum L-10 life at the maximum fan RPM.

.3 Provide with pre-filled factory extended lubrication lines terminating at the fan housing exterior.

.6 Drive: Adjustable pitch V-belt drive.

.7 Finish and Coating:

.1 Entire fan assembly, excluding the shaft, to be thoroughly degreased and deburred before application of a rust-preventative primer.

.2 A finish coat of paint shall be applied to the entire fan assembly.

.8 Belt Guard

.1 Fabricated sheet metal enclosed on all sides with punched slotted cover plate for ventilation of drive.

.9 Acceptable material: Northern Blower, Twin City, Penn Barry.

Part 3 Execution

3.1 Fan Installation

.1 Install fans as indicated, complete with resilient mountings specified in Section 15072 - Vibration Isolation, flexible electrical leads and flexible connections in accordance with Section 15800 - Ductwork.

.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.

END OF SECTION

Part 1 General

1.1 General

.1 For additional information, refer to Section 15010 – Mechanical General Requirements and Division 1 - General Conditions of the Contract.

.2 For a list of applicable codes and standards, refer to Section 15010 – Mechanical General Requirements.

.3 The mechanical contractor shall be responsible for coordinating all aspects of this work.

.4 The positions indicated on the drawings are approximate only. Check the location of the outlets and make any necessary adjustments in positions to conform with the architectural features, symmetry and lighting arrangement.

1.2 Separate, Alternate Units Prices

.1 Provide the following separate, alternate and unit prices.

1.3 Scope of Work

.1 The scope of work for this section includes, but is not limited to, the following:

.1 Provision of all grilles, registers, diffusers and door grilles specified in this Section and shown on the Drawings.

.2 Provision of all exterior louvres, roof mounted hoods and gooseneck hoods specified in this Section and shown on the Drawings.

1.4 Shop Drawings

.1 Shop drawings shall be submitted for the following items:

.1 Grilles, registers, diffusers and door grilles.

.2 Exterior louvres, roof mounted hoods and gooseneck hoods.

.2 Shop drawings shall indicate the following:

.1 Size and free area.

.2 Noise level and throw characteristics at the specified air volumes.

.3 Mounting methods.

.4 Finish.

.5 Accessories such as volume control dampers and equalizing grids.

Part 2 Products

2.1 General

.1 Air outlets shall be based on a noise level of NC30 maximum unless otherwise specified.

.2 Provide plaster frames for diffusers located in plaster surfaces.

.3 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces, such as acoustical plaster.

.4 Refer to Diffuser, Grille, Register and Louvre Schedule for Manufacturer's accessories.

2.2 Rectangular Ceiling Diffusers

.1 Air Pattern: 360°, fixed.

.2 Construction: steel, multi-core, stamped with sectorizing baffles where indicated on drawings.

.3 Accessories: frame suitable for ceiling type scheduled.

.4 Volume Control: radial opposed blade damper, adjustable from diffuser face, equalizing grid.

.5 Acceptable material: Price, Nailor, Titus.

2.3 Sidewall Supply Grilles

.1 Air Pattern: adjustable pattern with two way deflection.

.2 Construction: streamlined and adjustable 20 mm (3/4") deep curved blades on 20 mm (3/4") centres, constructed of extruded aluminum with mitred corners.

.3 Volume Control: integral, gang operated, opposed blade dampers with removable key operator, operable from face.

.4 Mounting: 30 mm (1-1/4") wide margin border frame with mitred corners and concealed clips.

.5 Acceptable material: Price, Nailor, Titus.

2.4 Linear Bar Grilles (Sidewall/Sill Floor Mount)

.1 Air Pattern: 0° deflection.

.2 Construction: fixed bar type louvers parallel to long dimensions with 3 mm (1/8") thick x 13 mm (1/2") deep bars on 12 mm (1/2") centres with 25 mm (1") border, extruded aluminum.

.1 Floor mounted grilles shall feature heavy duty construction suitable for pedestrian traffic areas.

.3 Accessories: Provide blank off strips on inactive sessions.

.4 Volume Control: opposed blade damper, operable from face of grille.

.5 Mounting: concealed clips or screws where noted.

.6 Acceptable material: Price, Nailor, Titus.

2.5 Ceiling Eggcrate Return/Exhaust Grilles

.1 Construction: aluminum fixed grid of 13 x 13 x 13 mm (½" x ½" x ½").

.2 Mounting: 30 mm (1-1/4") frame with countersunk oval head screws, lay in frame for suspended grid ceilings, suitable for ceiling scheduled.

.3 Volume Control: integral, gang operated opposed blade damper with removable key operator, operable from face.

.4 Acceptable material: Price, Nailor, Titus.

2.6 Sidewall Exhaust/Return Grilles

.1 Construction: extruded aluminum or 0.9 mm thick (20 gauge) steel with 0.8 mm thick (22 gauge) x 20 mm (3/4") deep blades, 0° deflection with horizontal blades spaced 20 mm (3/4") on centre.

.2 Volume Control: integral, gang operated, opposed blade dampers with removable key operator, operable from face.

.3 Mounting: 30 mm (1-1/4") wide margin border frame with mitred corners and countersunk oval head screws.

.4 Acceptable material: Price, Nailor, Titus.

2.7 Door Grilles

.1 Construction: V-shaped louvers constructed of 1.0 mm thick (20 gauge) steel, 25 mm (1") deep, 13 mm (1/2") on centre with 1.0 mm thick (20 gauge) steel frame with auxiliary frame to give finished appearance on both sides of door.

.2 Mounting: countersunk, oval head screws.

.3 Acceptable material: Price, Nailor, Titus.

2.8 Air Intake/Exhaust Louvers

.1 Construction:

.1 Aluminum: 2 mm thick (14 gauge) extruded aluminum blades and frame, welded construction.

.2 Steel: 1.6 mm thick (16 gauge) steel frames and blade, welded construction with exposed joints ground flush and smooth.

.2 Louver Depth: 100 mm (4").

.3 Blade Configuration: storm-proof blades on 30° slope with 20 mm (3/4") vertical/horizontal top and bottom margins, horizontal middle "ridge" over entire length on each blade for water protection, blades spaced on 125 mm (5") centre, maximum blade length 1,500 mm (60").

.4 Mounting: countersunk screws in frame to fasten into jamb.

.5 Accessories: 13 mm (1/2") square exhaust, 25 mm (1") square, 2 mm thick (14 gauge) intake birdscreen in frames; middle mullions at maximum 1,500 mm (60") on centre, folded extruded aluminum.

.6 Finish:

.1 Steel: baked enamel, colour selected by Contract Administrator from manufacturer's standard colour range.

.2 Aluminum: baked enamel, colour selected by Contract Administrator from manufacturer's standard colour range.

.7 Louver Free Area: as specified in the attached schedule on the drawings.

.8 Air Intake Louver Water Penetration: not to exceed 43 g/m^2 (0.14 oz/ft^2) of free area when tested to AMCA Standard 500.

.9 Pressure Loss: as specified in the Air Outlet Schedule on the drawings.

.10 Acceptable material: Airolite.

2.9 Goosenecks

.1 Construction: fabricate to SMACNA Low Pressure Duct Construction Standards, minimum thickness of 1.2 mm (18 gauge) galvanized steel.

.2 Accessories: 13 mm (1/2") square mesh by 2 mm thick (14 gauge) birdscreen.

.3 Roof Clearance: minimum 900 mm (36") above roof.

Part 3 Execution

3.1 Installation

.1 Make airtight connections between diffusers and ductwork.

.2 Provide balancing damper on duct take-off to each diffuser at main branch take-off, even when volume dampers are specified as part of grille assembly. For details of balancing dampers, refer to Section 15800, Ductwork Accessories.

.3 Sizes indicated are nominal. Provide the correct standard product nearest to nominal, which delivers the capacity listed without an increase in noise level or pressure drop.

.4 Arrange to paint any ductwork which is visible behind air outlets-matte black.

.5 Confirm all air outlet/inlet and louver dimensions. Coordinate mounting details, finish and colours with ceiling and wall construction prior to submitting shop drawings.

.6 Adjust supply outlets to deliver patterns defined on drawings or as directed by Contract Administrator.

.7 Provide factory finish on each air inlet/outlet, louver and intake hood as indicated on the Air Outlet Schedule on the drawings.

.8 Mount roof hoods and goosenecks on a 300 mm (12") high curb base.

END OF SECTION

Part 1 General

1.1 General Scope And Related Work

.1 All Work required by these Controls Specifications, Schedules, Point Lists and Drawings shall be coordinated and provided by the single Contractor referenced in these Specifications as the Controls Contractor.

.2 If the Controls Contractor believes there are conflicts or missing information in the Contract Documents then the Contractor shall promptly request clarification and instruction from the Consultant before proceeding.

.3 The Controls Contractor shall have visited the Project site and obtained information as necessary prior to submittal of the bid to ensure that prevailing physical conditions and Project arrangements that may be material to the performance of the Work have been ascertained and accommodated in the bid. No claims for additional payments will be accepted due to the Contractor's failure to complete this survey.

.4 If, in order to complete the Work of the Controls Contract, private and/or public telephone lines and connections, including ISDN lines and/or LAN/WAN support and connections, are required then these shall be provided by the City to the Controls Contractor, at the City's direct cost, in a timely manner.

1.2 Controls Systems Description

.1 The Controls Contractor's work shall consist of the provision of all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services and items required by the Contract that are required for the functional turn-key operation of the complete and fully functional Controls Systems.

.2 Provide a complete, neat and workmanlike installation. Use only employees who are qualified, skilled, experienced, manufacturer trained and familiar with the specific equipment, software and configurations to be provided for this Project.

.3 The Controls Contractor shall employ qualified and experienced Controls Systems, Software, Application Design, Installation and Project Supervision personnel to provide the specific solutions required to meet the Project requirements and who are available to undertake this work as scheduled.

.4 Manage and coordinate the Controls Systems work in a timely manner in consideration of the Project master schedules. Coordinate cooperatively with the associated work of the other trades so as to assist the progress and not impede or delay the work of associated trades.

.5 Controls Systems as provided shall incorporate, at minimum, the following integral features, functions and services:

.1 All automated monitoring, supervision, control, information storage and presentation as required by these Specifications.

.2 Operator information on all supervised building arrangements including but not limited to current status and value, historical archived information, summaries, analysis, displays, reports and operator control and management functions as required by the Specifications.

.3 The detection, annunciation and management of all alarm and unexpected conditions as required by the Specifications.

.4 The diagnostic monitoring and reporting of system functions, Nodes and communication networks.

.5 Interfaces between individual elements and the systems and networks provided by other trades as required by the Contract Documents.

.6 All other Controls Systems functions as required by the Contract Documents.

.6 The Controls System as provided shall comprise, at a minimum, the following primary elements:

.1 Application Nodes.

.2 Field Devices.

.3 Control wiring.

1.3 Quality Assurance

.1 General Requirements:

.1 The following companies are approved Controls Contractors

.1 Johnson Controls Branch Office, BDS, Mikkelsen-Coward.

.2 All devices shall be CSA certified and UL or FM listed and labeled for the specific use, application and environment to which they are applied.

.3 All electronic equipment shall conform to the requirements of FCC regulations, part 15, section 15, governing radio frequency electromagnetic interference, and be so labeled.

.2 Workplace Safety And Materials Management

.1 Provide a safety program in compliance with the Contract Documents.

.2 The Controls Contractor shall have a comprehensive Safety Manual and a designated Safety Supervisor for the Project.

.3 The Contractor and its employees and sub trades shall comply with Federal, Provincial and local safety regulations.

.4 The Contractor shall ensure that all subcontractors and employees have written safety programs in place that cover their scope of work.

.5 Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.

.6 Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the City within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.

1.4 Submittals

.1 Shop Drawings, Product Data and Samples:

.1 The Controls Contractor shall submit shop drawings for review and acceptance by the Architect or City.

.2 Provide at minimum the following basic submittals:

.1 Individual System Schematics including sequences of operation.

.2 Complete Bill of Materials.

.3 Valve and Damper Schedules.

.4 Descriptions and/or product data sheets for all equipment, materials, software, firmware components and items to be furnished and provided. Information shall be Project specific and not general advertising.

.5 Samples of system graphic, zone control graphic and overall system Navigation Scheme.

.6 Details of telephone line, ISP and associated requirements to be provided by the City, at its cost, in order for the Contractor to complete the work.

.2 Operation and Maintenance Manuals

.1 At the completion of the project the Controls Contractor shall submit three sets of as-built documentation for the City's Operation and Maintenance Manuals which shall include the following as a minimum:

.1 Name and address of installing contractor along with 24-hour emergency service telephone number.

.2 As-built version of Shop Drawings.

.3 Licenses, Guarantees and warranty documents for all equipment and systems.

.4 Include sections dedicated to software that includes a system overview and a detailed description of each software feature. The manual shall instruct the user on programming or re-programming any portion of the Controls Systems. Include complete documentation on all control programs, algorithms, setpoints, alarms, etc.

1.5 Warranty

.1 Standard Material and Labor Warranty:

.1 Provide a one-year labor and material Warranty on Controls Contract work provided under this Contract.

.2 If within twelve (12) months from the date of acceptance of the Controls Contract work and following receipt of written notice from the City the product is found to be defective in operation, workmanship or materials, then the product shall be promptly replaced, repaired or adjusted at the option of the Controls Contractor at the cost of the Controls Contractor.

.3 Maintain an adequate supply of materials available directly to the Project site such that replacement of key parts, including programming, may be promptly carried out. Warranty work shall be done during the Controls Contractor's normal business hours.

Part 2 2.0 Products

2.1 Controls System Architecture

.1 General

.1 The Controls Systems shall consist of Application Nodes and their associated equipment.

2.2 Application Nodes

.1 General

.1 The Controls Systems shall be composed of a mixture of Network and Application Nodes as required to meet the project requirements.

.2 The Nodes shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer.

.3 A failure at a Node shall not cause failures or non-normal operation at any other system Node other than the possible loss of active real-time information from the failed Node.

.4 Ancillary equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.

.2 Application Nodes:

.1 Application Nodes (AN) shall provide both standalone and networked direct digital control of mechanical and electrical building systems as required by the Specifications.

.2 Each AN shall retain program, control algorithms, and setpoint information for at least 72 hours in the event of a power failure and shall return to normal operation upon stable restoration of normal line power.

.3 Each AN shall monitor its communication status and provide a system advisory upon communication failure and restoration.

.4 The AN shall provide the functionality to download and upload configuration data

.5 The AN shall perform the functional monitoring of all Controls Application variables, both from real hardware points, software variables, and controller parameters such as setpoints.

.6 The AN shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this project.

.7 HVAC Systems

.1 Central HVAC Systems

.1 Standalone AN(s) shall be provided and programmed to control the Central Air Handlers, Heating and Cooling Plants as described in the sequence of operation

.2 Terminal HVAC Systems

.1 A dedicated AN shall be provided and configured for each Terminal HVAC Unit (CV and VAV Boxes, Dual Duct Boxes, Fan Coil Unit, Heat Pump, Unit Ventilator, packaged RTU, etc.)

.2 The Zone Temperature sensor associated with each AN controlling a CV, VAV or Dual Duct Box shall provide the ability (password protected access) to setup the box operating parameters (min/max flows, flow pickup Area, flow pickup K factor, etc.) or shall support the plug-in (at the sensor) of a portable service tool to do the same,

.3 Standalone AN(s) shall be provided and configured to control heating and cooling elements such as Wall Fin Radiation, Ceiling Radiant Heating and or Cooling, In-floor radiant Heating, Unit Heaters and Force Flows as called for in the sequences of operation.

.3 Mechanical Equipment with Microprocessor based Controls

.1 Controls Contractor shall integrate real-time data from building systems supplied by other trades and databases originating from other trades as called for in the sequences of operation.

.2 The Controls Systems shall include necessary hardware, equipment and software to allow data communications between the Controls Systems and building systems supplied by other trades.

.3 The trade contractors supplying other associated systems and equipment shall provide their necessary hardware and software at their cost and shall cooperate fully with the Controls Contractor in a timely manner and at their cost to ensure complete functional integration.

2.3 Controls Systems Field Devices

.1 Input Devices:

.1 Temperature Sensors

.1 Outdoor Air Temperature Transmitter shall contain an RTD sensing element mounting in an enclosure rated for outdoor use. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of + 1% over the full range.

.2 Pipe Temperature Transmitter shall contain an RTD sensing element to monitor water temperature. The Contractor shall provide brass wells of sufficient size for the pipe to be installed. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of + 1% over the full range.

.3 Duct Type Temperature Transmitter shall be a general purpose RTD sensing element, moisture resistant transmitter for mounting into a duct. The operating range shall be as indicated with an accuracy of + 1% over the full range. The output shall be compatible with the panel it serves.

.4 Duct Averaging Type Temperature Transmitter shall be a general purpose RTD sensing element, moisture resistant transmitter for mounting into a duct. The operating range shall be as indicated with an accuracy of + 1% over the full range. The output shall be compatible with the panel it serves. The sensing element shall be of sufficient length to provide a minimum of one (1) foot of element for every two (2) square feet of coil area.

.5 Space Temperature Transmitter shall contain an RTD sensing element to monitor room air temperatures in the range of 30 degrees F to 90 degrees F, unless indicated otherwise. The transmitter shall be factory calibrated to an accuracy of + 1%. The output shall be compatible with the panel it serves. Transmitter shall be factory calibrated to an accuracy of + 1% over the full range.

.2 Pressure Sensors

.1 Pressure Transducers for steam service shall utilize a stainless steel sensor. The device shall output a 4-20 mA or VDC signal which is linear in relation to the sensed pressure. Accuracy shall be + 0.5% of the full scale. Power shall be from the controller and range from 22-26 volts DC. The unit shall have temperature compensation so that thermal effects are no more than + .05% of the full scale from 0-175 DEGF. The unit shall be suitable for the media and pressure measured.

.2 Differential Pressure Transducer shall be for air or water service. The device shall output a 4-20 mA or VDC signal which is linear in relation to the sensed pressure. Accuracy shall be + 0.5% of full scale. The power shall be from the controller and shall be in the range of 22-26 volts DC. The unit shall have temperature compensation so that thermal effects are no more than + .05% of the full scale from 32-100 DEGF. The transducer shall be suitable for the media and pressure measured.

.3 Safeties and Alarms

.1 Low Limit Thermostats shall be of manual reset type, with setpoint adjustment. The sensing element shall be of sufficient length to provide a minimum of one (1) foot of element for every two (2) square feet of coil area. The element shall run fully across the coil on each pass. When any one foot of the element senses a temperature as low as the setpoint, the thermostat contacts shall open. These shall contain double pole switches for simultaneous remote alarms or as desired.

.2 Differential Pressure Switch for water shall have a single-pole, single-throw (SPST) contact, adjustable setpoint, UL rated 6 amperes at 120 volts, 100 psig design.

.3 Differential Pressure Switch for air shall have a single-pole, single-throw (SPST) contact, adjustable setpoint, UL rated 9.8 amperes at 120 volts

.4 Current Sensing Transducers shall be self-powered, solid state with adjustable trip current. Each transducer shall be selected to match the current and voltage of the application. The output shall be compatible with the panel it serves. Each transducer shall include an LED to indicate output status.

.4 Specialty Sensors

.1 Carbon Monoxide Monitor shall be capable of providing continuous measurement of Carbon Monoxide levels with an over the normal operating range of 0 – 250 ppm.

.2 Nitrogen Dioxide Monitor shall be capable of providing continuous measurement of Nitrogen Dioxide levels with an over the normal operating range of 0 – 10 ppm.

.2 Output Devices:

.1 Control Dampers:

.1 Dampers required in the temperature and smoke control functions of the automatic control system shall be sized as shown on drawings or as specified.

.2 All damper frames shall be constructed of 13 gauge galvanized sheet metal or extruded aluminum of 12 gauge thickness, and shall have a flange or duct mounting. The blades shall be parallel or opposed, as required, and suitable for the air velocities to be encountered in the system. Replaceable Butyl rubber seals are to be provided on damper

blades and installed along with the top and bottom of the frame. Stainless steel damper blades and seals shall be installed inside the frame sides. Seals and bearings shall be able to withstand temperatures ranging from - 40°C to 93°C (- 40°F to 200°F).

.3 Dampers shall be leak rated for 15.2 lps/m^2 (3 cfm/$ft.^2$) at 250 kPa (1" WC) and 20 CFM/foot. squared at 1000 kPa (4" WC) or less in full closed position at 1000 kPa (4" WC) pressure differential across damper.

.4 Damper blades shall not exceed 150 mm (6") in width. All blades are to be corrugated type construction, fabricated from two sheets of #22 gauge galvanized sheet steel, spot welded together. Blades are to be suitable for high velocity performance.

.5 Dampers shall be Ruskin CD-60 or equivalent.

.6 All smoke control dampers must conform to UL5555 and be Ruskin SD-60 or equivalent.

.2 Control Valves:

.1 Valves shall be sized by the control manufacturer to produce the required capacity at a pressure loss not exceeding the allowable pressure drop indicated on the drawing.

.2 Nominal body rating shall be not less than 860 kPa (125 PSI). However, the valve body and packing selected shall be sized to withstand the system static head plus the maximum pump head and the maximum temperature of the control medium, chilled water, steam, and/or hot water.

.3 Two-way modulating valves shall have close-off ratings exceeding the maximum pressure difference, at any load condition, between the outlet and inlet. Each valve shall be equipped with proper packing to assure there will be no leakage at the valve stem.

.4 Terminal unit two-way control valves shall have equal percentage characteristics. Terminal unit three-way control valves shall have linear flow characteristics.

.5 Valve sizes 12 mm to 50 mm (½" to 2") shall have screwed connections. Valve sizes 63 mm (2-1/2") and larger shall have flanged connections.

.3 Damper and Valve Operators:

.1 Damper and valve operator shall be electric and be provided for each automatic damper or valve and shall be of sufficient capacity to operate the damper or valve under all conditions and to guarantee tight close-off of valves, as specified, against system pressure encountered.

.2 Damper operators shall be direct drive and equal to those manufactured by Belimo. Provide sufficient quantity of damper operators to provide a minimum of 5.9 Nm/m^2 (5 in-lbs/ft^2) of damper area.

.3 Each central system damper or valve operator shall be provided with spring-return for normally closed or normally open position for fail safe

operation to account for fire, low temperatures, or power interruption as indicated or as appropriate.

.4 Electric to Pressure Transducers:

.1 Electric to pressure transducers shall be used to interface to pneumatically actuated field devices.

.2 Transducers shall produce a high volume pneumatic output.

.3 Transducers shall include both zero and span adjustment capabilities.

Part 3 3.0 Execution

3.1 Installation Practices:

.1 Controls Systems Wiring

.1 All conduit raceways, wiring, accessories and wiring connections required for the installation of the Controls Systems shall be provided by the Controls Contractor except as shown on the Electrical Trade documents. All wiring shall comply with the requirements of applicable portions of the Electrical Trade work and all local and national electric codes and the requirements of the AHJ.

.2 All Controls Systems wiring materials and installation methods shall comply with the original equipment manufacturer recommendations and standards.

.3 The sizing type and provision of cable, conduit, cable trays and raceways shall be the design responsibility of the Controls Contractor.

.4 Class 2 Wiring

.1 All Class 2 (30VAC or less) wiring shall be installed in conduit unless otherwise specified.

.2 Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5 ft. from the building structure. Wiring shall be installed parallel to the building structural lines.

.5 Class 2 signal wiring and 24VAC power may be run in the same conduit. Power wiring 120VAC and greater shall not share the same conduit with Class 2 signal wiring.

.2 Line Voltage Power Sources

.1 120-volt AC circuits for the Controls Systems shall be taken by the Controls Contractor from electrical trade panelboards and circuit breakers as designated on the electrical drawings.

.2 Circuits used for the Controls Systems shall be dedicated to these Controls systems and shall not be used for any other services.

.3 Controllers for powered terminal units may use 120-volt AC power from motor power circuits.

.3 Controls Systems Raceways

.1 All wiring shall be installed in conduit or raceway except as noted elsewhere in the Specification.

.2 Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

.3 All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the supporting surface.

.4 UL/ULC Listed Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls and for final connection to equipment.

.4 Field Panel Installation and Location

.1 The Controls Systems panels, enclosures and cabinets shall be located as coordinated with the Architect at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

.2 All field devices shall be installed per the manufacturer recommendation and in accessible locations as coordinated with the Architect.

.3 Panels to be located in damp areas or areas subject to condensation shall be mounted with wall standoffs.

.4 Conduit configurations entering or leaving panels and devices shall be such as to preclude condensation traps.

.5 Identification

.1 All control components and services shall be identified with appropriately sized lamecoid labels with a unique name/number referencing item back to the shop drawings and or maintenance manuals.

.2 All control wiring conduits shall be color-coded and identified so as to be distinguishable from standard electric conduiting.

.3 All control wiring terminations shall be taqgged and referenced.

3.2 Verification:

.1 Fully test and verify all aspects of the Controls Systems Contract work on a point/system/integrated operational basis for all points, features and functions specified.

.1 Calibrate all temperature, humidity and pressure sensors with a hand held digital meter with equal or better accuracy.

.2 Calibrate all gas detectors with appropriate gas samples.

.2 Provide all necessary specialist labor, materials and tools to demonstrate to the Architect that the Controls Systems have been verified and are operating in compliance with the Controls Systems Contract.

.3 Promptly rectify all deficiencies and submit in writing to the Architect a signed report that this has been done.

.4 The Architect will retest the deficiencies in conjunction with the Controls Contractor at the Architect's option.

3.3 Training:

.1 The Controls Contactor shall provide the following training services for up to three (3) City's Representatives at common sessions:

.1 Provide one half (1/2) day of on-site training by a Field Technician who is fully knowledgeable of the specific installation details of the Project. This training shall, at a minimum, consist the following:

.1 Review of project documentation.

.2 Basic Controls System operation.

3.4 Sequences of Operation:

.1 Garage (MAU-1 and MAU-2):

.1 Make-up air units MAU-1 and MAU-2 and exhaust fans EF-1, EF-2, EF-3 and EF-4 will provide ventilation for the garage area. MAU-1 is interlocked with EF-1, EF-2 and EF-3, while MAU-2 is interlocked with EF-4.

.2 Normal Operation: During normal operation MAU-2 and EF-4 (and associated motorized damper) will be energized and ventilate the garage area. The discharge air temperature for MAU-1 and MAU-2 will be maintained at 16°C (60°F) during heating season and at outside ambient temperatures during cooling seasons.

.3 CO or NO_x Operation: When any of the four CO or NO_x detectors located in the garage space detect a high level of either gas (25 ppm CO or 4 ppm NO_x) MAU-1 and associated exhaust fans (and associated motorized damper) shall be energized. The systems will de-energize with the ambient levels drop to 20 ppm CO or 3 ppm NO_x. If the levels continue to rise the control system shall sound an audible signal to indicate that the garage doors are to be opened.

.4 Heating/Cooling Operation: The selection for the heating/cooling mode operation shall be a manual selection. Space temperature shall be maintained during heating operation by the existing unit heaters located in the space.

.2 Chainsaw Sharpening (MAU-3):

.1 Make-up air unit MAU-3 shall provide ventilation air for the chainsaw sharpening area, storage area and the wash area.

.2 Normal Operation: During normal operation MAU-3 will be energized to ventilate and pressurize the spaces in relation to the adjacent garage. EF-5 will be energized by the space occupants while sharping chainsaws. When EF-5 is

not in operation the excess air will be relieved into the adjacent garage by backdraft dampers located in the walls to the garage space. The excess air for the storage and wash area will relieved through backdraft dampers located walls to the adjacent garage area. The discharge air temperature for MAU-3 will be maintained at 16°C (60°F) during heating season and at outside ambient temperatures during cooling seasons.

.3 Heating/Cooling Operation: The selection for the heating/cooling mode operation shall be a manual selection.

END OF SECTION

Part 1 General

1.1 General

.1 Mechanical General Conditions, Section 15010, shall be part of this Section.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this Section.

1.2 Qualifications of TAB Personnel

.1 Names of all personnel proposed to perform TAB to be submitted to and approved by the Contract Administrator within 90 days of award of contract.

.2 Provide documentation confirming qualifications and successful experience when requested.

.3 Personnel performing TAB to be current member(s) in good standing of Associated Air Balance Council (AABC) and qualified to standards of AABC.

.4 Quality assurance: perform TAB under direction of superior qualified to AABC standards.

1.3 Purpose of TAB

.1 Testing to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, peak loads and as otherwise detailed.

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges where described.

1.4 Exceptions

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.5 Coordination

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems. Interlocks as defined in system controls and/or electrical sections.

1.6 Pre-TAB Review

.1 Review contract documents before project construction is started and confirm in writing to Contract Administrator adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Contract Administrator in writing all proposed procedures which vary from standard.

.3 During construction, coordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

1.7 Start-Up

.1 Perform TAB after equipment start-up has been performed by Mechanical Contractor or other authorized parties.

1.8 Operation of Systems During TAB

.1 Operate systems for length of time required for TAB and as required by Contract Administrator for verification of TAB reports.

1.9 Start of TAB

.1 Notify Contract Administrator 7 days prior to start of TAB.

.2 Start TAB only when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weatherstripping, sealing, caulking.

.3 All pressure, leakage, other tests specified elsewhere Division 15.

.4 All provisions for TAB installed and operational.

.5 Start-up, verification for proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 All outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

1.10 Application Tolerances

.1 Do TAB to following tolerances of design values:

.1 All HVAC systems: plus 10%, minus 5%.

.2 Hydronic systems: plus or minus 10%.

1.11 Instruments

.1 Submit to Contract Administrator a list of instruments used together with serial numbers as part of TAB report.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate mechanical and electromechanical within 3 months of TAB. Provide letter of certification that electronic devices are operating within tolerance under bench test conditions. Include certificate of calibration and certification letter(s) in TAB report.

.4 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 Submittals

.1 Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.13 TAB Report

.1 Format to be in accordance with AABC.

.2 Provide draft report, prior to submission of final TAB report, with all field test results.

.3 TAB report to show all results to match construction drawings or use dual units (metric/imperial)

.4 Submit 6 copies of TAB report to Contract Administrator for approval, in English, in D-ring binders, complete with index tabs.

.5 Revise and resubmit TAB reports to include any comments or clarifications requested following Contract Administrator's review.

.6 Base building plans in AutoCad format will be made available to TAB for use in report preparation.

1.14 Verification

.1 All reported results subject to verification by Contract Administrator.

.2 Provide manpower and instrumentation to verify up to 10% of all reported results.

.3 Number and location of verified results to be at discretion of Contract Administrator.

.4 Bear costs to repeat TAB as required to satisfaction of Contract Administrator.

1.15 Settings

.1 After TAB is completed to satisfaction of Contract Administrator, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.

.2 Permanently mark all settings to allow restoration of any time during life of facility. Markings not to be eradicated or covered in any way.

1.16 Completion of TAB

.1 TAB to be considered complete only when final TAB report received and approved by Contract Administrator.

1.17 Air Systems

.1 Standard: TAB to be to most stringent of this section and TAB standards of AABC.

.2 Do TAB of all ventilation systems shown on drawings.

.3 Measurements: to include, but not limited to, the following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross sectional area, RPM, electrical power, voltage, vibration.

.4 Locations of equipment measurements: To include, but not be limited to, the following as appropriate:

.1 Inlet and outlet of each damper, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At each controller, controlled device.

.5 Locations of systems measurements to include, but not be limited to, the following as appropriate: Each main duct, main branch, sub-branch, run-out (or grille, register or diffuser).

.6 Assist in calibration of control system end devices and thermostats by making comparative measurements.

1.18 Hydronic Systems

.1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, condenser water, glycol systems.

.2 Standard: TAB to be to most stringent of this section and TAB standards of AABC.

.3 Do TAB of all hydronic systems shown on drawings.

.4 Measurements: to include, but not be limited to, the following as appropriate for systems, equipment, components, controls: flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power voltage, noise, vibration.

.5 Locations of equipment measurement: to include, but not be limited to, the following as appropriate:

.1 Inlet and outlet of each heat exchanger (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.

.2 At each controller, controlled device.

.6 Locations of systems measurements to include, but not be limited to, the following as appropriate: supply and return of each primary and secondary loop (main, main branch, branch, sub-branch) of all hydronic systems, inlet connection of make-up water.

.7 Assist in calibration of control system and thermostats by making comparative measurements.

1.19 Other TAB Requirements

.1 Direct natural gas fired make-up air units:

.1 Standard: CGAB149.1 Natural Gas Installation Code.

.2 Provide correction of air flow for outdoor air temperature.

.3 Interlocked exhaust fan(s) operation to be minimum 95% of make-up air unit supply air volume.

1.20 Fire Dampers

.1 Provide inspection and verification of access and movement (by removing fusible link) of all fire dampers and fire stop flaps indicated in the design documents.

.2 Provide a detailed drawing(s) to indicate location of fire damper. Where design documents do not indicate a numbering system, number all fire dampers for ease of reference.

1.21 Duct Leakage

.1 Provide services to ventilation trades for pressure testing of ductwork.

.2 Provide report on results of testing and pass/no pass compliance with SMACNA standards for duct leakage.

1.22 Drive Adjustment

.1 TAB personnel are to identify revised drive requirements where the factory or existing drive is no longer applicable to the required operating conditions.

.2 Drive components and their selection criteria are covered under other sections of this specification. Replacement drives will be provided as required to achieve the specified performance.

.3 Drive replacement, tensioning, alignment, adjustment and retesting is included in the scope of this section.

Part 2 Products

.1 Not Used.

Part 3 Execution

.1 Not Used.

END OF SECTION