1. GENERAL

1.1 Summary

.1 This Section covers the general requirements for HVAC equipment, valves and ancillary components, plumbing, building mechanical piping and ancillary components.

.2 Refer to Section 11000 for additional requirements.

1.2 Intent

.1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accordance with current edition of applicable codes and ordinances.

.2 Follow Manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of the Final Design.

.3 Install equipment to provide access and ease of maintenance and platform for elevated areas.

.4 Uncrate equipment, move in place and install complete, test, start-up and commission.

.5 Install control valves, control dampers, thermal wells, and other devices on piping and ducts, furnished by Controls Contractor.

.6 'Provide' shall mean 'supply and install'.

1.3 Coordination of Work

.1 Cooperate and coordinate with other trades on the project.

.2 Refer to electrical, mechanical, process, controls, structural and architectural Drawings when setting out work. Consult with respective Divisions in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

.3 Where dimensional details are required, work with the applicable architectural and structural Drawings.

.4 Full-size and detailed Drawings shall take precedence over scale measurements from Drawings. Drawings shall take precedence over Specifications.

.5 Any areas indicated as space for future materials or equipment shall be left clear.

1.4 Quality Assurance

.1 All work shall be performed by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Design Builder.

1.5 Standards

.1 Associated Air Balance Council (AABC).

.2 Air-conditioning, Heating, and Refrigeration Institute (AHRI):

  .1 Standard 260 Sound Rating of Ducted Air Moving and Conditioning Equipment.

  .2 Standard 575 Method of Measuring Machinery Sound within an Equipment Space.

  .3 Standard 880 Air Terminals.

  .4 Standard 885 Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

  .5 Standard 890 Rating of Air Diffusers and Diffuser Assemblies.

.3 American Conference of Governmental Industrial Hygienists Handbook (ACGIHH). Industrial Ventilation: A Manual of Recommended Practices.

.4 Air Movement and Control Association (AMCA):

  .1 AMCA 99 - Standards Handbook.

  .2 AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

  .3 AMCA 300 - Test Code for Sound Rating Air Moving Devices.

  .4 AMCA 301 - Method of Publishing Standard Ratings for Air Moving Devices.

  .5 ANSI/AMCA Standard 330 Laboratory Method of Testing to Determine the Sound Power in a Duct.

  .6 AMCA 500 Test Methods for Louver, Dampers, and Shutters.

.5 American National Standards Institute/Manufacturers Standardization Society (ANSI/MSS):

  .1 ANSI Z21.13/CSA 4.9 - Gas-Fired Low Pressure Steam and Hot Water Boilers.

  .2 ANSI/MSS-SP-58 - Pipe hangers and Supports, Materials, Design and Manufacture.

  .3 ANSI/MSS-SP-69 - Pipe Hangers and Supports Selection and Application.

  .4 ANSI S12.2 - Criteria for Evaluating Room Noise.

.6 American Refrigeration Institute (ARI):

  .1 ARI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment.

  .2 ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.

  .3 ARI 430 - Standard for Central Station Air Handling Units.

.7 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE Standard 110 Method of Testing Performance of Laboratory Fume Hoods.

.2 ASHRAE Practical guide to Seismic Restraint.

.3 ASHRAE Standard 135 A Data Communication Protocol for Building Automation and Control Networks.

.4 ASHRAE Handbook Series.

.5 ANSI/ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy.

.6 ANSI/ASHRAE Standard 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings.

.7 ASHRAE Laboratory Design Guide.

.8 ANSI/ASHRAE Standard 70 Method of testing for rating the performance of air outlets and inlets.

.9 ANSI/IES ASHRAE Standard 113 The Commissioning Process.

.8 American Society of Mechanical Engineers (ASME):

.1 ASME B 31.1 - Power Piping.

.2 ASME B 31.5 - Refrigeration Piping and Heat Transfer Components.

.3 ASME B 31.9 - Building Service Piping.

.4 ASME PTC 25 - Pressure Relief Devices.

.5 ASME CSD-I - Controls and Safety Devices for Automatically Fired Boilers.

.6 ASME/ANSI PVHO-1 - Safety Standard for Pressure Vessels for Human Occupancy.

.9 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Publications:

.1 HVAC Duct Construction Standards, Second Edition 2005.

.2 Fire, Smoke and Radiation Damper Installation Guide, Fifth Edition 2002.

.3 ANSI/SMACNA 001-2008 3rd Seismic Restraint Manual: Guidelines for Mechanical Systems.

1.6 Submittals

.1 Provide submittals in accordance with Section 01300.

.2 Provide Shop Drawings for HVAC equipment, valves and ancillary components, plumbing, building mechanical piping and ancillary components.

1.7 Metric Conversion

.1 All units in this division are expressed in SI units.

.2 Equivalent nominal diameters of pipes - Metric and Imperial:

.1 Where pipes are specified with Metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment and piping.

.2 When CSA approved SI Metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI Metric pipes and all new and existing pipes, fittings, and equipment.

mm (in. NPS)	mm (in. NPS)	mm (in. NPS)
3 (1/8)	65 (2½)	375 (15)
6 (1/4)	65 (2½)	450 (18)
10 (3/8)	75 (3)	500 (20)
15 (1/2)	100 (4)	600 (24)
20 (3/4)	125 (5)	750 (30)
25 (1)	150 (6)	
30 (1¼)	200 (8)	
40 (1½)	250 (10)	
50 (2)	300 (12)	

.3 Metric Duct Sizes:

.1 The Metric duct sizes are expressed as 25 mm = 1 inch.

1.8 Cutting, Patching and Coring

.1 Provide holes and sleeves, cutting and fitting required for mechanical work.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the City before cutting or burning structural members.

.4 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm or larger in diameter. Field-cut smaller than 100 mm.

.5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section. Patched areas shall match the insulation rating of the original building materials.

1.9 Outdoor Piping Sealant

.1 In general, all outdoor openings around pipe penetrations shall have the gap filled with an adhesive/sealant to provide a weatherproof seal.

.2 Adhesive/sealant shall be polyurethane based, temperature range of minus 40°C to 93°C, paintable with the use of primer, sandable, and have high UV resistance.

.3 Acceptable adhesive/sealant:

.1 Silaprene Solid Seal from Faucher Industries (Model: 642-2256, White).

.2 Silaprene Solid Seal from Faucher Industries (Model: 642-2263, Grey).

.3 Silaprene Solid Seal from Faucher Industries (Model: 642-2270, Black).

.4 Or approved equivalent.

1.10 Fire-Stopping

.1 Fire-stop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations.

.2 Fire-stopping materials to meet ULC CAN 2S115.

.1 Acceptable Materials:

.1 "Tremco".

.2 "National Firestopping".

.3 Hilti CP680 Cast-in-Place Firestopping System.

.4 Or approved equivalent.

.3 Preparation of surfaces and installation of fire-stopping materials shall be carried out as per Manufacturer's instructions.

1.11 Connections to Existing Services

.1 Maintain liaison with the City and provide a schedule to interrupt, re-route or connect to water, or sewer systems, with minimum interruption of services.

.2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on site.

.3 Connections to existing services shall be in accordance with the Schedule 18 Technical Requirements.

1.12 Equipment and Materials

.1 Materials and equipment installed shall be new, full weight and of quality specified.

.2 Each major component of equipment shall bear Manufacturer’s name, address, catalogue and serial number in a conspicuous place according to 01080.

.3 Where two or more products of the same type are required, products shall be of the same Manufacturer.

1.13 Equipment Protection and Clean-Up

.1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory temporary protective covers in place as long as practical. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Repair and/or replace any installed equipment or material which is deemed by the Design Builder to be damaged.

.4 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.

.5 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other detrimental foreign substances.

.6 Protect bearings and shafts during installation. Coat shafts and sheaves with acceptable material to prevent corrosion. Supply and install extended nipples outside guards for lubrication purposes.

1.14 Electrical Motors

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI. All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Inspection and Technical Services, Manitoba.

.3 All motors intended for use with a variable speed drive (variable frequency drive) shall be inverter rated. Variable speed drive shall be matched to motor. Coordinate with Division 16.

.4 Two speed motors shall have a separate winding for each speed.

.5 Unless specified otherwise, provide motors designed for full voltage starting, EEMAC Design B. Motors driving high torque or high inertia loads may be EEMAC Design C or D.

.6 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment Specifications. Provide all motors with thermal overload protection.

.7 In general, motors less than 1/2 hp shall be 120 V, 60 Hz, 1 phase and motors 1/2 hp and larger shall be 3 phase at the indicated voltage.

.8 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings. Motors connected to belt drives shall be rated for such service.

.9 Provide motors designed with Class B insulation, Class F insulation for totally enclosed motors.

.10 Refer to electrical Specifications, Division 16, for voltage, frequency, and phase data. This shall take precedence over any reference in Division 15.

.11 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.

1.15 Miscellaneous Metals

.1 Provide all necessary miscellaneous metals to hang or support materials, equipment and provide access for work under this Contract.

.2 Refer to Section 05500 for material, finish and fabrication Specifications.

.3 The Contractor will be responsible to produce sealed engineering Drawings for all elevated equipment, piping and ductwork stands.

.4 Equipment elevated above the floor or grade shall follow the requirements set out in the City of Winnipeg, Winnipeg Sewage Treatment Program – Building Mechanical Design Guideline (Appendix 18D) for access requirements for placement, service platforms, ladders and fall protection.

.5 Service platforms shall be sized to allow removal of any serviceable component of the associated equipment.

.6 Elevated service platforms and duct supports: The equipment Manufacturer's approved submittal Drawings shall be the basis for the design.

.7 Supports, stands and platforms will not block access to equipment, service clearances, hatches, doors, egress routes or operable devices (valves, dampers, etc.).

.8 Miscellaneous metals shall include but are not limited to:

  .1 Hangers and supports for equipment, piping and ductwork.

  .2 Support for equipment.

  .3 Access platforms and catwalks.

1.16 Painting and Identification

.1 Refer to Section 01080.

1.17 Temporary Heat

.1 The permanent system shall not be used or permitted to be used for temporary heating purposes without written permission from the City. The Contractor shall in writing, seek written permission from the City at least twenty (20) working days in advance of the anticipated date for the requirements of temporary heat.

.2 Where written permission is given by the City, the Contractor shall:

  .1 Within five (5) workings days of the anticipated date for the requirement of temporary heat, provide the City with a written statement and plan outlining acceptance of the conditions listed below and providing details of how the criteria will be met. The City reserves the right to reject the statement and plan should it not comply with the criteria below.

.2 Thoroughly clean and overhaul permanent equipment used during the construction period, replace worn or damaged parts before final inspection.

.3 Operate heating systems under conditions which ensure no temporary or permanent damage. Operate with proper safety devices and controls installed and fully operational. Operate systems only with treated water as specified. Comply with the requirements of the Manufacturer's printed instructions. Comply with all relevant Codes, Statutes and By-Laws.

.4 Provide an alarm indicating a system failure. Connect alarm to independent alarm company system.

.3 Where written permission is given by the City:

.1 The use of permanent systems for temporary heat shall not modify terms of warranty.

.2 Any and all damaged caused to the heating system shall be rectified to the satisfaction of the City, replacing complete system components as required.

.3 The use of permanent systems for temporary heat shall be solely at the Contractor's risk.

.4 The Contractor shall make restitution for any and all damages to the building structure, and any consequential damages as a result of a failure of the temporary heating system.

.4 Air systems shall not be used for temporary heating.

1.18 Temporary or Trial Usage

.1 Temporary or trial usage by the City or Engineer of mechanical equipment supplied under contract shall not represent acceptance.

.2 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

.3 Avoid thermal shock to heating system by coordination with the City during planning, construction and operation of temporary heating system.

1.19 Substantial Completion

.1 Reference Schedule 18 Technical Requirements and all documents referenced within supplemented by the specific requirements listed below.

.2 Requirements prior to the application for Substantial Completion:

.1 Heating air conditioning and plumbing systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation. Commissioning checklists must be submitted prior to the request by the contractor to have a substantial completion inspection.

.2 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.

.3 Air and water systems have been balanced with draft report submitted to the City.

.4 Tagging, signage and identification is complete and in accordance with Division 1.

.5 Systems have been chemically cleaned. Flush and initiate water treatment. Provide report from Manufacturer's Representative to confirm status of treatment.

.6 Final Operation and Maintenance Manuals have been submitted.

.7 Operating and Maintenance demonstrations have been provided to the City.

.8 Written inspection report by Manufacturer's representative has been submitted for noise and vibration control devices and flexible connections.

.9 As-built Drawings have been submitted.

.10 Fan plenums have been cleaned, and temporary filters have been replaced with permanent filters.

.11 All previously identified deficiencies have been corrected.

.3 The following shall be an outline checklist of the minimum requirements to be met by the Contractor prior to the Contractor requesting an inspection for final deficiency purposes by the City. In addition to the checklist the contractor shall provide a list of items known prior to inspection to have been identified as deficient and still to be rectified to the City's satisfaction.

- ☐ Complete Commissioning Checklists.
- ☐ Final Plumbing Inspection Certificate from local plumbing inspector.
- ☐ Final Backflow Prevention test reports for all backflow devices.
- ☐ Controls Commissioning Checklist and 15 day trend logs for all major equipment.
- ☐ Vibration isolation supplier's inspection report.
- ☐ Potable water main's flushing and chlorination test certificate.
- ☐ Final air and water balance report.
- ☐ Sound level tests reports (as required).
- ☐ Major equipment – suppliers start-up test sheets and letters certifying start up. (air handlers, heat recovery ventilators, packaged equipment).
- ☐ Final As-Built Drawings ready for review.
- ☐ Operation and Maintenance Manuals, ready for review.

2. PRODUCTS

2.1 Configuration, Components and Features

.1 Access Doors:

.1 Supply flush mounted access doors, for installation in furred ceilings and walls, to permit servicing of mechanical equipment and accessories, inspection of life safety or operating devices including:

.1 Valves.

.2 Volume and splitter dampers.

.3 Fire dampers.

.4 Control dampers.

.5 Cleanouts and traps.

.6 Controls.

.7 Expansion joints.

.8 Filters.

.9 Strainers.

.2 At a minimum, access doors are to be 450 mm x 450 mm for body entry; 300 mm x 300 mm for hand entry and cleanout access. Access doors in building surfaces are to be at least 50 percent larger than the as duct access panels accessed through them and are to be oversized when necessary to facilitate maintenance. Size to suit masonry modules when located in a masonry wall.

.3 Locate access doors so that all concealed items are readily accessible for adjustment, operation and maintenance. Locate in service and storage areas wherever possible. Access doors in panelled, feature or special finish walls are not acceptable.

.4 Access doors in fire separations of 3/4 hour rating, and higher, and firewalls are to have a compatible fire rating and a ULC label with tamper-proof latch, self-closing.

.5 Minimum Requirements:

.1 180 degree door swing, mitred rounded safety corners flush welded, concealed hinges, screwdriver latches, and anchor straps or lugs to suit construction, all steel prime coated.

.2 Plaster or wet wall construction: 14 gauge bonderized steel flush with wall or ceiling type with concealed flange.

.3 Masonry or drywall construction: 16 gauge for 400 mm x 400 mm and smaller, 14 gauge for 450 mm x 450 mm and larger bonderized steel face of wall type with exposed flange.

.4 Tile, ceramic tile, marble, terrazzo, plaster or wet wall construction in washrooms and other special areas: 14 gauge stainless steel flush with wall or ceiling type with concealed flange.

.5 Acoustical tile ceiling and similar block materials: 14 gauge bonderized steel recessed ceiling type.

.6 Feature wall construction: Recessed wall type that is selected to complement and conform with the architectural module, treatment, or panelling. The size is to conform to adjacent finishes.

.7 Access panels in fire separations and fire walls are to have a compatible fire rating and ULC label.

.6 Acceptable Manufacturers:

.1 Zurn.

.2 Wade.

.3 Acudo.

.4 Can-Aqua.

.5 Milco.

.6 Maxam.

.7 Van-Met.

.8 Or approved equivalent.

.2 Counter Flashing Materials:

.1 Counterflashings: galvanized sheet steel of 0.85 mm minimum thickness.

.2 Counterflashings are attached to mechanical equipment and lap the base flashings on the roof curbs.

.3 All joints in counterflashings shall be flattened and soldered double seam. Storm collars shall be adjustable to draw tight to pipe with bolts. Caulk around the top edge. Storm collars shall be used above all roof jacks.

.4 Vertical flange section of roof jacks shall be screwed to face of curb.

2.2 Spare Parts

.1 Provide spare parts that are identical to and interchangeable with similar parts installed and in accordance with Schedule 18 Technical Requirements.

.2 In addition to those listed in individual equipment Specifications, provide:

.1 One (1) set of packing for each pump.

.2 One (1) casing joint gasket for each size pump.

.3 One (1) set of gaskets for each heat exchanger.

.4 One (1) set of V-belts for each piece of machinery.

.5 One (1) filter cartridge for each filter installed (pre and final filters).

.6 Two (2) sets of panel air filters to be used during testing and commissioning. Initial plus one (1) replacement for all particulate, chemical and carbon media cartridge filters.

.7 One (1) set of seals for each pump.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Comply with the requirements Section 11000 and the additional requirements stated herein.

.4 Excavation and Backfill:

.1 Refer to requirements of Division 2.

.2 Provide all excavating and backfilling to facilitate installation of the mechanical work, including shoring, pumping, 150 mm compacted sand bedding under and first 300 mm of compacted sand over piping and ducting.

.5 Concealment:

.1 Conceal all piping, ductwork and conduit in partitions, walls, crawlspaces and ceiling spaces.

.2 Do not install piping and conduit in exterior walls or roof slabs.

.6 Accessibility:

.1 Install all work so as to be readily accessible for adjustment, operation and maintenance.

.7 Protection of Work:

.1 Air systems to have air filters installed before fans are operated within 20 Days.

.8 Service Penetrations in Rated Fire Separations:

.1 All piping, tubing, ducts, wiring and other conduits passing through rated fire separations to be smoke and fire proofed with ULC approved materials in accordance with CAN4-S115-M85 and ASTM E814 standards.

.2 Fire resistance rating of installed firestopping assembly not to be less than fire resistance rating of surrounding assembly as required for the Final Design.

.3 Smoke and fire stopping installer to submit a letter certifying that all work is complete and in accordance with the Schedule 18 Technical Requirements.

.4 Install fire stopping and smoke seal material and components in accordance with ULC certification and Manufacturer's instructions in formed, sleeved or cored penetrations.

.9 Service Penetrations in Non-Rated Separations:

.1 All piping, tubing, ducts, wiring and conduits passing through non-rated fire separations and non-rated walls and floors are to be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent the passage of smoke and/or transmission of sound. Provide packing and sealing of service penetrations in accordance with the Standard Details.

.10 Escutcheons and Plates:

.1 Provide escutcheons or plates on pipes passing through finished walls, partitions, floors and ceilings.

.2 Plates are to be stamped steel, split type, chrome plated, or stainless steel, concealed hinge, complete with springs, suitable for external dimensions of piping/insulation. Secure to pipe or finished surface. For all pipes passing through suspended ceilings and uninsulated piping passing through walls. Outside diameter is to cover opening or sleeve.

.3 Where pipe sleeve extends above finished floor, escutcheons or plates are to clear sleeve extension.

.4 Do not install escutcheons and plates in concealed locations.

.11 Equipment Installation:

.1 Pipe all equipment drains to building drains in a safe manner. Avoid tripping hazards such that discharge does not create back up or overflow flooding.

.2 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems and without interfering with building structure or other equipment.

.3 Line up equipment, rectangular cleanouts and similar items with building walls wherever possible.

.4 Maintain permanent access to equipment for maintenance.

.12 Building Flush Out:

.1 Operate the air systems to "flush out" chemical fumes that may be present from building products, furniture, carpets, equipment or other products for a period of four (4) weeks.

.2 Keep the ductwork systems, plenums, and equipment debris free and take all necessary measures to minimize dust contamination of systems.

.3 Adjust the controls and dampers on all systems to achieve the following conditions:

.1 Fans to run continuously complete with temporary filters in place.

.2 Systems to run on maximum outside air or to the highest percentage that can be tolerated by the system capacity and the freeze protection.

.3 Room temperature to be maintained at during the flush out:

.1 Heating to 10°C.

.2 Cooling to 25°C.

.4 At the end of the four-week period, readjust the controls to return the air systems to the design conditions established in the Final Design.

.5 After the flush out period replace all air filters.

.4 Report:

.1 Provide a letter stating the dates of the "flushing" period and the approximate percentage of outside air used. Include the letter in the Operation and Maintenance Information.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of expansion fittings and loops for HVAC piping including:

.1 Flexible pipe connections.

.2 Expansion joints and compensators.

.3 Alignment guides and anchors.

.4 Pipe loops, offset and swing joints.

.2 Coordinate requirements with Section 15241.

1.2 Standards

.1 Expansion Joint Manufacturers Association (EJMA).

.2 American Society of Mechanical Engineers (ASME):

.1 Boiler and Pressure Vessel Code.

.2 ASME B18.10 - Track Bolts and Nuts.

.3 ASME B31.9 - Building Services Piping.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A36 - Standard Specification for Carbon Structural Steel.

.2 ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.3 ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts.

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

.5 ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

.6 ASTM C898 - Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Separate Wearing Course.

.7 ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

.8 ASTM F1007 - Standard Specification for Pipeline Expansion Joints of the Packed Slip Type for Marine Application.

.9 ASTM F1120 - Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications.

.10 ASTM F1123 - Standard Specification for Non-Metallic Expansion Joints.

.4 Canadian Standards Association (CSA):

.1 CSA W47.1 - Fusion Welding of Steel Company Certification.

.2 CSA W59 - Welded Steel Construction (Metal Arc Welding).

.5 Fluid Sealing Association (FSA):

.1 FSA-PSJ-703 - Guidelines for Elastomers Used in Piping Systems Non-Metallic Expansion Joints.

.2 Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors.

.6 Manufacturers' Standardization Society (MSS):

.1 SP-69: Pipe Hangers and Supports - Selection and Application.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Grooved joint couplings and fittings to be shown on Drawings and product submittals, and to be specifically identified with the applicable style or series designation.

1.4 General Requirements

.1 Provide anchors or expansion joints required to protect piping systems.

.2 Make provision for expansion and contraction of all pipe work. All piping to be anchored and supported in such a manner that strain or weight shall not be applied on any apparatus or pipe branch connection. Expansion joints and compensators shall be installed and guided in accordance with Manufacturer's recommendations. Connect all equipment with unions or flanges to provide for easy removal. Where piping passes through walls or floor slabs, the sleeves shall be of sufficient size to accommodate the expansion and the pipe insulation without binding or crushing the insulation or preventing the expansion of the piping.

.3 All castings to be date stamped for quality assurance and traceability.

.4 Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

.5 Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Provide all grooved joint couplings, fittings, and specialties from a single Manufacturer. Grooving tools to be of the same Manufacturer as the grooved components.

.2 Flexible Hoses – Braided:

.1 Acceptable Products:

.1 Flextech Series 301.

.2 Or approved equivalent.

.3 Expansion Compensators:

.1 Acceptable Manufacturers:

.1 Adsco.

.2 Flexonics.

.3 Flextech Industries.

.4 Hydroflex.

.5 Metraflex.

.6 Vibra-Flo.

.7 Or approved equivalent.

.4 Alignment Guides:

.1 Acceptable Manufacturers:

.1 Metraflex.

.2 Flexonics.

.3 Vibro-Acoustics.

.4 Or approved equivalent.

2.2 Flexible Hoses - Braided

.1 Stainless steel convoluted bellows with braided stainless steel sleeve.

.2 Suitable for system operating temperature and pressure; rated minimum 1000 kPa.

.3 Minimum static bending radius of 2.5 times diameter.

.4 Connections:

.1 50 mm and under, screwed connections.

.2 65 mm and over, flanged connections.

.5 Length to be nominally 1200 mm, unless noted otherwise.

.6 Suitable for installation and removal, with wrench grip and union connection at each end.

2.3 Expansion Compensators

.1 Copper Pipe Expansion Compensator - Low Pressure:

.1 Bronze or stainless steel convoluted bellows.

.2 Pressure rating:

.1 Up to 1000 kPa working pressures for non-potable water.

.2 Up to 1000 kPa working pressure for potable water.

.3 20 mm to 32 mm diameter, suitable for 12 mm compression and 6 mm extension.

.2 Steel Pipe Expansion Compensator:

.1 Factory assembled unit, with stainless steel or phosphor bronze bellows in carbon steel casing.

.2 Anti-torque groove in casing, internal pipe guide at both ends, full length internal liner.

.3 Suitable for 1035 kPa operating pressure.

.4 Suitable for 38 mm compression and 6 mm extension.

2.4 Alignment Guides

.1 Four finger "spider" inside a guiding sleeve formed of two halves suitable for clamping onto pipe.

.2 Guided sleeve formed of two parts, suitable to be bolted to supporting structure.

.3 Guide length to be minimum 300 mm.

.4 Anchor Materials:

.1 Steel Shapes and Plates: ASTM A36.

.2 Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.

.3 Washers: ASTM F844, steel, plain, flat washers.

.4 Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, with tension and shear capacities appropriate for application.

.1 Stud: Threaded, Type 304 stainless steel.

.2 Expansion Plug: Type 304 stainless steel.

.3 Washer and Nut: Type 304 stainless steel.

.5 Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened Portland cement concrete, with tension and shear capacities appropriate for application.

.1 Bonding Material: ASTM C881, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

.2 Stud: ASTM F593, Type 304 stainless steel with continuous thread on stud, unless otherwise indicated.

.3 Washer and Nut: Type 304 stainless steel.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install all piping systems with due regard and provision for expansion avoiding strain or damage to equipment and building.

.4 Provide pipe guides as required to ensure correct pipe alignment for expansion joints.

.5 Install expansion loops, cold sprung 50 percent of the calculated expansion.

.6 Install at least three (3) elbows in all branch connections. Where space does not permit three (3) elbows, install braided flexible pipe connectors in accordance with Manufacturer's recommendations. Three (3) elbow branch connections to have sufficient developed length to ensure that excessive stresses are not generated in the piping and in no case less than 900 mm.

3.2 Pipe Loop and Swing Connection Installation

.1 Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

.2 Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

.3 Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

.4 Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 Alignment Guide and Anchor Installation

.1 Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

.2 Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

.3 Attach guides to pipe, and secure guides to building structure.

.4 Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

.5 Anchor Attachments:

  .1 Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

  .2 Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

.6 Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and CSA W47.1 and W59.

  .1 Anchor Attachment to Steel Structural Members: Attach by welding.

  .2 Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener Manufacturer's written instructions.

.7 Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of meters and gauges for building mechanical piping including:

.1 Bimetallic-actuated thermometers.

.2 Liquid-in-glass thermometers.

.3 Duct-thermometer mounting brackets.

.4 Thermowells.

.5 Dial-type pressure gages.

.6 Gauge attachments.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B1.1 - Unified Inch Screw Threads.

.2 ASME B1.20.1 - Pipe Threads, General Purpose.

.3 ASME B 40.100 - Pressure Gauges and Gauge Attachments.

.4 ASME B40.200 - Thermometers, Direct Reading and Remote Reading.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Products and Manufacturers

.1 Positive Displacement Meters:

.1 Nutating disc measuring chamber, disc material to suit fluid encountered, odometer-type direct reading totaliser counter with six numerical wheels for cumulative readings, complete with 4-20 mA or 0-10 VDC output for DDC system connection.

.2 Venturi Flow Meters:

.1 Each Venturi element shall be complete with safety shut-off valves and quick coupling connections. A permanent metal tag shall be attached with a chain showing designed flow rates, meter readings for designed flow rates, metered fluid, line size and tag number.

.2 Liquid Service: Insert type carbon steel Venturi element.

.3 Steam Service:

.1 Size to 50 mm: Machined carbon steel, welded connections. Stainless steel valves. Rating: 1725 kPa (250 psi), 120°C (250°F). Presco.

.2 Size over 50 mm: Machined cast steel, stainless steel valves, welded ends. Rating: 2760 kPa (400 psi), 150°C (300°F).

.4 Accuracy of flow measuring elements shall be +1/4% calibrated and +1% uncalibrated.

.5 Provide a portable meter set of dry diaphragm type with a round 150 mm diameter dial. All wetted parts shall be of 316 SS construction. Meter shall include pulsation dampers, equalising valve, 2-bleed valves, master chart for direct conversion of meter readings to metric engineering units, rust proof carrying case, two 3.0 m each rubber test hoses with brass quick connect valves to Venturi element. Provide meter complete with 4-20 mA or 0-10 VDC output for connection to DDC system, c/w calibration and algorithm software as required.

.3 Thermometers:

.1 Select thermometer gauges so that normal operating point is approximately mid-point of instrument range.

.2 Provide pipe-mounted thermometers and wells on the flow and return pipes to each individual piece of equipment and on flow and return headers.

.3 Dual Celsius and Fahrenheit scale.

.4 Acceptable Manufacturers:

.1 Marsh.

.2 Moeller.

.3 Trerice.

.4 Weiss.

.5 Weksler.

.6 Winters.

.7 Or approved equivalent.

.5 Bimetallic-Actuated Thermometers:

.1 Standard: ASME B40.200.

.2 Case: Liquid-filled and sealed type(s); stainless steel with 75 mm (3 inch) nominal diameter.

.3 Dial: Nonreflective aluminum with permanently etched scale markings.

.4 Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

.5 Connector Size: 13 mm (1/2 inch), with ASME B1.1 screw threads.

.6 Stem: 6 mm (0.25 inch) or 10 mm (0.375 inch) in diameter; stainless steel.

.7 Window: Plain glass or plastic.

.8 Ring: Stainless steel.

.9 Element: Bimetal coil.

.10 Pointer: Dark-colored metal.

.11 Accuracy: Plus or minus 1 percent of scale range.

.6 Liquid-In-Glass Thermometers:

.1 Metal-Case, Compact-Style, Liquid-in-Glass Thermometers.

.2 Standard: ASME B40.200.

.3 Case: Cast aluminum; 15 0mm (6 inch) nominal size.

.4 Case Form: Straight unless otherwise indicated.

.5 Tube: Glass with magnifying lens and blue or red organic liquid.

.6 Tube Background: Nonreflective aluminum with permanently etched scale markings.

.7 Window: Glass or plastic.

.8 Stem: Aluminum or brass and of length to suit installation.

.1 Design for Air-Duct Installation: With ventilated shroud.

.2 Design for Thermowell Installation: Bare stem.

.9 Connector: 19 mm (3/4 inch), with ASME B1.1 screw threads.

.10 Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

.4 Pressure Gauges:

.1 Minimum Requirements:

.1 Standard: ASME B40.100.

.2 Select gauges so that normal operating point is approximately mid-point of instrument range.

.3 115 mm cast aluminum, stainless steel case, with stainless steel or chrome plated face ring.

.4 White background with pressure range in black.

.5 Dual kilopascal and psig scale.

.6 Phosphor bronze bourdon tube, silver brazed tip and socket 6 mm national pipe thread (NPT) lower connection.

.7 Rotary type bushed movement, silicone dampened to prevent pointer oscillation.

.8 Gauges to be registered with Provincial Boiler and Pressure Vessel Safety Branches with Canadian Registration Number (CRN) number.

.9 ULC listed for use on fire protection systems.

.10 Accuracy is to be 1 percent off full scale over the middle half of the scale.

.2 Accessories:

.1 Snubbers: ASME B40.100, brass; ASME B1.20.1 pipe threads and piston surge-dampening device for water service. Include extension for use on insulated piping.

.2 Siphons: Loop-shaped section of stainless-steel pipe for steam service.

.3 Valves: Brass ball, with ASME B1.20.1 pipe threads.

.3 Acceptable Manufacturers:

.1 Marsh.

.2 Moeller.

.3 Trerice.

.4 Weiss.

.5 Weksler.

.6 Winters.

.7 Or approved equivalent.

.5 Test Plugs for Pressure and Temperature:

.1 Provide 6 mm NPT solid brass test plug fitting complete with brass chain upstream and downstream of all hydronic heating or cooling equipment and upstream and downstream of all pumps.

.2 Test plugs are to be capable of receiving either a pressure or temperature probe. 3 mm OD dual seal core is to be Nordel suitable for temperature of 177°C and is to be rated zero leakage from vacuum to 6895 kPa.

.3 Provide one (1) master test kit containing two (2) test pressure gauges of suitable range, one (1) gauge adaptor 3 mm O.D. probe and two (2) stem pocket testing thermometers of suitable range.

.4 Acceptable Products:

.1 Sisco P/T Plugs.

.2 Flow Design - Superseal.

.3 Or approved equivalent.

.6 Test Thermometer:

.1 Provide a test thermometer in protective case at Substantial Completion. Provide the same make and type as the permanently installed thermometers suitable for use with pipe mounted wells. Range 0°C to 115°C.

.7 Duct-Thermometer Mounting Brackets:

.1 Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

.8 Thermometer Wells:

.1 Standard: ASME B40.200.

.2 Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.

.3 Material for Use with Copper Tubing: CNR or CUNI.

.4 Material for Use with Steel Piping: CRES.

.5 Type: Stepped shank unless straight or tapered shank is indicated.

.6 External Threads: DN 15, DN 20, or DN 25 (NPS 1/2, NPS 3/4, or NPS 1), ASME B1.20.1 pipe threads.

.7 Internal Threads: 13, 19, and 25 mm (1/2, 3/4, and 1 inch), with ASME B1.1 screw threads.

.8 Bore: Diameter required to match thermometer bulb or stem.

.9 Insertion Length: Length required to match thermometer bulb or stem.

.10 Lagging Extension: Include on thermowells for insulated piping and tubing.

.11 Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

.12 Heat-Transfer Medium: Mixture of graphite and glycerin.

.13 Thermowells to be registered with Provincial Boiler and Pressure Vessels Safety Branch with CRN number.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install isolating globe, ball, or needle valves with 6 mm male end Society of Automotive Engineering (SAE) flare connection on pressure tapping connections.

.4 Provide and install gauge couplings with shut-off cocks.

.5 Install all thermometers in wells.

.6 Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to affect proper flow across the entire area of the well. Well shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area.

.7 Install thermometers on the inlets and outlets of:

  .1 Heat exchangers.

  .2 Water heating and cooling coils.

  .3 Domestic hot water (DHW) tanks.

  .4 Boilers.

.8 Use extensions where thermometers or pressure gauges are installed through insulation.

.9 Install pressure gauges in the following locations:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of PRVs.

.3 Inlet and outlet of waterside of coils (excluding terminal unit coils) and heat exchangers.

.4 In other locations as required by the Final Design.

.10 Where a single gauge is used for multiple measurements, provide needle valves to isolate each source and the gauge.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the general requirements for selection, supply, installation, inspection, and testing of pipe materials, fittings, appurtenances, expansion control, supports and restraints for plumbing and fire protection piping.

.2 Use the general requirements specified in this Section integrally with the more specific requirements listed in Section 15055 and other referenced Sections. Except where referenced Specification sections specify alternate provisions, the requirements of this Section apply to all piping systems.

1.2 Standards

.1 American National Standards Institute (ANSI):

- .1 ANSI B16.21 - Non-metallic Flat Gaskets for Pipe Flanges.
- .2 ANSI B31.1 - Power Piping.
- .3 ANSI B31.9 - Building Services Piping 1.3.19.
- .4 ANSI Z223.1 - National Fuel Gas Code.
- .5 ANSI/ISA-S70.01 - Quality Standard for Instrument Air.

.2 American Society of Mechanical Engineers (ASME):

- .1 ASME B1.1 - Unified Inch Screw Threads.
- .2 ASME Section IX, Boiler and Pressure Vessel Code; Welding and Brazing Requirements.

.3 American Society for Testing and Materials (ASTM):

- .1 ASTM F37 - Sealability of Gasket Materials.
- .2 ASTM F104 - Non-metallic Gasket Materials.
- .3 ASTM F152 - Tension Testing of Non-metallic Gasket Materials.

.4 AWWA C651 - Disinfecting Water Mains.

.5 Canadian Standards Association (CSA):

- .1 CSA B-52 - Mechanical Refrigeration Code.
- .2 CSA/ANSI B149.6 - Digester Gas, Landfill Gas, and Biogas Generation and Utilization.

.6 City of Winnipeg Standard Construction Specifications:

.1 CW 2030, Excavation Bedding and Backfill.

1.3 Definitions

.1 Maximum pressure: The greatest continual pressure at which the piping system operates.

.2 Test pressure: The hydrostatic pressure used to determine system compliance.

.3 Take down coupling: Pipe couplings that facilitate disassembly of piping systems without damage or demolition of piping system components.

.4 Encased piping: Buried piping enveloped in reinforced concrete, typically under structures and under roadways.

.5 Pipe and appurtenance location terms and exposures, used in this and other related sections, are specified in Section 01450.

.6 CDN: Condensate.

.7 G: Natural Gas Supply (Off-Site).

.8 GC: Sludge Gas, for Circulation.

.9 LSG: Low Pressure Sludge Gas.

.10 MSG: Medium Pressure Sludge Gas

.11 NG: Natural Gas.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 For each piping system (refer to Section 15055), submit document listing pipe, fittings, linings, coatings, valves, flexible connectors, couplings, bolts, gaskets, restraints, and other items provided for each pipe size and category.

.2 Welding: Prior to welding of steel or stainless steel pipe, supports and structural attachments, prepare and submit a written description of welding techniques including but not limited to materials, methods, and quality control. Identify differences in shop and field techniques. Indicate in the submission that the welding technique has been reviewed for each commodity and certify that the technique is acceptable for the intended service condition (piping service commodity defined in Section 15055 and area exposure designation specified in Section 01450). Written procedures to be stamped and sealed by a qualified professional for welding design.

.3 Provide details of pipe supports, restraints, and expansion control as specified in Section 15096 and 15098. Submittals are to be suitably detailed to demonstrate compliance with pipe support, restraint, and expansion control specified in the Schedule 18 Technical Requirements.

.1 Submit piping layout Drawings by plant area for all piping systems. Indicate assembly details, location and placement of field welds, unions and flanges, fittings, valves, flushing connections, drains, sample taps, cathodic protection, restraint system, expansion joints, guides, anchors, hangers, supports, and the provisions for thrust restraint, as well as any other pertinent details and appurtenances for all piping, including wall and floor penetrations, where applicable, in that area. Indicate location and clearances from structures and other utilities such as ductwork, conduit, and electrical tray. Include details of connections to equipment, piping and structures. Identify the invert elevation of buried pipe at changes in slope, pipe crossings, and connections to structures on piping layout Drawings in addition to providing coordinates for locating changes in horizontal alignment of buried pipe.

1.5 Piping System Design

.1 Piping System Design Configuration:

.1 The specified piping system configurations comply with the following design standards:

.1 Building Services Piping - ANSI/ASME B31.9.

.2 Digester and other flammable, non-fuel gas piping – ANSI/ASME B31.1.

.3 Fuel gas piping –NFPA 54 (ANSI Z223.1) National Fuel Gas Code and ANSI/ASME B31.1.

.4 Steel water pipe - ANSI/ASME B31.3.

.5 Steel Pipe – A Guide for Design and Installation - AWWA M11.

.2 Expansion control, anchorage, and pipe flexibility provisions are to be specified in the Final Design and in Section 15098. Where pipe anchors are specified, they have been designed for longitudinal seismic loading, in addition to other longitudinal forces associated with expansion control, and pipe thrust for the associated piping that is anchored.

.3 In addition to maintaining compliance with the design standards and objectives identified, any modifications, substitutions, or deviations shall include consideration of and provisions for:

.1 Support and restraint of pipe independent of equipment and without equipment supported loads exceeding equipment manufacturer's requirements. Obtain maximum nozzle loads from the equipment manufacturer.

.2 Electrical bonding for all gas, fuel and pneumatic conveyance systems.

.3 Dielectric separation, as specified.

.4 Provide and install supports, hangers, guides, structural attachments, joints, seismic restraints and other mounting elements and as required for the Final Design.

.5 Include all elements of piping systems required for fabrication and construction in the piping layout submittals. Depict couplings, restraint, anchorage, expansion control measures and other elements of the piping system.

.6 Depict fitting angles and vertical and horizontal pipe locations, on piping layout Drawings.

.7 Pipe support and seismic restraint placement shall be subordinate to the function of anchorage, flexibility, and expansion control provisions. Do not interfere with the function of anchorage, flexibility, and expansion control.

1.6 Coordination

.1 Refer to Section 01080 for piping identification requirements.

.2 Pipe Sleeves: Coordinate placement of sleeves and penetrations in cast-in-place concrete with raceway, duct, and pipe penetrations prior to concrete placement. Coordinate placement of sleeves and wall penetration prior to construction of masonry building elements.

2. PRODUCTS

2.1 Performance Criteria

.1 All pipe materials to be new, free from defects and conforming to the requirements and standards identified in Section 15055 and related sections.

.2 Select materials from those listed on the piping system Specification sheets (Section 15055), including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings.

.3 Fittings and Coupling Compatibility: To assure uniformity and compatibility of piping components, furnish fittings and couplings for grooved-end or shouldered-end piping systems from the same manufacturer.

2.2 Pipe and Valve Compatibility

.1 Coordinate the selection of pipe materials, linings and end connections so that valves operate properly over their entire range (e.g., sufficient disk clearance for butterfly valves). Support wafer style valves or spectacle flanges between flanges of equal inside diameter.

2.3 Bonding Jumpers

.1 Provide plated, flexible copper braid jumpers with unplated copper ferrules for attachment to pipe flanges, rated for a 100 amp minimum. Provide sufficient conductive, anti-oxidant compound to protect ferrules.

.1 Acceptable Products:

.1 Burndy Electrical, Type B series.

.2 Or approved equivalent.

2.4 Joints – General

.1 Provide joints for disassembly within 1 m of any connection to equipment, on both sides of structural penetrations, and within 0.6 m of all threaded end valves. Unless otherwise specified, adapt all equipment connections to a flanged connection compatible with the connected piping system.

.2 Flexible Joints at Structural Joint Crossings: As specified, provide a flexible joint on all piping crossing structural joints.

2.5 Flanges and Other Couplings

.1 General requirements for flanges are as follows:

   .1 Reface raised-face flanges. Flange face to be flush with flat-faced companion flanges on flat-faced valve or equipment flanges.

   .2 Provide flat-faced flanges on each side of butterfly valves.

   .3 For steel piping, provide weld neck flanges on both sides of wafer or lug body valves.

.2 Slip-on flanges that are attached to a pipe by means of set screws and gaskets are not permitted.

2.6 Fittings – General

.1 Fittings are specified with associated piping for the piping system specified in the PIPESPEC System sheets (Section 15055).

.2 Provide eccentric reducers in horizontal lines with the flat side on top.

.3 Provide concentric reducers in vertical lines.

.4 Provide reducers upstream and downstream of flow measurement devices to adapt line size to the specified flow measurement device dimension according to the minimum distance required by the Manufacturer.

.5 Provide long radius (greater than or equal to 1.5 times nominal diameter) elbows.

2.7 Gasket Materials

.1 For flat faced flanges, use full-face gaskets. For raised-face flanges, use flat ring gaskets. Conform to ANSI B16.21.

.2 Refer to the detailed PIPESPEC System sheets in Section 15055 for the specified gasket material. Material designations used in the detailed pipe Specification sheets are as follows:

   .1 EPDM: ethylene-propylene-diene-terpolymer 70 durometer.

   .2 Bl. Neoprene: neoprene (black) 70 durometer.

   .3 Nitrile: nitrile (Buna N).

.4 SBR: Styrene-butadiene (red).

.5 Natural rubber: natural rubber.

.6 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400), and neoprene binder: 1.7 MPa (ASTM F152), 0.2 mL/h Leakage Fuel A (ASTM F37).

.7 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400) and SBR binder: 1.7 MPa (ASTM F152), 0.1 mL/h Leakage Fuel A (ASTM F37).

.8 Gylon - Type 1: Garlock Style 3500, 1.35 MPa (ASTM F152), 0.22 mL/h Leakage Fuel A (ASTM F37).

.9 Gylon - Type 2: Garlock Style 3510, 1.35 MPa (ASTM F152), 0.04 mL/h Leakage Fuel A (ASTM F37).

.10 CPE - Chlorinated Polyethylene.

2.8 Dissimilar Metal Connections

.1 Where dissimilar metals are in direct contact, furnish and install dielectric fittings or isolating flanges, including bolt sleeves and washers.

2.9 Cathodic Protection

.1 Provide cathodic protection of piping, pipe fittings and appurtenances.

2.10 Structural Element Penetrations

.1 Penetrations through structural elements to be in accordance with the Standard Details and as required for the Final Design based on the type of structure, exposure and type of pipe.

.2 Provide pipe sleeves capable of supporting the loads applied during placement of concrete or during block work erection.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Joint and Fitting Options:

.1 Provide pipe connection (joint and fitting) options as specified on the Section 15055 PIPESPEC System sheets.

.2 If the PIPESPEC System sheet lists several connection options, then any of the listed options may be used, but the selected option shall be used consistently. Provide couplings for all piping systems in accordance with Section 15085.

.3 Continuous welding for straight runs of pipe is acceptable only where the individual PIPESPEC System sheet allows welding as a connection option.

.4 Provide rigid, non-rotating connections at all valves and equipment.

.4 Small Bore Utility Piping:

.1 Field route small bore (less than 75 mm) diameter branch piping for utility services.

.2 Install small bore utility piping that will be drained to provide freeze protection with a continuous slope down to the drain.

.5 Bonding:

.1 The following commodities require bonding of piping to control static electricity: CDN, G, GC, LSG, and NG at a minimum.

.2 Construct electrically continuous piping for these commodities and connect directly or indirectly to earth ground.

.3 Provide bonding jumpers where sections of pipe are interrupted with non-conducting sections, fully lined valves that are not through-bolted or other interruption in continuity.

.4 Remove any coatings, dirt, grease or other contaminants from flanges where jumpers are to be installed. Apply sufficient conductive, anti-oxidant compound to protect the entire ferrule from galvanic action and hydrogen sulfide attack.

.6 Plumbing Drainage Piping:

.1 Run horizontal drainage piping as straight as practicable and at uniform pitch.

.2 Install pipe 75 mm diameter and smaller with pitch of not less than 2 percent unless otherwise specified.

.3 Install pipe larger than 75 mm diameter with pitch of not less than 1 percent unless required by Applicable Law.

.7 Sleeves:

.1 Locate and place sleeves prior to construction of cast-in-place elements and prior to the construction of concrete and masonry building elements.

.8 Pipe Joints and Connections:

.1 Field cuts for glass-lined pipe shall not be permitted for pipe greater than 250 mm in diameter.

.9 Couplings:

.1 Provide couplings at the locations specified in the Final Design and in accordance with this Section.

.2 Provide couplings at changes in piping direction and where required for the Final Design on straight runs of pipe.

.3 Provide screw unions, flanged or grooved end mechanical coupling type joints as couplings.

.4 Employ flanged or grooved end joints on pipelines 65 mm in diameter and larger.

.5 Where piping passes through walls, unless otherwise specified, provide couplings within 1000 mm of the wall.

.6 Provide a union or flanged connection within 600 mm of each threaded end valve. Design the disconnected piping to allow for the removal of the valve without additional removal of piping or equipment.

.10 Installation of Buried Pipe and Pipe Below Structures:

.1 Trenching and backfill for buried pipe: conform to CW2030.

.2 Pipe laying and bedding: conform to CW2030.

.3 Protect pipe laid below structures with a concrete surround having a minimum coverage of 100 mm all around the pipe and extend concrete surround to undisturbed ground.

.4 Restrain all plugs, caps, tees and bends in buried pressure piping systems by means of restrained joints as specified in the respective PIPESPEC System sheets in Section 15055.

.5 In accordance with Section 15085, provide flexibility in accordance with specified details where buried pipe passes under, through, or is connected to structures. Provide restraint joint connections or provide restraints across each joint with unrestrained joints.

.6 Install pipe in straight alignment. Do not exceed 10 mm variance from the true alignment in any direction.

.7 Slope gravity lines uniformly from point of origin to discharge.

.8 Ensure the pipe alignment stays true during and after placement of concrete surround.

.9 Ensure that the method used to prevent pipe uplift during placement of concrete surround results in an invert and crown true to intended grade.

.10 Maintain circular cross section of pipe.

.11 Provide lean concrete below the underside of the slab or footing for backfill over pipe laid below structures when pipe is less than 150 mm below the underside of the slab or footing, unless specified otherwise.

.12 Place concrete in accordance with Section 03300.

.13 Provide heat-shrinkable cross-linked polyolefin coating or tape wrap coating on all fittings and flanged, grooved, plain end, and welded joints that are buried or below structures.

.14 Use anti-seize compound with all stainless steel nuts and bolts.

.11 Exposed Installation:

.1 Fabricate and install exposed pressure piping in accordance with the ASME pressure vessel code and The Workplace Safety and Health Act of Manitoba, Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulations. Fabricate and install domestic hot and cold water piping, sanitary piping and storm drainage piping in accordance with the Manitoba Plumbing Code.

.12 Provide pipe system layout in accordance with the following criteria:

.1 Maintain minimum clear areas through tunnels and principal access aisles as required by the City of Winnipeg, WSTP Process Mechanical Design Guideline (Appendix 18D).

.2 Expanding or swaging of tubing to fit iron pipe size (IPS) fitting sockets are not permitted.

.3 Use reducing fittings where change in pipe size occurs.

.4 Use couplings only where pipe runs are longer than standard supplied pipe lengths.

.5 Make exposed polished or enameled connections to fixtures or equipment with special care to avoid damage to finished surfaces.

.6 Make changes in direction only with fittings.

.7 Install piping with sufficient pitch to ensure adequate drainage and venting.

.8 Maintain clear areas around equipment to allow adequate access for maintenance as specified in this Section.

.9 Ensure manual valve operators are accessible from floor level. Provide chain wheel operators for valves with centreline elevations of 2000 mm above the floor or higher. The chain shall extend to within 1200 mm of the floor.

.10 Ensure piping ancillaries and in-pipe instrumentation is installed in accessible locations which do not create problems for traffic in the clear areas.

.11 Make adequate provision in piping and pipe support systems for expansion, contraction, slope, and anchorage.

.12 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag or stress.

.13 Install expansion joints where specified to allow for piping expansion and contraction.

.14 Install expansion loops or bends where specified to allow for proper pipe expansion. Construct expansion loops with long radius welded bends.

.15 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.

.16 Accurately cut all piping for fabrication to field measurements.

.17 Install pipes in straight alignment and parallel to wall. Do not exceed 10 mm in 10 m variance from the true alignment, in any direction. Fabricate and assemble pipe runs so that the pipework is not stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. The "springing" of pipe and fittings to ensure alignment is not permitted. If necessary, undo and subsequently remake all pipework connections to ensure that springing does not occur. Take care not to damage equipment, valves or flanges.

.18 Slope instrument air piping to condensate traps.

.19 Do not cut or weaken the building structure to facilitate installation of piping.

.20 In parallel pipe runs, offset flanges and grooved joint fittings by a minimum of 200 mm longitudinally.

.21 In vertical pipe runs of diameter greater than 250 mm, provide 200 mm long spool piece on lower side of each valve.

.22 Do not install water piping over electric switchboards, transformers, cable tray or electric motor starters.

.13 Threaded Joints:

.1 Conform to the requirement of ANSI B31.1.

.2 Ream the end of all pipes to remove all burrs and cuttings when fabricating threaded joints.

.3 Clean out pipe and repair linings and coatings prior to joining.

.4 Apply Teflon tape to male threads and join pipe. Use both Teflon tape and Teflon sealing compound on stainless steel pipe threads. Do not apply extra tape to make up for slack in the joint.

.14 Flanged Joints:

.1 Maintain consistent flange bolt hole positions along the entire length or run of the pipe.

.2 Straddle the vertical and horizontal centreline of flanges with flange bolt holes equidistant from the flange centreline, “Two-Holed”.

.3 For pipe installed with a horizontal axis, position flange bolt holes so that the vertical centreline of the flange face bisects the arc between flange bolt holes.

.4 For pipe installed with a vertical axis, position flange bolt holes so that the horizontal centreline of the flange face bisects the arc between flange bolt holes and is perpendicular to the closest structural wall.

.5 Lubricate gaskets with soapy water and apply anti-seize compound to the bolts.

.6 Bring flanges into close parallel and lateral alignment.

.7 Tighten bolts progressively. Proceed from side to side of the flange.

.8 Use proper length bolts for each size flange on flanged connections. Washers may not be used to take up excess bolt length. Provide approximately two full threads bolt projection beyond nuts. Bolts with excessive length of exposed threads are not permitted. All-thread rod is not permitted for bolting flanges.

.9 When joining steel to cast iron flanges, take care to avoid damage to the cast iron flange. Ensure both flanges are flat-faced and use full face gaskets.

.10 Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place strain on the equipment.

.11 Allow a minimum of 150 mm to face or 200 mm to edge of flange from wall, floor or ceiling unless otherwise specified.

.15 Insulation:

.1 Insulate piping systems in accordance with Sections 15055 and 15261.

.16 Flexible Hose Connectors:

.1 Accurately align pipelines to receive flexible connectors before installing the connectors. Do not stretch, compress, misalign or offset the connectors.

.2 Support, anchor and guide the piping so that the flexible connectors are not required to absorb any axial compression or elongation of flexible hose.

.3 Do not torque or twist the flexible connectors.

.4 Check bolt tightness and tighten where necessary, a maximum of one week after commissioning and periodically thereafter. Avoid stretching of bolts.

.17 Expansion Joints:

.1 Accurately align pipelines to receive expansion joints before installing the joint. Do not stretch, compress or offset the joint to fit the piping. Install expansion joints in accordance with manufacturer’s instructions prior to releasing preload.

.2 Align and install each expansion joint in accordance with EJMA standards and with the manufacturer's written instruction; properly guide and anchor all expansion joints. No lateral movement is permitted on compensator type expansion joints.

.3 On rubber expansion joints, check bolt tightness, and tighten where necessary one week after commissioning is completed.

.18 Repair and Restoration:

.1 Repair pipe with damaged protective coatings and linings in accordance with Manufacturer's directions.

.2 Field cutting of glass lined pipe is permitted for pipe diameters between 100 mm and 250 mm and limited to one piece per run of pipe for closure purposes only. Cuts are to be made in strict accordance with glass lining Manufacturer’s directions. All field cut edges are to be repaired using a high solids epoxy repair kit in strict accordance with glass lining Manufacturer’s directions.

.3 Damaged glass lining, in cases other than described in item 2 above, cannot be repaired. Pipe with damaged glass lining shall be replaced.

.4 Patching inserts, overlays, or pounding out of dents shall not be permitted.

3.2 Equipment Checkout

.1 In addition to the requirements set out in related section of Part 1 of this Specification Section, complete the following additional activities:

.1 Provide seven (7) day’s notice prior to testing.

.2 Do not insulate or conceal work until piping systems are tested and accepted.

.3 Complete any required weld tests.

.4 Supply all water, air and inert gases required for pressure testing.

.5 Supply all pumps, compressors, gauges and other equipment required for testing.

.6 Install air threadolets, air relief valves and line fitting valves as necessary to complete testing. Remove after testing and plug threadolets for future use.

.7 Cap or plug all lines which are normally open ended. Remove on completion of testing.

.8 Provide all temporary thrust restraints necessary for testing. Remove upon completion of testing.

.9 Test all underground lines prior to backfilling. Do not place concrete surround (encasement) until lines are tested.

.10 Isolate all low-pressure equipment and appurtenances during testing so as not to place any excess pressure on the operating equipment.

.11 Where defective material or equipment is identified, repair or replace using new material.

.12 Flush and drain liquid pipes after pressure tests. Purge all gas pipes after pressure tests.

.13 Dispose of flushing water in manner, which causes no damage to buildings, site works or the environment.

.14 Hydrostatic Pressure Testing of Liquid Lines:

.1 Hydrostatically test all lines normally used for the conveyance of liquids using water as the test medium, unless otherwise specified in this Section.

.2 Test pressures and durations as specified in the PIPESPEC System sheets in Section 15055.

.3 Ensure all lines are filled with water. Bleed air from all high spots using taps provided specifically for that purpose.

.4 Lined pipelines: Allow filled pipeline or section thereof to stand under a slight pressure for at least eight (8) hours (twenty-four (24) hours for cement mortar lining) to allow the lining to absorb water and to allow the escape of air from air pockets.

.5 Zero leakage is permitted throughout the specified test period for all exposed piping, buried insulated piping, and any liquid chemical lines.

.6 For hydraulic and lube oil systems, test using the medium of service. Provide zero loss of pressure through the specified test period.

.15 Pneumatic Pressure Testing:

.1 Use nitrogen gas or oil free dry air to test piping systems where air or nitrogen is the specified testing medium in the PIPESPEC.

.2 Submit a testing plan and a safety plan for each piping system that is to be pressure tested with nitrogen gas or oil free dry air. Do not perform pressure testing with air or nitrogen until the safety plan and testing plan is accepted by Professional of Record.

.3 Provide a separate pressure relief valve for pneumatic pressure testing.

.4 Locate pressure relief valve within visual range (sight) of the test gauge and with exhaust to a safe location.

.5 Relieve at not more than full test pressure plus ten (10) percent.

.6 Continuously monitor and control testing to assure personnel safety and piping integrity.

.7 Protect installed work from potential damage from pressure testing failures.

.8 When using nitrogen or dry air to test steel or stainless steel pipelines, gradually introduce the test gas up to a pressure of 300 kPa or one-third of specified test pressure, whichever is less.

.9 While maintaining this pressure, test lines for leaks using soapy water.

.10 When the line is free from leaks at this pressure, increase by increments of 350 kPa or one-third of specified test pressure (whichever is less) to the specified test pressure.

.11 After each increment, retest using soapy water; take corrective action as necessary.

.12 Provide high purity nitrogen gas used for testing, in cylinders fitted with pressure regulators for 0 to 2000 kPa and all necessary fittings and adaptors necessary to complete the connection between the source and the system header. Provide self-relieving type pressure regulator that vents to the atmosphere and include a throttling valve.

.13 Provide oil free air with a relative humidity of zero for testing. Provide all fittings, adaptors, accessories, and the pressure regulator and throttling valve that are suitable for pressure testing with air and rated for 2000 kPa service.

.16 Testing of Hazardous Gas and Liquid Lines:

.1 The following commodities, at a minimum, are to be tested as hazardous gas or liquid lines: CDN, G, GC, LSG, MSG, NG.

.2 Remove components which may be damaged by test pressures and plug openings. Provide tee in any existing lines to be tested adjacent to the terminal valve.

.3 Pressure test after cleaning:

.1 Zero leakage at specified test conditions is required. Repair and retest lines until successful test is achieved. Test all LSG lines in accordance with CAN/CGA B149.6. Test all refrigerant commodity lines in accordance with CSA B-52.

.2 Plug and/or disconnect all vents to the atmosphere, close all valves to the atmosphere, and open all in-line valves. Return the system to its appropriate operating condition after testing.

.3 Hydrostatically test steel and plastic pipelines using water as the test medium.

.4 Replace all moisture absorbing gaskets and valve packing after hydrostatic testing.

.5 After testing, dry all lines.

.1 Steel Lines: Pass steam through the lines from the high end until all lines are thoroughly heated. Allow condensate and foreign material to drain during steaming. Disconnect and drain lines from all low points. While lines are warm, blow dry, oil-free air with a dew point below minus 40°C through the system until the existing dew point is the same as the supply air. Fix valves in the half open position during drying. Ensure that valves temporarily removed from the system during drying operations are completely free of moisture prior to reinstallation.

.2 PVC Lines: Drying applies solely to vacuum lines. Drain and remove all free water and moisture from the system. Swab the pipe to remove any excess water. Air dry the pipe in the same manner as steel lines, additionally ensuring that the entering air temperature is not greater than 50°C.

.4 Fill the line with inert gas if service gas is reactive with air.

.5 Introduce service gas immediately after testing and drying and inert gas filling. Test the system for leaks. Allow time for the complete replacement of air or inert gas from the piping with the service gas.

.6 Use an appropriate sensing device when testing for leaks.

.7 If leaks are detected when the system is tested with service gas, do not implement repairs until all gas has been purged from the system. Repeat the hydrostatic testing and drying sequence prior to retesting the line with service gas.

.17 Cleaning and Flushing:

.1 Clean and flush HVAC lines in accordance with Section 15546.

.2 After installation and prior to testing, perform initial cleaning of mechanical and utility lines. Clean piping greater than 150 mm and less than 600 mm by passing a tightly fitting cleaning ball or swab through the pipeline, unless specified otherwise. Lines greater than 600 mm may be cleaned manually or with a cleaning ball or swab. Give lines smaller or equal to 150 mm an initial flush or purge.

.3 After initial cleaning, connect the piping systems to related process and mechanical equipment. Insert temporary screens, provided with visible locator tabs, in the suction of pumps and compressors in accordance with the following table:

Suction Size, mm	Maximum Screen Opening, mm
0-25	1.5
30-75	6.25
80-150	12.5
>150	25

.4 Maintain the screens during testing, flushing and purging, initial start-up, and the initial operating phases of the commissioning. Install screens for initial operation on liquid systems handling solids. Initial operation on solids systems following clean water testing may be without screens.

.5 Unless specified otherwise, flush liquid systems after testing, with clean water and screens in place. Maintain flushing for a minimum of fifteen (15) minutes or until no debris is collected in the screens, whichever is longer.

.6 Remove the screens and make the final connections after the screens have remained clean for a minimum of twenty-four (24) consecutive hours of operation. Keep screens in place for twenty-four (24) hours of clean water operation on solids handling systems; remove prior to placing the system into solids handling service.

.7 In air or gas systems with pipe less than or equal to 150 mm in diameter, purge with air or inert gases (as appropriate) before testing. Upon completion of testing and cleaning, drain and dry the piping with a dry air stream. Satisfy ANSI/ISA-S7.0.01 standards for instrument air systems. Purge LSG systems with inert gas only and dry in accordance with CGA B149.6.

.8 Purge LSG, natural gas, and propane systems with nitrogen gas and provide a nitrogen pad maintained at 65 kPa until put in service.

.9 For hazardous gas and liquid systems, clean interior of the pipelines by drawing a cloth or swab impregnated with an appropriate solvent (carbon tetrachloride or trichloroethylene) through the pipe. Do not clean interior of refrigerant lines. Dismantle valves and hand clean. Plug lines at the end of each day. Properly dispose of all waste solvents.

.18 Disinfection:

.1 Flush and disinfect lines intended for potable water service after testing in accordance with AWWA C651.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section covers materials for piping systems. The PIPESPEC Systems in this Section specify piping system materials for groups of similar commodities.

.2 Refer to Section 15050 for general requirements for selection, supply, installation, submittals, inspection, and testing of pipe materials, fittings, appurtenances, expansion control, supports and restraints for plumbing and fire protection piping.

.3 Table 1.1.3 lists commodities and the PIPESPEC System. See Part 2 for PIPESPEC System sheets that define materials for piping systems. The detailed PIPESPEC System sheets are included at the end of this Specification Section.

.4 Commodities and PIPESPEC reference:

Abbreviation	Commodity	PIPESPEC No
BCTL	boiler chemical treatment, low pressure	8
BCTM	boiler chemical treatment, medium pressure	8
BDL	boiler blowdown, low pressure	8
BDM	boiler blowdown, medium pressure	8
BFL	boiler feedwater, low pressure	8
BFM	boiler feedwater, medium pressure	8
CHR	chilled water return	8
CHS	chilled water supply	8
D	drain (non-process)	24
DHR	domestic hot water return	7
DHW	domestic hot water	7
FPG	fire protection glycol solution	32
GR	glycol return	8
GS	glycol supply	8
HRR	heat reservoir return	8
HRS	heat reservoir supply	8
RWL	rain water, leader	24
SAN	sanitary drainage	24
STW	stormwater drainage	24A
SW	seal water	11
PW	Potable Water (domestic)	11
NPW	Non-potable Water	11
VS	vent, sanitary	24

.5 If any commodities included in the Final Design are not listed in the table above, select a PIPESPEC System that most closely matches the commodity and service conditions and refine the Specification to suit the Final Design and include in the blacklined Specification submitted for review. The quality of products and scope of execution for any such commodities shall not be lower than the minimum standards set out in this Section.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B1.20.1 - Pipe Threads, General Purpose.

.2 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.

.3 ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.

.4 ASME B16.5 - Pipe Flanges and Flanged Fittings.

.5 ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.

.6 ASME B16.11 - Forged Steel Fittings, Socket Welding and Threaded.

.7 ASME B16.12 - Cast Iron Threaded Drainage Fittings.

.8 ASME B16.15 - Pipe Flanges and Flanged Fittings, Classes 150 and 300.

.9 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

.10 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.11 ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

.12 ASME B31.1 - Power Piping.

.13 ASME B31.9 - Building Services Piping.

.14 ASME B32 - Solder Metal.

.15 ASME B36.10M - Welded and Seamless Wrought Steel Pipe.

.16 ASME B36.19M - Stainless Steel Pipe.

.17 ASME B1.1 - Unified Inch Screw Threads.

.18 ASME Section IX - Boiler and Pressure Vessel Code; Welding and Brazing Requirements.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A47 - Malleable Iron Castings.

.2 ASTM A53 - Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A74 - Cast Iron Soil Pipe and Fittings.

.4 ASTM A105/A105M - Forgings, Carbon Steel, for Piping Components.

.5 ASTM A106 - Seamless Carbon Steel Pipe for High Temperature Service.

.6 ASTM A126 - Grey-Iron Castings for Valves, Flanges, and Pipe Fittings.

.7 ASTM A135 - Electric-Resistance-Welded Steel Pipe.

.8 ASTM A139 - Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over).

.9 ASTM A167 - Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate.

.10 ASTM A181/181M - Forgings, Carbon Steel, for General Purpose Piping.

.11 ASTM A182/182M - Forged or Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

.12 ASTM A193/193M - Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service.

.13 ASTM A194/194M - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.

.14 ASTM A197 - Cupola Malleable Iron.

.15 ASTM A234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

.16 ASTM A240 - Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

.17 ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.18 ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.

.19 ASTM A307 - Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength.

.20 ASTM A312/312M - Seamless and Welded Austenitic Stainless Steel Pipe.

.21 ASTM A320/320M - Alloy Steel Bolting Materials for Low-Temperature Service.

.22 ASTM A403/A403M - Wrought Austenitic Stainless Steel Piping Fittings.

.23 ASTM A409/A409M - Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service.

.24 ASTM A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

.25 ASTM A536 - Ductile Iron Castings.

.26 ASTM A563 - Carbon and Alloy Steel Nuts.

.27 ASTM A570/A570M - Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.

.28 ASTM A774/A774M - As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

.29 ASTM A778 - Welded, Unannealed Austenitic Stainless Steel Tubular Products.

.30 ASTM B88 - Seamless Copper Water Tube.

.31 ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

.32 ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.33 ASTM D638 - Test Method for Tensile Properties of Plastics.

.34 ASTM D792 - Test Method for Specific Gravity and Density of Plastics by Displacement.

.35 ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.

.36 ASTM D1457 - PTFE Molding and Extrusion Materials.

.37 ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

.38 ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

.39 ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

.40 ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

.41 ASTM D2467 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

.42 ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.

.43 ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

.44 ASTM D2665 - Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

.45 ASTM D2996 - Filament-Wound Reinforced Thermosetting Resin Pipe.

.46 ASTM D3212 - Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.

.47 ASTM D3261 - Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Fittings.

.48 ASTM D3350 - Polyethylene Plastics Pipe and Fittings Materials.

.49 ASTM D4101 - Propylene Plastic Injection and Extrusion Materials.

.50 ASTM D4174 - Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems.

.51 ASTM F441 - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

.52 ASTM F894 - Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

.3 American Water Works Association (AWWA):

.1 AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.

.2 AWWA C110 - Ductile-Iron and Grey-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids.

.3 AWWA C111 - Rubber-Gasket Joints for Ductile-Iron and Grey-Iron Pipe and Fittings.

.4 AWWA C115 - Flanged Ductile-Iron and Grey-Iron Pipe with Threaded Flanges.

.5 AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Moulds or Sand-Lined Moulds, for Water and Other Liquids.

.6 AWWA C200 - Steel Water Pipe, 6 Inches and Larger.

.7 AWWA C203 - Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.

.8 AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inches through 144 Inches.

.9 AWWA C206 - Field Welding of Steel Water Pipe.

.10 AWWA C207 - Steel Pipe Flanges for Waterworks Services - Sizes 4 Inch Through 144 Inch.

.11 AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.

.12 AWWA C209 - Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines.

.13 AWWA C210 - Coal-Tar Epoxy Coating System for the Interior and Exterior of Steel Water Pipe.

.14 AWWA C214 - Tape Coating Systems for the Exterior of Steel Water Pipelines.

.15 AWWA C301 - Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.

.16 AWWA C303 - Reinforced Concrete Pressure Pipe - Steel Cylinder Type, Pretensioned, for Water and Other Liquids.

.17 AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtenances.

.18 AWWA C606 - Grooved and Shouldered Joints.

.19 AWWA C651 - Disinfecting Water Mains.

.20 AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water.

.21 AWWA M11 - Steel Pipe - A Guide for Design and Installation.

.4 CGA - Canadian Gas Association Standards.

.5 Canadian Standards Association (CSA):

.1 CSA B52 - Mechanical Refrigeration Code.

.2 CSA B137.3 - Rigid PVC Pipe for Pressure Applications.

.3 CSA CAN3-Z299.3 - Quality Verification Program Requirements.

.4 CSA CAN-Z183 - Oil Pipeline Systems.

.5 CAN/CGA B105 - Installation Code for Digester Gas Systems.

.6 Cast Iron Soil Pipe Institute (CISPI):

.1 CISPI 301 - Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings.

.7 CPC - Canadian Plumbing Code.

.8 EJMA STDS - Standards of Expansion Joint Manufacturers' Association, Edition No. 6.

.9 Fluid Sealing Association Technical Handbook, Rubber Expansion Joint Division.

.10 FEDSPEC, L-C-530B (1) - Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy.

.11 United States Military Standard (MIL):

.1 MIL-H-13528B - Hydrochloric Acid, Inhibited, Rust Removing.

.2 MIL-S-8660C - Silicone Compound.

.3 MIL-STD-810C - Environmental Test Methods.

.12 Manufacturers Standardization Society (MSS):

.1 MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS SP-43 - Wrought Stainless Steel Butt Welding Fittings.

.3 MSS SP-97 - Integrally Reinforced Forged Branch Outlet Fittings – Socket Welding, Threaded, and Buttwelding Ends.

.4 MSS SP-114 - Corrosion Resistant Pipe Fittings Threaded and Socket Welding Class 150 and 1000.

.13 Society of Automotive Engineers (SAE):

.1 SAE J1227 - Assessing Cleanliness of Hydraulic Fluid Power Components and Systems.

.14 The Society for Protective Coatings (SSPC):

.1 SSPC-SP3 – Power Tool Cleaning.

.2 SSPC-SP6 – Commercial Blast Cleaning.

.3 SSPC-SP10 – Near-White Blast Cleaning.

1.3 Definitions

.1 Pipe Connections and Joints:

.1 THD: threaded.

.2 BW: butt weld.

.3 SW: socket weld.

.4 BSW: butt-strap welded joint.

.5 SLW: single lap weld (bell and spigot).

.6 DLW: double lap weld (bell and spigot).

.7 FSW: fusion socket weld.

.8 FLG: flanged.

.9 RGRV: rolled grooved flexible coupling.

.10 CGRV: cut grooved rigid coupling.

.11 BSS: bolted split sleeve coupling.

.12 HLF CPLG: half coupling.

.13 LR ELL: long radius elbow.

.14 SR ELL: short radius elbow.

.15 FP: full penetration.

.16 FLRD: flared.

.17 CPRSN: compression.

.18 SLV: solvent weld.

.19 CPO: compression type push-on.

.20 RPO: restrained push-on joint.

.21 RMJ: restrained mechanical joint.

.22 BAS: bell and spigot.

.23 RBAS: restrained bell and spigot.

.24 PO: push-on.

.25 MJ: mechanical joint.

.26 BFW: butt fusion weld.

.27 EFSW: electro-fusion socket weld.

.28 STD: standard.

.29 UN: union.

.2 Flanges:

.1 RF: raised face.

.2 FF: full face.

.3 SO: slip-on.

.4 LJ: lap joint.

.5 WN: weld neck.

.6 LWN: long weld neck.

.3 Materials:

.1 SS: stainless steel.

.2 DI: ductile iron.

.3 SV: service (cast iron soil pipe available with SV rating or XH, extra heavy, rating).

.4 Welding:

.1 FP: full penetration.

.5 Pipe wall thickness”

.1 Std. Wt.: standard weight

1.4 Submittals

.1 Provide submittals in accordance with Section 15050.

2. PRODUCTS

2.1 Materials

.1 Pipe size (nominal diameter, DN) is specified in pipe line labels on the drawings. Install pipelines with pipe size per Section 15050 if the pipe size is not indicated by a line label on the Drawings.

.2 Provide piping system materials and components per the PIPESPEC Systems requirements for the specified commodity and pipe size.

.3 Detailed Specification sheets follow.

3. EXECUTION

3.1 General

.1 Refer to Section 15050 for installation and inspection.

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

PIPESPEC System 7

Commodity	Domestic Hot Water	Domestic Hot Water Return				
Abbreviation	DHW	DHR				

Test Conditions			**Maximum Conditions**	
Pressure (kPa)	Duration (min.)	Medium	Pressure (kPa)	Temperature (°C)
1350	120	Water	1035	105

General Requirements

1. Design, manufacture, and install piping in accordance with ASME B31.9 Building Services Piping code.
2. Full-faced flanges mated with raised face flanges are not permitted.
3. Mating flanges are to be of the same drilling pattern.
4. Provide concrete surround for installation below structures as specified in Section 15050.

Notes:

1. Provide unions as indicated in the Final Design to allow for pipe disassembly.
2. For steel piping, provide weld neck flanges on both sides of flanged, wafer or lug body valves.
3. Bolt length per ASME B16.5. Hex head bolt dimensions per ASME B18.2.1. Class 2A standard coarse series threads per ASME B1.1. Hex nut dimensions per ASME B18.2.2 (heavy hex). Class 2B standard coarse series threads per ASME B1.1.
4. For indoor service, copper piping system. For outdoor service, galvanized steel piping system.
5. Hard, drawn, furnished in straight lengths. Lead free solder per ASTM B32 all services, install per Manitoba Plumbing Code.
6. Annealed or Drawn, furnished in straight lengths or coils. Lead free solder per ASTM B32 all services, install per Manitoba Plumbing Code.
7. Furnish threaded adapters at connections to valves.
8. Furnish long radius elbows. 3-piece elbows acceptable for steel pipe sizes 400 – 600 mm; material same as pipe, dimensions per AWWA C208.
9. Below structure and submerged applications not allowed for pipe sizes 10 - 65 mm.
10. Provide unicellular elastomeric thermal type insulation for outdoor installations. Cellular glass or fibreglass is not permitted for outdoor installations.
11. Butterfly valve for flow control only. Wafer style body for installation between two Class 150 flanges.

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	10 - 65 (indoor)	Type L	SLDR	Copper Tube: ASTM B88	15066	1, 4, 5
	10 - 65 (outdoor)	Std. Wt.	THD	Steel: ASTM A53 Gr B, Type E or Type S, galvanized, Dim. per B36.10	15061	1, 4
	75 - 600	Std. Wt.	RGRV, CGRV, FLG	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	1
Lining for Pipe & Fittings	75 - 600	410 microns	—	Liquid Epoxy: Factory Applied, AWWA C210, NSF 61 certified	15061	
External Coating	10 - 65	—	—	None	—	
	75 - 600	—	—	Liquid Epoxy: Factory Applied Primer, 75-100 micron (AWWA C210), Field Applied Finish Coat per Spec. Section	—	
Fittings	10 - 65 (indoor)	Class 250	SLDR	Wrought Copper or Bronze, Soldered: Material and Dim. per ASME B16.22.	15066	7
	10 - 65 (outdoor)	Class 150 Std. Wt.	THD	Malleable Iron: ASTM A197, galvanized, Dim. per ASME B16.3 Forged Steel: ASTM A105, galvanized, Dim. per ASME B16.11	15061	8
	75 - 600	Std. Wt. Class 150	RGRV, CGRV, FLG	Grooved Steel: ASTM A234-WPB, Dim. per ASME B16.9 Forged Steel: ASTM A105, galvanized, Dim. per ASME B16.5	15061	8
Taps	10 - 65	—	SLDR x THD	Wrought Copper or Bronze Tee: Material and Dim. per ASME B16.22, Reducing bushings to 20 mm FNPT connection as necessary	15066	
	75 - 300	Class 3000	FP Beveled Fillet Weld	Forged Steel Olet or Half Coupling: ASTM A105, Dim. per ASME B16.11 20 mm FNPT branch/ tap	15061	
Weldolets / Threadolets	None	—	—	None	—	

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Valves	10 - 65	—	THD	Ball: BV01 Gage/Root: GA01 Needle: NV01 Swing check: CV01 Globe: GL01 Gate: GV01	15105	2,7
	75 - 250	—	FLG	Check: CV06		2,7
	75 - 600	—	FLG	Butterfly: BF01 Globe: GL04 Gate: GV04		2,7,11
	50 - 1200	—	FLG	Butterfly: BF01		2,7
Flanges	75 - 600	Class 150 Class D	WN, SO	Forged Steel: ASTM A105, FF or RF, Dim. per ASME B16.5 Plate Steel: ASTM A36 or ASTM 516-Gr 60, Gr 65 or Gr 70, FF, Dim. per AWWA C207	15061	2
Flange gaskets	75 - 250	1.6 mm	FLG	Neoprene	15050	
	250 - 600	3.2 mm	FLG	Neoprene	15050	
FLG Bolts, nuts and hardware	All	All	—	Carbon Steel Bolts: ASTM A307-Gr B Carbon Steel Nuts: ASTM A563-Gr A, heavy hex nuts	—	3
Grooved Coupling	75 - 600	—	RGRV	Rigid Grooved Coupling: ASTM A-536-65/45/12, Dim. per AWWA C606	15061	
Mechanical Coupling Gaskets	All	All	Mech. CPLG	Neoprene	15050	
Compression and Push-On Gasket	None	—	—	None	—	
Insulation	10 - 600	25 mm thk	—	Temperature Class: Low Insulation Service: EC	15261	10

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Buried (Includes Enshrouded and Embedded)

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	10 - 65	Type K	SLDR	Copper Tube: ASTM B88	15066	1,6,9
	75 - 600	Std. Wt.	RGRV, CGRV, FLG	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	
Lining for Pipe & Fittings	75 - 600	410 microns	—	Liquid Epoxy: Factory Applied, AWWA C210, NSF 61 certified	15061	
External Coating	10 - 65	2 mm	—	Tape Wrap: Factory Applied, AWWA C209 and AWWA C214	—	
	75 - 600	thk per std	—	Liquid Epoxy: Factory Applied Primer, 75-100 micron (AWWA C210), Field Applied Finish Coat per Spec. Section	15061	
	Valves	—	—	Manufacturer's standard prime coat: Factory Applied. Liquid Epoxy: Factory Applied Primer, 75-100 micron (AWWA C210), Field Applied Finish Coat per Spec. Section	—	
Fittings	10 - 65	Class 250	SLDR	Wrought Copper or Bronze, Soldered: Material and Dim. per ASME B16.22	15066	7,9
	75 - 600	Sch. 40 Class 150	RGRV, CGRV, FLG	Grooved Steel: ASTM A234-WPB, r/D dimensions per ASME B16.9 Forged Steel: ASTM A105, galvanized, Dim. per ASME B16.5	15061	8
Taps	10 - 65	—	SLDR x THD	Wrought Copper or Bronze Tee: Material and Dim. per ASME B16.22, Reducing bushings to 20 mm FNPT connection as necessary	15066	
	75 - 600	—	—	None	—	
Weldolets / Threadolets	None	—	—	None	—	
Valves	10 - 65	—	THD	Ball: BV01 Gage/Root: GA01 Needle: NV01 Swing check: CV01 Globe: GL01 Gate: GV01	15105	2,7
	75 - 250	—	FLG	Check: CV06		2,7
	75 - 600	—	FLG	Butterfly: BF02 Globe: GL04 Gate: GV04		2,7,11,

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Buried (Includes Enshrouded and Embedded)

Component	**Line Size, mm**	**Rating**	**Conn./Joints**	**Material**	**Spec Section**	**Notes**
Flanges	75 - 600	Class 150 Class D	WN, SO	Forged Steel: ASTM A105, FF or RF, Dim. per ASME B16.5 Plate Steel: ASTM A36 or ASTM 516-Gr 60, Gr 65 or Gr 70, FF, Dim. per AWWA C207	15061	2
Flange gaskets	75 - 250	1.6 mm	FLG	Neoprene	15050	
	250 - 600	3.2 mm	FLG	Neoprene	15050	
FLG Bolts, nuts and hardware	All	All	—	Non Corrosive, High-Strength, Low-Alloy Steel Bolts: ASTM A 449- Gr 3, Class C or Class D, having the metallurgy specified in ASME/AWWA C111/A21.11, regardless of any protective coating Carbon Steel Bolts: ASTM A307-Gr B with Xlyan fluoropolymer coating, Tripac 2000 Blue Carbon Steel Nuts: ASTM A563-Gr A with Xlyan fluoropolymer coating, Tripac 2000 Blue	—	3
Grooved Coupling	75 - 600	—	RGRV	Rigid Grooved Coupling: ASTM A-536-65/45/12, Dim. per AWWA C606	15061	
Mechanical Coupling Gaskets	All	All	Mech. CPLG	Neoprene	15050	
Compression and Push-On Gasket	None	—	—	None	—	
Insulation	10 - 600	25 mm thk	—	Waterproof jacket for buried service		

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

PIPESPEC System 8

Commodity	Boiler Chemical Treatment, Low Pressure	Boiler Chemical Treatment, Medium Pressure	Boiler Blowdown, Low Pressure	Boiler Blowdown, Medium Pressure	Boiler Feedwater, Low Pressure	Boiler Feedwater, Medium Pressure
Abbreviation	BCTL	BCTM	BDL	BDM	BFL	BFM
Commodity	Heat Reservoir Return	Heat Reservoir Supply	Glycol Return	Glycol Supply	Chilled Water Return	Chilled Water Supply
Abbreviation	HRR	HRS	GR	GS	CHR	CHS

Test Conditions			**Maximum Conditions**	
Pressure (kPa)	Duration (min.)	Medium	Pressure (kPa)	Temperature (°C)
1000	120	Water	300	115

General Requirements

1. Full-faced flanges mated with raised face flanges are not permitted.
2. Mating flanges are to be of the same drilling pattern.
3. Concrete surround for installation below structures.

Notes:

1. Provide unions or flanges as indicated in the Final Design to allow for pipe disassembly. Unions and flange connections are to be provided for piping disassembly; spacing is not to exceed 12 m for unions and 18 m for flanges.
2. For steel piping, provide weld neck flanges on both sides of wafer, lug body, or flanged valves.
3. Bolt length per ASME B16.5 plus three additional threads. Hex head bolt dimensions per ASME B18.2.1. Class 2A standard coarse series threads per ASME B1.1. Hex nut dimensions per ASME B18.2.2. Class 2B standard coarse series threads per ASME B1.1.
4. Finish coat colour per Section 15061. Provide primer and epoxy coating suitable for temperatures up to 120°C.
5. Provide long radius elbows.
6. Valve type CV01 to be used in GR and GS services only.
7. All glycol drain valves are to be labelled “GLYCOL – DO NOT DRAIN” per Section 01080.
8. Pre-start-up cleaning and chemical treatment per Section 15546.
9. HRR/HRS/GLR/GLS operating temperature is medium temperature range, insulation EC; CWR and CWS operating temperature is low temperature range, insulation EC or CC, insulation rating 25 mm THK.

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	13 - 65	Sch. 40	THD	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	
	75 - 600	Std. Wt.	BW, FLG	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	2
Lining for Pipe & Fittings	All	—	—	None	—	
External Coating	All	75-100 micron DFT	—	Three Coat High Temperature Epoxy: Factory Applied High Temperature Primer, 75-100 micron	—	
	Valves	75-100 micron DFT	—	Three Coat High Temperature Epoxy: Factory Applied High Temperature Primer, 75-100 micron	—	
Fittings	13 - 65	Class 150 Sch. 40	THD	Malleable Iron: ASTM A197, Dim. per ASME B16.3 Forged Steel: ASTM A105, Dim. per ASME B16.11	15061	
	75 - 600	Std. Wt.	BW, FLG	Wrought Steel: ASTM A234-WPB, Dim. per ASME B16.5 and ASME B16.9	15061	5
Taps	12 - 65	Class 3000 Sch. 40	THD, SW, BW	Forged Steel: ASTM A105, Dim. per ASME B16.11 Wrought Steel: ASTM A234-WPB, Dim. per ASME B16.9 20 mm FNPT branch	15061	
	75 - 600	Class 3000	FP Beveled Fillet Weld	Forged Steel Threadolet or Half Coupling: ASTM A105, Dim. per ASME B16.11 20 mm FNPT branch/ tap	15061	
Weldolets / Threadolets	50 - 300	Class 3000	THD, BW	Forged Steel: per ASTM A105, Dim. per MSS-SP-97	15061	

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	**Line Size, mm**	**Rating**	**Conn./Joints**	**Material**	**Spec Section**	**Notes**
Valves	10 - 50	—	THD	Balancing: CB01	15105	8
	10 - 65	—	THD FLG THD	Ball: BV01 Butterfly: BF03 Check Valve: CV01	15105	2,7,8
	10 - 200	—	THD	Two-way: TW01 Three-way: TW02	15105	8
	65 - 200	—	FLG	Balancing: CB02	15105	2,8
	65 - 300	—	THD	Pump Discharge: PD01	15105	8
	75 - 450	—	FLG	Ball: BV09 Check Valve: CV15 Check Valve: CV10	15105	2,6,7,8
Flanges	75 - 600	Class150	LWN, WN, SO	Forged Steel: ASTM A105, FF, Dim. per ASME B16.5	15061	1
Flange gaskets	75 - 250	1.6 mm	FLG	Neoprene	15050	
	300 - 600	3.2 mm	FLG	Neoprene	15050	
FLG Bolts, nuts and hardware	All	—	—	Carbon Steel Bolts: ASTM A307-Gr B Carbon Steel Nuts: ASTM A563-Gr A, heavy hex nuts	—	3
Grooved Coupling	None	—	—	None	—	
Mechanical Coupling Gaskets	None	—	—	None	—	
Compression and Push-On Gasket	None	—	—	None	—	
Indoor Insulation	10 - 600	50 mm thk	All	Operating Temperature Range: Medium Insulation Service: EC Operating Temperature Range: Low Insulation Service EC and CC	15261	9

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Outdoor Insulation	10 - 600	50 mm thk	All	Operating Temperature Range: Medium Insulation Service: FP Operating Temperature Range: Low Insulation Service EC and CC	15261	9
Expansion Joints	All	—	—	—	15090	

Buried (Includes Enshrouded and Embedded)

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	75 - 600	Sch. 40 (Std. Wt)	BW	<u>Steel</u>: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	
Lining for Pipe & Fittings	All	—	—	None	—	
External Coating	All	75-100 micron DFT	—	<u>Three Coat High Temperature Epoxy</u>: Factory Applied High Temperature Primer, 75-100 micron	—	
	Valves	—	—	<u>Coating System M-1</u>	09905	
Fittings	75 - 600	Sch. 40 (Std. Wt)	BW	<u>Wrought Steel</u>: ASTM A234-WPB, Dim. per ASME B16.9	15061	5
Taps	None	—	—	None	—	
Weldolets / Threadolets	None	—	—	None	—	
Valves	None		—	None	—	
Flanges	None	—	—	None	—	
Flange gaskets	None	—	—	None	—	
FLG Bolts, nuts, and hardware	None	—	—	None	—	
Grooved Coupling	None	—	—	None	—	

Buried (Includes Enshrouded and Embedded)

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Mechanical Coupling Gaskets	None	—	—	None	—	
Compression and Push-On Gasket	None	—	—	None	—	
Insulation	10 - 600	50 mm thk	—	Insulation per Specification Insulation Service: Underground		
Expansion Joints	All	—	—	—	15090	

PIPESPEC System 11

Commodity	Potable Water (domestic)	Non-potable Water	Seal Water			
Abbreviation	PW	NPW	SW			

Test conditions			**Maximum Conditions**	
Pressure (kPa)	Duration (min.)	Medium	Pressure (kPa)	Temperature (°C)
1000 Note 9	120	Water	750 Note 9	20

General Requirements

1. Full-faced flanges mated with raised face flanges are not permitted.
2. Mating flanges are to be of the same drilling pattern.
3. Provide concrete surround for installation below structures.

Notes:

1. Provide unions as indicated in the Final Design to allow for pipe disassembly. Unions connections are to be provided for piping disassembly; spacing is not to exceed 12 m.
2. For steel piping, provide weld neck flanges on both sides of flanged, wafer or lug body valves.
3. Bolt length per ASME B16.5 plus three additional threads. Hex head bolt dimensions per ASME B18.2.1. Class 2A standard coarse series threads per ASME B1.1, standard coarse thread series. Hex nut dimensions per ASME B18.2.2 (heavy hex). Class 2B standard coarse series threads per ASME B1.1.
4. For indoor service, copper piping system. For outdoor service, galvanized steel piping system.
5. Hard, drawn, furnished in straight lengths. Lead-free solder per ASTM B32 all services, BCPC for PW and NPW.
6. Annealed or Drawn, furnished in straight lengths or coils. Lead free solder per ASTM B32 all services, BCPC for PW and NPW.
7. Furnish threaded adapters at connections to valves.
8. Furnish long radius elbows. Three piece elbows acceptable for steel pipe sizes 400 – 600 mm; material same as pipe, dimensions per AWWA C208.
9. Where connection to FPS system and NFPA regulations mandate, the maximum operating pressure is 1050 kPa and the test pressure is 1575 kPa.
10. Not used.
11. Butterfly valve for flow control only. Wafer style body for installation between two Class 150 flanges.
12. Below structure and submerged applications not allowed for pipe sizes 10 - 65 mm.
13. Provide stem extension and valve box.

14. Insulation for condensation Control (CC) not required for C3 or C7 pipe. Provide unicellular elastomeric thermal type insulation for outdoor installations. Cellular glass or fibreglass is not permitted for outdoor installations.
15. Use valve type NV01 in C2 service only.

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	10 - 65 (indoor)	Type L	SLDR	Copper Tube: ASTM B88	15066	1, 4, 5
	10 - 65 (outdoor)	Std. Wt.	THD	Steel: ASTM A53 Gr B, Type E or Type S, galvanized, Dim. per B36.10	15061	1, 4
	75 - 600	Std. Wt.	RGRV	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	
Lining for Pipe & Fittings	75 - 600	410 microns	—	Liquid Epoxy: Factory Applied, AWWA C210, NSF 61 certified	15061	
External Coating	10 - 65	—	—	per Spec. Section	09905	
	75 - 600	410 microns	—	Liquid Epoxy: Factory Applied Primer, 3-4 mils (AWWA C210), Field Applied Finish Coat, per Spec. Section	09905	
	Valves	410 microns	—	Liquid Epoxy: Factory Applied Primer, 3-4 mils (AWWA C210), Field Applied Finish Coat, per Spec. Section	09905	
Fittings	10 - 65 (indoor) 10 - 65 (outdoor)	Class 250 Class 150 Std. Wt.	SLDR THD	Wrought Copper or Bronze, Soldered: Material and Dim. per ASME B16.22 Malleable Iron: ASTM A197, galvanized, Dim. per ASME B16.3 Forged Steel: ASTM A105, galvanized, Dim. per ASME B16.11	15066 15061	7 8
	75 - 600	Std. Wt.	RGRV	Grooved Steel: ASTM A234-WPB, Dim. per ASME B16.9, groove per manufacturer	15061	8
Taps	10 - 65	—	SLDR x THD	Wrought Copper or Bronze Tee: Material and Dim. per ASME B16.22, Reducing bushings to 20 mm FNPT connection as necessary	15066	
	75 - 300	Class 3000	FP Beveled Fillet Weld	Forged Steel Olet or Half Coupling: ASTM A105, Dim. per ASME B16.11 20 mm FNPT branch/tap	15061	
Weldolets / Threadolets	None	—	—	None	—	

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Valves	10 - 65	—	THD	Ball: BV01 Gage/Root: GA01 Needle: NV01 Swing check: CV01 Globe: GL01 Gate: GV01	15105	2,7,15
	75 - 250	—	FLG	Check: CV06		2,7
	75 - 600	—	FLG	Butterfly: BF01 Globe: GL04 Gate: GV04		2,7,11
	50 - 1200	—	FLG	Butterfly: BF01		
Flanges	75 - 600	Class 150 Class D	LWN, WN, SO	Forged Steel: ASTM A105, FF or RF, Dim. per ASME B16.5 Plate Steel: ASTM A36 or ASTM 516-Gr 60, Gr 65 or Gr 70, FF, Dim. per AWWA C207	15061	2
Flange gaskets	75 - 250	1.6 mm	FLG	Neoprene	15050	
	250 - 600	3.2 mm	FLG	Neoprene	15050	
FLG Bolts, nuts and hardware	All	All	—	Carbon Steel Bolts: ASTM A307-Gr B Carbon Steel Nuts: ASTM A563-Gr A, heavy hex nuts	—	3
Grooved Coupling	75 - 600	—	RGRV	Rigid Grooved Coupling: ASTM A-536-65/45/12, Dim. per AWWA C606	15061	
Mechanical Coupling Gaskets	All	All	Mech. CPLG	Neoprene	15050	
Compression and Push-On Gasket	None	—	—	None	—	
Indoor Insulation	10 - 600	25 mm thk	All	Operating Temperature Range: Low Insulation Service: CC	15261	14
Outdoor Insulation	10 - 100	25 mm thk	All	Operating Temperature Range: Low Insulation Service: FP	15261	14
	125 - 600	38 mm thk	All	Operating Temperature Range: Low Insulation Service: FP	15261	14

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Expansion Joints	All	—	—	—	15090	

Buried (Includes Encased and Embedded)

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	10 - 65	Type K.	SLDR	Copper Tube: ASTM B88	15066	1, 6, 12
	75 - 600	Std. Wt	RGRV	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	
Lining for Pipe & Fittings	75 - 600	410 microns	—	Liquid Epoxy: Factory Applied, AWWA C210, NSF 61 certified	15061	
External Coating	10 - 65	2 mm	—	Tape Wrap: Factory Applied, AWWA C209 and AWWA C214	—	
	75 - 600	thk per std	—	Liquid Epoxy: Factory Applied Primer, 3-4 mils (AWWA C210), Field Applied Finish Coat, per Spec. Section	15061	
	Valves	—	—	Coating System M-1	09905	
Fittings	10 - 65	Class 250	SLDR	Wrought Copper or Bronze, Soldered: Material and Dim. per ASME B16.22	15066	7
	75 - 600	Sch. 40	RGRV	Grooved Steel: ASTM A234-WPB, Dim. per ASME B16.9, groove per manufacturer	15061	8
Taps	10 - 65	—	SLDR x THD	Wrought Copper or Bronze Tee: Material and Dim. per ASME B16.22, Reducing bushings to 20 mm FNPT connection as necessary	15066	
	75 - 600	—	—	None	—	
Weldolets / Threadolets	None	—	—	None	—	
Valves	—	—	—	—	—	
Flanges	75 - 600	Class 150 Class D	LWN, WN, SO	Forged Steel: ASTM A105, FF, Dim. per ASME B16.5 Plate Steel: ASTM A36 or ASTM 516-Gr 60, Gr 65 or Gr 70, FF, Dim. per AWWA C207	15061	2
Flange gaskets	75 - 250	1.6 mm	FLG	Neoprene.	15050	

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Buried (Includes Encased and Embedded)

Component	**Line Size, mm**	**Rating**	**Conn./Joints**	**Material**	**Spec Section**	**Notes**
	250 - 600	3.2 mm	FLG	Neoprene.	15050	
FLG Bolts, nuts and hardware	All	All	—	Non Corrosive, High-Strength, Low-Alloy Steel Bolts: ASTM A 449- Gr 3, Class C or Class D, having the metallurgy specified in AWWA C111/A21.11, regardless of any protective coating Carbon Steel Bolts: ASTM A307-Gr B with Xlyan fluoropolymer coating, Tripac 2000 Blue Carbon Steel Nuts: ASTM A563-Gr A with Xlyan fluoropolymer coating, Tripac 2000 Blue	—	3
Grooved Coupling	75 - 600	—	RGRV	Rigid Grooved Coupling: ASTM A-536-65/45/12, Dim. per AWWA C606	15061	
Mechanical Coupling Gaskets	All	All	Mech. CPLG	Neoprene	15050	
Compression and Push-On Gasket	None	—	—	None	—	
Insulation	All	—	—	None	—	
Expansion Joints	All	—	—	—	15090	

PIPESPEC System 24

Commodity	Drain (non-process)	Rain Water Leader	Sanitary Drainage	Vent, Sanitary			
Abbreviation	D	RWL	SAN	VS			

Test Conditions			**Maximum Conditions**	
Pressure (kPa)	Duration (min.)	Medium	Pressure (kPa)	Temperature (°C)
30	15	Water	15	25

General Requirements

1. External coating may be omitted for Encased Pipe.
2. Piping under structures, concrete encased pipe from the structure, and piping extended from the structure through the interface between piped commodities common to process, mechanical and yard piping, are to be either CISP or DIP, as specified.
3. Refer to Section 15450 for plumbing fixtures and trim.

Notes:

1. Omit polyethylene encasement for pipes installed in concrete encasement.
2. Provide unions and flange connections for piping disassembly; spacing not to exceed 6 m.
3. Provide long radius elbows.
4. Install polyethylene encasement in accordance with Method B of AWWA C105.

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	**Line Size, mm**	**Rating**	**Conn./Joints**	**Material**	**Spec Section**	**Notes**
Pipe	10 - 65	Std. Wt.	SW, THD	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per ASME B36.10	15061	2
	75 - 300	SV	Hub & Spigot	Cast iron soil pipe (CISP): CAN/CSA-B70 (ASTM A74)	—	—
Lining for Pipe & Fittings	10 - 65	—	—	None	15050	
	75 - 300	—	—	Manufacturer's Standard Asphaltic Coating: Factory Applied	—	
External Coating	10 - 65	—	—	Liquid Epoxy: Factory Applied Primer, 75-100 micron (AWWA C210), Field Applied Finish Coat per Spec. Section	15061	
	75 - 300	—	—	Manufacturer's Standard Asphaltic Coating: Factory Applied	—	
	Valves	—	—	None	—	
Fittings	10 - 65	Class 150 Sch. 40		Malleable Iron: ASTM A197, Dim. per ASME B16.3 Forged Steel: ASTM A105, Dim. per ASME B16.11		3
	75 - 300	SV	Hub & Spigot	Cast iron soil pipe (CISP): CAN/CSA-B70 (ASTM A74)	—	
Taps	All	—	—	None	—	
Weldolets / Threadolets	All	—	—	None	—	
Valves	All	—	—	None	—	
Flanges	All	—	—	None	—	
Flange gaskets	All	—	—	None	—	
FLG Bolts, nuts, and hardware	All	—	—	Carbon Steel Bolts: ASTM A307-Gr B Carbon Steel Nuts: ASTM A563-Gr A, heavy hex nuts		
Grooved Coupling	All	—	—	None	—	
Mechanical Coupling Gaskets	All	—	—	None	—	
Compression and Push-On Gasket	75 - 300	—	Hub & Spigot PO	Neoprene: ASTM C564 Neoprene or Nitrile: ASTM F477	15050	
Insulation	All	—	—	None	—	

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Buried (Includes Enshrouded and Embedded)

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	75 - 300	SV	Hub & Spigot	Cast iron soil pipe (CISP): CAN/CSA-B70 (ASTM A74)	—	—
Lining for Pipe & Fittings	75 - 300	—	—	Manufacturer's Standard Asphaltic Coating: Factory Applied		
External Coating	All	—	—	Polyethylene Encasement: Field applied, AWWA C105, Linear low-density polyethylene film or High-density cross-laminated polyethylene film	-	1,4
	Valves	—	—	None	—	
Fittings	75 - 300	SV —	Hub & Spigot PO	Cast iron soil pipe (CISP): CAN/CSA-B70 (ASTM A74) PVC: ASTM D1784-Class 12454-B, Dim. Per ASTM D3034	—	 3
Taps	All	—	—	None	—	
Weldolets / Threadolets	All	—	—	None	—	
Valves	All	—	—	None	—	
Flanges	All	—	—	None	—	
Flange gaskets	All	—	—	None	—	
FLG Bolts, nuts, and hardware	All	—	—	None	—	
Grooved Coupling	All	—	—	None	—	
Mechanical Coupling Gaskets	75 - 300	—	Mech. CPLG	Neoprene: ASTM C564	—	
Compression and Push-On Gasket	75 - 300	—	Hub & Spigot PO	Neoprene: ASTM C564 Neoprene or Nitrile: ASTM F477	15050	
Insulation	All	—	—	None	—	

PIPESPEC System 24A

Commodity	Stormwater Drainage						
Abbreviation	STW						

Test Conditions			Maximum Conditions	
Pressure (kPa)	Duration (min.)	Medium	Pressure (kPa)	Temperature (°C)
30	15	Water	15	25

General Requirements

1. External coating may be omitted for Encased Pipe.
2. Piping under structures, concrete encased pipe from the structure, and piping extended from the structure through the interface between piped commodities common to process, mechanical and yard piping, are to be either CISP or DIP, as specified.

Notes:

1. Omit polyethylene encasement for pipes installed in concrete encasement.
2. Provide unions and flange connections for piping disassembly; spacing not to exceed 6 m.
3. Provide long radius elbows.
4. Install polyethylene encasement in accordance with Method B of AWWA C105.
5. Do not use PVC for pipe beneath or within 1.5 m horizontally of buildings.
6. Mechanical couplings are not permitted for PVC pipe.
7. Not required for PVC.

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	10 - 65	Std. Wt.	SW, THD	Steel: per ASTM A53 Gr B or A106 Gr B, Seamless, galvanized, threaded per ANSI B1.20.1	15061	2
	75 - 300	SV	Hub & Spigot	Cast iron soil pipe (CISP): CAN/CSA-B70 (ASTM A74)	—	—
Lining for Pipe & Fittings	10 - 65	—	—	None	15050	
	75 - 300	—	—	Manufacturer's Standard Asphaltic Coating: Factory Applied	—	
External Coating	10 - 65	—	—	Liquid Epoxy: Factory Applied Primer, 75-100 micron (AWWA C210), Field Applied Finish Coat per Spec. Section	15061	
	75 - 300	—	—	Manufacturer's Standard Asphaltic Coating: Factory Applied	—	
	Valves	—	—	None	—	
Fittings	10 - 65	Class 150 Sch. 40		Malleable Iron: ASTM A197, Dim. per ASME B16.3 Forged Steel: ASTM A105, Dim. per ASME B16.11		3
	75 - 300	SV	Hub & Spigot	Cast iron soil pipe (CISP): CAN/CSA-B70 (ASTM A74)	—	
Taps	All	—	—	None	—	
Weldolets / Threadolets	All	—	—	None	—	
Valves	All	—	—	None	—	
Flanges	All	—	—	None	—	
Flange gaskets	All	—	—	None	—	
FLG Bolts, nuts, and hardware	All	—	—	Carbon Steel Bolts: ASTM A307-Gr B Carbon Steel Nuts: ASTM A563-Gr A, heavy hex nuts		
Grooved Coupling	All	—	—	None	—	
Mechanical Coupling Gaskets	All	—	—	None	—	
Compression and Push-On Gasket	75 - 300	—	Hub & Spigot PO	Neoprene: ASTM C564 Neoprene or Nitrile: ASTM F477	15050	
Insulation	All	—	—	None	—	

Buried (Includes Enshrouded and Embedded)

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	75 - 300	SV	Hub & Spigot	Cast iron soil pipe (CISP): CAN/CSA-B70 (ASTM A74) PVC: ASTM D1784-Class 12454-B, Dim. Per ASTM D3034.	—	5
Lining for Pipe & Fittings	75 - 300	—	—	Manufacturer's Standard Asphaltic Coating: Factory Applied		7
External Coating	All	—	—	Polyethylene Encasement: Field applied, AWWA C105, Linear low-density polyethylene film or High-density cross-laminated polyethylene film	-	1,4,7
	Valves	—	—	None	—	
Fittings	75 - 300	SV —	Hub & Spigot PO	Cast iron soil pipe (CISP): CAN/CSA-B70 (ASTM A74) PVC: ASTM D1784-Class 12454-B, Dim. Per ASTM D3034	—	3
Taps	All	—	—	None	—	
Weldolets / Threadolets	All	—	—	None	—	
Valves	All	—	—	None	—	
Flanges	All	—	—	None	—	
Flange gaskets	All	—	—	None	—	
FLG Bolts, nuts, and hardware	All	—	—	None	—	
Grooved Coupling	All	—	—	None	—	
Mechanical Coupling Gaskets	75 - 300	—	Mech. CPLG	Neoprene: ASTM C564 or CAN/CSA-B602	—	
Compression and Push-On Gasket	75 - 300	—	Hub & Spigot PO	Neoprene: ASTM C564 or CAN/CSA-B602 Neoprene or Nitrile: ASTM F477	15050	6
Insulation	All	—	—	None	—	

PIPESPEC System 32

Commodity	Fire Protection Glycol Solution						
Abbreviation	FPG						

Test conditions			**Maximum Conditions**	
Pressure (kPa)	Duration (min.)	Medium	Pressure (kPa)	Temperature (°C)
1575	120	Water	1050	20

General Requirements

1. Tapewrap all buried metallic pipe outside of building.

Notes:

1. For steel piping, provide weld neck flanges on both sides of wafer or lug body valves.
2. Bolt length per ANSI B16.5. Hex head bolt dimensions per ANSI B18.2.1. Class 2A standard coarse series threads per ANSI B1.1, standard coarse series threads. Hex nut dimensions per ANSI B18.2.2 (Heavy Hex). Class 2B standard coarse series threads per ANSI B1.1.
3. Furnish threaded adapters at connections to valves.
4. Furnish long radius elbows. Segmentally welded 3-piece elbows acceptable for 400 – 600 mm; material same as pipe, dimensions per AWWA C208.
5. Ductile iron disk with bronze trim for butterfly valves larger than 300 mm.
6. Type BF01 valve for flow control only. Wafer style body for installation between two Class 150 flanges.
7. Below structure, buried, outdoor, and submerged applications not allowed for pipe sizes 10 - 75 mm.
8. Provide stem extension and valve box.
9. Concrete surround for installation below structures.
10. Full-faced flanges mated with raised face flanges are not permitted.
11. Mating flanges to be of the same drilling pattern.
12. Insulate pipe, fittings, valves, and appurtenances that are freeze protected with electric heat tracer tape as specified in Section 15265.
13. Finish coat colour: Red per Section 09900.
14. Refer to Detailed Valve Specification Sheets in Section 15105 for valve rating.

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	**Line Size, mm**	**Rating**	**Conn./Joints**	**Material**	**Spec Section**	**Notes**
Pipe	10 - 75	Sch. 40	THD	Steel: ASTM A53 Gr B, Type E or Type S, galvanized, Dim. per B36.10	15061	7
	100 - 600	Sch. 40	RGRV	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	
Lining for Pipe & Fittings	10 - 75	—	—	Unlined	—	
	100 - 600	410 microns	—	Liquid Epoxy: Factory Applied, AWWA C210, NSF 61 certified	15061	
External Coating	All	410 microns	—	Liquid Epoxy: Factory Applied Primer, 3-4 mils (AWWA C210), Field Applied Finish Coat, per Spec. Section	09905	13
	Valves	410 microns	—	Liquid Epoxy: Factory Applied Primer, 3-4 mils (AWWA C210), Field Applied Finish Coat, per Spec. Section	—	
Fittings	10 - 75	Class 150 Sch. 40	THD	Malleable Iron: ASTM A197, galvanized, Dim. per ANSI B16.3 Forged Steel: ASTM A105, galvanized, Dim. per ANSI B16.11	15061	4,7
	100 - 600	Sch. 40	RGRV	Fabricated Steel: ASTM A234-WPB, Dim. per ANSI B16.9, ASTM A53 grooved tangents per Manufacturer dim.	15061	4
Taps	None	—	—	None	—	
Weldolets / Threadolets	None	—	—	None	—	
Manual Valves	10 - 65	—	THD	Check:CV01	15105	7, 14
	50 - 300	—	FLG	Gate: GVO5	15105	7, 14
	75 - 600	—	FLG	Check:CV12	15105	7, 14
	75 - 600	—	FLG	Gate: GVO4	15105	7, 14
Flanges	75 - 600	Class 150	LWN, WN, SO	Forged Steel: ASTM A105, FF, Dim. per ANSI B16.5	15061	1, 10, 11
Flange gaskets	75 - 250	1.6 mm	FLG	Neoprene	15050	
	250 - 600	3.2 mm	FLG	Neoprene	15050	
FLG Bolts, nuts and hardware	All	All	—	Carbon Steel Bolts: ASTM A307-Gr B Carbon Steel Nuts: ASTM A563-Gr A, heavy hex nuts	—	2
Grooved Coupling	100 - 600	—	RGRV	Rigid Grooved Coupling: ASTM A-536-65/45/12, Dim. per AWWA C606	15061	
Mechanical Coupling Gaskets	All	All	Mech. CPLG	Neoprene	15050	

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Indoor Dry, Indoor Wet, Outdoor – Exposed

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Compression and Push-On Gasket	None	—	—	None	—	
Insulation	All	FP	—	Low Temperature Class	15261	12

Buried (Includes Enshrouded and Embedded)

Component	Line Size, mm	Rating	Conn./Joints	Material	Spec Section	Notes
Pipe	100 - 600	Sch. 40 (Std. Wt.)	RGRV	Steel: ASTM A53 Gr B, Type E or Type S, Dim. per B36.10	15061	
Lining for Pipe & Fittings	100 - 600	410 microns	—	Liquid Epoxy: Factory Applied, AWWA C210, NSF 61 certified	15061	
External Coating	100 - 600	2 mm	—	Tape Wrap: Factory Applied, AWWA C209 and AWWA C214	15061	
	Valves	—	—	Coating System M-1	09905	
Fittings	10 - 75	Class 150 Sch. 40	THD	Malleable Iron: ASTM A197, galvanized, Dim. per ANSI B16.3 Forged Steel: ASTM A105, galvanized, Dim. per ANSI B16.11	15061	4
	75 - 600	Sch. 40	RGRV	Fabricated Steel: ASTM A234-WPB, Dim. per ANSI B16.9, ASTM A53 grooved tangents per Manufacturer dim.	15061	4
Taps	None	—	—	None	—	
Weldolets / Threadolets	None	—	—	None	—	
Manual Valves	10 - 65	—	THD	Check:CV01	15105	7, 14
	50 - 300	—	FLG	Gate: GVO5	15105	7, 14
	75 - 600	—	FLG	Check:CV12	15105	7, 14
	75 - 600	—	FLG	Gate: GVO4	15105	7, 14
Flanges	75 - 600	Class 150	LWN, WN, SO	Forged Steel: ASTM A105, FF, Dim. per ANSI B16.5	15061	1, 10, 11
Flange gaskets	75 - 250	1.6 mm	FLG	Neoprene	15050	
	250 - 600	3.2 mm	FLG	Neoprene	15050	

DETAILED BUILDING MECHANICAL PIPING SPECIFICATION SHEETS

Buried (Includes Enshrouded and Embedded)

Component	**Line Size, mm**	**Rating**	**Conn./Joints**	**Material**	**Spec Section**	**Notes**
FLG Bolts, nuts and hardware	All	All	—	Non-Corrosive, High-Strength, Low-Alloy Steel Bolts: ASTM A 449- Gr 3, Class C or Class D, having the metallurgy specified in ANSI/AWWA C111/A21.11, regardless of any protective coating Carbon Steel Bolts: ASTM A307-Gr B with Xlyan fluoropolymer coating, Tripac 2000 Blue Carbon Steel Nuts: ASTM A563-Gr A with Xlyan fluoropolymer coating, Tripac 2000 Blue	—	2
Grooved Coupling	100 - 600	—	RGRV	Rigid Grooved Coupling: ASTM A-536-65/45/12, Dim. per AWWA C606	15061	
Mechanical Coupling Gaskets	All	All	Mech. CPLG	Neoprene.	15050	
Compression and Push-On Gasket	None	—	—	None	—	
Insulation	All	—	—	None	----	

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of steel pipe and fittings.

1.2 Standards

.1 American National Standards Institute (ANSI):

  .1 ANSI B16.3 – Malleable Iron Threaded Fittings, Class 150 and 300.

  .2 ANSI B16.9 – Factory-Made Wrought Steel Buttwelding Fittings.

  .3 ANSI B16.11 – Forged Steel Fittings, Socket-Welding and Threaded.

.2 American Society for Testing and Materials (ASTM):

  .1 ASTM A36/A36M – Structural Steel.

  .2 ASTM A47 – Ferritic Malleable Iron Castings.

  .3 ASTM A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

  .4 ASTM A105/A105M – Forgings, Carbon Steel, for Piping Components.

  .5 ASTM A106 – Seamless Carbon Steel Pipe for High-Temperature Service.

  .6 ASTM A197 – Cupola Malleable Iron.

  .7 ASTM A234/A234M – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

  .8 ASTM A283/A283M – Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.

  .9 ASTM A536 – Ductile Iron Castings.

  .10 ASTM A570/A570M – Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.

  .11 ASTM A572/A572M – High Strength Low Alloy Columbium-Vanadium Steels of Structural Quality.

.3 American Water Works Association (AWWA):

  .1 AWWA C200 – Steel Water Pipe 6 Inches (150 mm) and Larger.

  .2 AWWA C205 – Cement-Mortar Protective Lining and Coating for Steel Water Pipe, DN100 mm and Larger, Shop Applied.

.3 AWWA C206 – Field Welding of Steel Water Pipe.

.4 AWWA C207 – Steel Pipe Flanges for Waterworks Services--Sizes 4 In. Through 144 In. (100 mm Through 3600 mm).

.5 AWWA C208 – Dimensions for Fabricated Steel Water Pipe Fittings.

.6 AWWA C209 – Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines.

.7 AWWA C210 – Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe.

.8 AWWA C213 – Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe.

.9 AWWA C214 – Tape Coating Systems for the Exterior of Steel Water Pipelines.

.10 AWWA C218 – Liquid Coating Systems for the Exterior of Aboveground Steel Water Pipelines and Fittings.

.11 AWWA C222 – Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.

.12 AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.

.13 AWWA C606 – Grooved and Shouldered Joints.

.14 AWWA M11 – Steel Pipe, a Guide for Design and Installation.

.4 The Society for Protective Coatings (SSPC):

.1 SSPC-SP10 – Near-White Blast Cleaning.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Indicate on the submittal each product to be used on PIPESPEC System.

.3 Submit certified letter of compliance documenting compliance with AWWA C200, ASTM A53, and ASTM A106 as applicable.

2. PRODUCTS

2.1 Materials and Products

.1 All pipe system materials to be new, free from defects and conforming to the requirements and standards identified in Section 15055 and related Sections.

.2 Pipe:

.1 Fabricate to sizes, dimensions, and shapes indicated.

.2 Sizes, Pipe, Fittings and Specials:

.1 300 mm and smaller: Nominal.

.2 350 mm thru 600 mm: Actual outside diameter.

.3 750 mm and larger: Nominal size to be I.D. after lining.

.3 Seams:

.1 Except for seamless mill type pipe, provide piping fabricated from steel plates rolled into cylinders or sections thereof with longitudinal seams or spiral seams butt welded.

.2 Do not use more than two longitudinal seams in piping 1800 mm and smaller in size.

.3 Butt weld girth seams at least 2 m apart, except in specials and fittings.

.4 Steel pipe 250 mm to 600 mm: ASTM A53 Type E or S, Grade B, Black.

Nominal Pipe Size, mm	**Minimum Wall Thickness, mm**
250	6.35 (SCH 20)
300	6.35 (SCH 20)
350	6.35 (SCH 10)
400	6.35 (SCH 10)
450	6.35 (SCH 10)
600	6.35 (SCH 10)

.5 Steel Pipe 750 mm diameter and larger: AWWA C200.

Nominal Pipe Size, mm	Minimum Wall Thickness, mm Interior Piping	Minimum Wall Thickness, mm Buried Piping
700	6.35	3.40
750	6.35	3.40
800	6.35	3.96
900	6.35	3.96
1000	6.35	4.60
1050	6.35	4.60
1200	6.35	5.23
1350	7.92	5.87
1500	7.92	6.50
1650	9.52	7.16
1800	9.52	7.82
2100	12.7	9.09
2250	12.7	9.73
2400	12.7	10.4
2550	12.7	11.0
2700	12.7	11.6
2850	12.7	12.3
3000	12.7	12.9

.6 Interior piping wall thickness: Increase wall thickness to limit combined stress (circumferential, longitudinal and localized) to 75 percent of the minimum yield of the steel used.

.3 Fittings:

.1 Fabricate in accordance with AWWA C208.

.2 Provide elbows with the following radius:

.1 Interior and Exposed Piping: 1.50 times the nominal diameter.

.2 Buried Piping: 2.50 times nominal diameter, unless otherwise indicated or specified.

.3 Provide elbows in accordance with the following:

Angle, degrees	Segments
0 to 22.50	2
23 to 45	3
46 to 67.50	4
68 to 90	5

.3 Provide reinforced tees, laterals, and outlets in accordance with ASME Pressure Vessel Code, Section VIII, Paragraph UG-37 or AWWA M-11, Chapter 13.

.4 Provide reducing sections with same shell thicknesses required for larger ends.

.5 Special Sections:

.1 Provide fittings and special sections with ends as indicated and fabricated to shapes, sizes, and dimensions indicated.

.6 Small Branch Connections:

.1 Provide branch connections 65 mm and smaller fabricated with welding fittings with threaded outlets.

.2 Provide branch connections 80 mm through 300 mm fabricated with pipe nipples or with welding fittings.

.3 Provide pipe nipples and welding fittings welded to pipe shell and reinforced to meet working and test pressure requirements.

.4 Provide pipe nipples of black steel pipe in accordance with ASTM A53 Type E or S Grade B, minimum thicknesses as listed in the above table.

.5 Provide threaded and welded outlets as indicated.

.6 Install small-branch connections so as not to interfere with joints, supports, or other details.

.7 Small Branch Connections:

.1 Provide fittings shop fabricated from previously hydrostatically tested straight pipe with magnetic particle non-destructive testing of all welds that were not previously tested in the straight pipe.

.4 Pipe Lining: Furnish pipe with lining as specified in PIPESPEC System Sheets in Section 15055.

.1 Epoxy Lining:

.1 Line pipe and fittings with a liquid epoxy as specified in AWWA C210.

.2 Do not incorporate coal tar products into the liquid epoxy.

.3 Apply to a minimum thickness of 410 microns in not less than two (2) coats.

.4 Patch field welds, connections and damaged lining in accordance with AWWA C210.

.2 Cement Mortar Lining:

.1 Line pipe and fittings with cement mortar as specified in AWWA C205.

.2 Fittings and specials larger than 600 mm, not fabricated from centrifugally lined straight sections, require 50 mm by 100 mm by 13 gauge self-furring wire mesh reinforcement for hand applied lining.

.3 Patch field welds, connections and damaged lining in accordance with AWWA C205.

.3 High-Temperature Service Epoxy Lining:

.1 Steel pipe and fittings: epoxy lined with not less than 260 microns of epoxy suitable for temperatures of 107°C.

.2 Prepare surfaces in accordance with SSPC SP 10 Near White Blast Cleaning, and apply lining as recommended by the Manufacturer.

.3 Acceptable Products:

.1 3M, Scotchkote 306.

.2 Porter, MCR 65 High Solids Epoxy.

.3 Or approved equivalent.

.4 Glass Lining:

.1 Glass Lining: Vitreous material that is smooth, continuous and formulated to prevent the adherence of grease, scum and crystalline metal salt deposits in sludge, scum and related process piping systems in wastewater and sewage treatment systems.

.2 Provide lining consisting of two (2) coats, separately applied and separately fired at a maturing temperature of approximately 760°C creating a molecular bond with the base metal and a total minimum lining thickness of 8-10 mils.

.3 Lining minimum hardness: 5 to 6 on the Mohs scale.

.4 Provide lining capable of withstanding an instantaneous thermal shock of 176°C differential without crazing, blistering or spalling.

.5 Provide lining capable of withstanding a strain of 0.025 mm/mm, the yield point of the base metal, without damage to the glass lining.

.6 Provide lining resistant to corrosion of between pH 3 to 10.

.7 Testing Procedure: In accordance with industry standards “MP-9.2.1-Industry Continuity Test Procedures-Porcelain Enamel (Glass) Lined Pipe and Fittings”.

.8 The following criteria represents non-visible pinholes detectable by low voltage spark test only. Any pinholes that are visible to the naked eye and expose the base metal shall not be permitted:

Diameter	Pinholes/Fitting	Pinholes/6 m Pipe
200 mm & smaller	3 to 5	10 to 12
250 to 450 mm	5 to 8	18 to 20
500 mm & larger	8 to 10	25 to 28

.9 Factory test all pipe and fittings, with certified copies of the test results accompanying each shipment.

.10 Provide documents identifying each individual item by mark number and description, the quality control sequence number, date tested, inspector, and the number of pinholes detected per item.

.11 Factory test all pipe and fittings for pinholes by the Manufacturer, with certified copies of the test results accompanying each shipment. These documents are to identify each individual item by mark number and description, the quality control sequence number, date tested, inspector, and number of pinholes detected per item. Upon request by the engineer, the Manufacturer is to perform random jobsite test verification.

.12 Acceptable Manufacturers:

.1 Custom-Fab.

.2 Or approved equivalent.

.5 Polyurethane Lining:

.1 Line pipe and fittings with polyurethane as specified in AWWA C222.

.2 Patch field welds, connections and damaged lining in accordance with AWWA C222.

.3 Acceptable Products:

.1 Lifelast Durashield 210.

.2 Or approved equivalent.

.5 Pipe Coating: Furnish pipe with coating as specified in Piping System Specification Sheets in Section 15055.

.1 Epoxy Coating:

.1 Line pipe and fittings with a liquid epoxy as specified in AWWA C210.

.2 Do not incorporate coal tar products into the liquid epoxy.

.3 Apply coating to a minimum thickness of 406 microns in not less than two (2) coats.

.4 Patch field welds, connections and damage in accordance with AWWA C210.

.2 Polyethylene Tape Coating:

.1 Coat and wrap pipe and fittings with prefabricated multilayer cold applied polyethylene tape coating in accordance with AWWA C209 and AWWA C214.

.2 Apply coating in a continuous step operation in conformance with AWWA C214, Section 3.

.3 The total coating thickness: not less than 1275 microns for pipe 600 mm and smaller and not less than 2030 microns for pipe 650 mm and larger.

.4 Patch field welds, connections and damage in accordance with AWWA C209 and AWWA C214.

.3 Polyurethane Coating:

.1 Coat pipe and fittings with polyurethane as specified in AWWA C222.

.2 Patch field welds, connections and damaged coating in accordance with AWWA C222.

.3 Acceptable Products:

.1 Lifelast Durashield 210.

.2 Or approved equivalent.

.4 Three Coat Zinc Epoxy Urethane Coating:

.1 Coat pipe and fittings with a liquid epoxy as specified in AWWA C218.

.2 Patch field welds, connections and damaged coating in accordance with AWWA C218.

.5 Cement Mortar Coating:

.1 Coat pipe and fittings with cement mortar as specified in AWWA C205.

.2 Patch field welds, connections and damaged coating in accordance with AWWA C205.

.6 Fusion Bonded Epoxy Coating and Lining:

.1 Line and coat per AWWA C213.

.2 NSF 61 certified.

.3 Application Method: fluidized bed method, attaining 12 mils minimum dry film thickness.

.4 Surface Preparation: in accordance with SSPC SP-10 Near-White Blast Cleaning.

.5 Patch field welds, connections and damaged areas according to the Manufacturer's instructions with 3M Scotchkote 306 and AWWA C213.

.6 Acceptable Manufacturers:

.1 3M Scotchkote 206N.

.2 Or approved equivalent.

.6 Steel Fittings:

.1 Furnish straight tapered reducers. Flanged & flued reducers and bushing type adapters are not permitted.

.2 Grooved Couplings and Fittings:

.1 When pipe wall thickness does not meet the minimum requirements of AWWA C606 for rolled or cut groove joints, shoulder ends per the requirements of AWWA C606 are to be used.

.2 Acceptable Manufacturers:

.1 Victaulic.

.2 Or approved equivalent.

.3 Bolted Split Sleeve Couplings:

.1 AWWA C227 compliant sleeve with single or double arch cross section of the same material with a body thickness equal to or greater than that of connecting pipe wall thickness.

.2 Acceptable Products:

.1 Victaulic, Style 231 through 234.

.2 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Use couplings and prefabrication of pipe systems at the factory to minimize field welding to the greatest extent possible. Pipe butt welds may be performed at the job site provided the welding requirements are rigidly adhered to.

.4 Install pipe in accordance with AWWA M11, Chapter 16.

.5 Field welding:

.1 Where space permits, provide double-groove (double-vee) circumferential welds. Where impractical, provide single-groove (singe-vee) circumferential welds. If backing rings are used, completely remove them after welding is complete and deburr, grind, and clean the area per AWWA C206.

.2 Weld 150 mm diameter and larger pipe joints in accordance with AWWA C206.

.3 Weld pipe smaller than 150 mm in diameter in accordance with Section IX of the ASME BPVC.

.4 Apply pipe lining and coatings at field joints as specified in this Section.

.5 Field coat buried mechanical couplings and valves as specified in Section 15050.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation, testing and commissioning of polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) pipe and fittings.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

  .1 ASME B31.3 - Process Piping.

.2 American Society for Testing and Materials (ASTM):

  .1 ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

  .2 ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

  .3 ASTM D2464 - Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

  .4 ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

  .5 ASTM D2467 - Socket Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

  .6 ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

  .7 ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

  .8 ASTM F402 - Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings.

  .9 ASTM F437 - Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

  .10 ASTM F438 - Socket Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

  .11 ASTM F439 - Socket Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

  .12 ASTM F441 - Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

  .13 ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

.14 ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

.15 ASTM F656 - Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 IPEX Guardian Centra-Lok system.

.2 Asahi.

.3 Fabco Plastics.

.4 Or approved equivalent.

2.2 Materials

.1 Furnish materials for PVC and CPVC piping systems as specified in Section 15055 and the specified process commodity.

2.3 Configuration, Components and Features

.1 PVC Pipe and Fittings:

.1 Schedule 80.

.2 Material: Type I, Grade I PVC compound with a Cell Classification of 12454 per ASTM D1784.

.3 Provide pipe and fittings manufactured in compliance to ASTM D1785 meeting and/or exceeding the quality assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

.4 Provide pipe and fittings manufactured in Canada or the United States, using domestic materials, by an ISO 9002 certified Manufacturer. Store all pipe indoors after production at the manufacturing site until shipped from factory.

.5 Provide standard lengths of pipe sizes 250 mm and larger beveled each end by the pipe Manufacturer.

.6 Provide pipe and fittings with the National Sanitation Foundation (NSF) seal of approval for potable water applications.

.7 Joining:

.1 Solvent cementing process.

.2 Provide flanges at valves, pumps and equipment only or as indicated and specified.

.3 Provide Type 316 stainless steel flange bolting and hardware for all piping systems except sodium hypochorite use titanium.

.2 CPVC Pipe and Fittings:

.1 Material: Type IV, Grade I CPVC compound with a Cell Classification of 23447 per ASTM D1784.

.2 Provide pipe and fittings manufactured in compliance to ASTM F441 meeting the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

.3 Provide pipe and fittings produced in the United States using domestic materials, by an ISO 9002 certified Manufacturer, and store indoors after production, at the manufacturing site, until shipped from factory.

.4 Provide pipe and fittings with the NSF seal of approval for potable water applications.

.5 Joining:

.1 Solvent cementing process.

.2 Use only Weld-On 724 for all sodium hypochlorite services.

.3 Provide flanges at valves, pumps and equipment unless otherwise indicated in the Final Design.

.4 Threaded connections are not permitted.

.5 Provide Type 316 stainless steel flange bolting and hardware for all piping system except sodium hypochorite. For sodium hypochlorite use titanium.

.3 PVC Clear Pipe and Fittings:

.1 Schedule 80 clear pipe.

.2 Material: Type I, Grade I PVC compound with a Cell Classification of 12454 per ASTM D1784.

.3 Provide pipe and fittings manufactured in compliance to ASTM D1785, consistently meeting and/or exceeding the applicable Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

.4 Provide pipe and fittings manufactured in the United States by an ISO 9002 certified Manufacturer.

.5 Provide all clear PVC pipe and fittings packaged immediately after its manufacture to prevent damage and stored indoors at the manufacturing site until shipped from factory.

.6 Joining:

.1 Solvent cementing process. Use a clear, medium-bodied, fast-setting cement in conjunction with a clear primer for optimum joint integrity.

.1 Acceptable Products:

.1 IPS Weld-on 705 Clear Cement.

.2 IPS Weld-On P-70 Clear Primer.

.3 Or approved equivalent.

.7 Clear female threaded transition fittings, incorporating a Type 316 stainless steel retaining ring. Provide all threaded joints with three wraps of tape in the direction of the threads on the male end, followed by one to two turns beyond finger tight.

.8 Standard rigid thermoplastic pipe fittings with flanges molded grooved coupling adapters and unions.

.9 Provide Type 316 stainless steel flange bolting and hardware for all piping system except sodium hypochorite use titanium.

.4 CPVC Solvent Weld Cement:

.1 150 mm and less in diameter.

.1 Acceptable Products:

.1 IPS 724 Weld-on Cement.

.2 Or approved equivalent.

.2 Greater than 150 mm in diameter:

.1 Acceptable Products:

.1 IPS 729 Weld-on Cement.

.2 Or approved equivalent.

.3 Heavy bodied, medium setting.

.4 ASTM F493, 100 percent solvent and CPVC resin. No fillers permitted.

.5 Universal plastic pipe solvent is not permitted.

.6 Formulate plastic pipe solvent for use with sodium hypochlorite or other chemical solutions as required for the Final Design.

.5 PVC Solvent Weld Cement:

.1 300 mm and less in diameter:

.1 Acceptable Product:

.1 IPS 711 Weld-on Cement.

.2 Or approved equivalent.

.2 Greater than 300 mm in diameter:

.1 Acceptable Product:

.1 IPS 719 Weld-on Cement.

.2 Or approved equivalent.

.3 Heavy bodied, medium setting.

.4 ASTM 2564, 100 percent solvent and PVC resin. No fillers permitted.

.5 Universal plastic pipe solvent is not permitted.

.6 Primer:

.1 Staining solvent conforming to standard ASTM F656.

.2 Manufactured by solvent weld cement Manufacturer.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Plastic pipe installation personnel to be trained to standard ASME B31.3.

3.2 Equipment Checkout

.1 Complete the following additional Equipment Checkout activities:

  .1 Pneumatic Test:

    .1 Medium: Instrument grade air or nitrogen.

    .2 Test pressure shall be the greater of:

      .1 35 kPa maximum.

      .2 As indicated in the Final Design and Construction Specifications.

      .3 As required for the Final Design with a safety factor of 2 times.

    .3 Duration: Two (2) hours.

    .4 Maximum allowable pressure drop: 0.7 kPa over two (2) hours.

    .5 As specified in Section 15050 for pneumatic pressure testing.

END OF SECTION

HIGH DENSITY POLYETHYLENE SDR PIPE

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation, testing and commissioning of heat fusible, uniform solid wall, HDPE pipe, fittings, and appurtenances. This section expressly excludes HDPE profile pipe.

1.2 Standards

.1 American Water Works Association (AWWA):

.1 AWWA M-55 - PE Pipe – Design and Installation.

.2 ANSI/AWWA C110/A21.10 - American National Standard for Ductile Iron and Gray-Iron Fittings, 3-inch through 48-inch, for water and other liquids.

.3 ANSI/AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM D1238 - Flow Rates of Thermoplastics by Extrusion Plastomer.

.2 ASTM D2122 - Determining Dimension of Thermoplastic Pipe and Fittings.

.3 ASTM D2321 - Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

.4 ASTM D2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

.5 ASTM D2657 - Heat Joining Polyolefin Pipe and Fittings.

.6 ASTM D2774 - Underground Installation of Thermoplastic Pressure Piping.

.7 ASTM D3261 - Butt Heat Fusion Polyethylene Plastic Fittings for PE Plastic Pipe and Tubing.

.8 ASTM D3350 - Polyethylene Plastics Pipe and Fitting Materials.

.9 ASTM F1055 - Electrofusion Type Polyethylene Fittings for OD Controlled PE Pipe and Fittings.

.10 ASTM F 1473 - Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins.

.11 ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe.

.12 ASTM F2164 - Standard Practice for Field Leak Testing of Polyethylene Pressure Piping Systems Using Hydrostatic Pressure.

.13 ASTM F714 REVA - Standard Specifications for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

.3 Plastics Pipe Institute (PPI):

.1 PPI - Polyethylene Pipe Handbook.

.2 PPI TN-38 - Bolt Torque for Polyethylene Flanged Joints.

.3 PPI TR-4 - HDB/HDS/SDB/PDB/MRS Listed Materials.

.4 PPI TR-21 - Thermal Expansion and Contraction in Plastic Pipe Systems.

.5 PPI TR 31 - Underground Installation of Polyolefin Piping.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Certified letter from a qualified professional verifying compliance of pipe materials furnished for the Project with AWWA C901 and/or AWWA C906, as appropriate for the pipe material specified in Section 15055.

.3 Qualifications of the certified fusion technician.

.4 Certified copies of test reports with each delivery documenting compliance with ASTM F714 and ASTM D3350, as appropriate.

.5 Records of each field butt-fusion joint installation, as specified in this section.

.6 Submit certified letter of compliance (as specified in AWWA C901 and AWWA C906) documenting compliance with materials verification as specified in AWWA C901 and/or AWWA C906, as appropriate for the pipe material specified in Section 15055.

2. PRODUCTS

2.1 Materials and Products

.1 Fittings:

.1 Provide sweep bends for long radius bends that are DN 350 or smaller. Bend radius three (3) times the nominal pipe size, measured to the centreline of the bend.

.1 Acceptable Products:

.1 ARCTM by Pipestar International.

.2 Or approved equivalent.

.2 Increase wall thickness to next nominal pressure rating (next lower SDR) for mitered bends and fabricated fittings. Two (2) miter segments minimum for deflections of 45 degrees or less. Four (4) miter segments minimum for deflections greater than 45 degrees.

.2 Flange Ends:

.1 HDPE stub end flange adapter and back up ring.

.2 Furnish beveled flange adapters for disk clearance on connections to butterfly valves.

.3 Furnished stub end flange adapters with concentric ring convolutions on the flange face. Furnish stub end flange adapters with a radius or chamfer outer diameter transition from pipe wall to stub end.

.4 Chamfer or radius flange ring bore to match transition on stub end flange adapter.

.5 Ductile iron back up rings encapsulated in polypropylene or CF8 (304) stainless steel back up rings:

.1 Acceptable Products:

.1 Improved Piping Products – PPDI.

.2 Improved Piping Products - SS-SDR.

.3 Or approved equivalent.

.2 Hardware: Type 316 stainless steel.

.3 Pipe Colour:

.1 Black.

.2 Where specified in Section 15055, provide three (3) longitudinal colour stripes equally spaced around the circumference of the pipe. Stripe colour as specified in Section 15055.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install piping system in accordance with ASTM D2321, AWWA C901 or AWWA C906 and pipe Manufacturer's recommendations.

.4 Field welding by butt fusion and/or electrofusion shall be performed by factory trained and certified fusion technician.

.5 Joining:

.1 Join pipe and fittings into continuous lengths at the job site, above ground.

.2 Butt-fusion welded, unless otherwise specified in this Section or Section 15055. Butt fusion welds in accordance with the pipe Manufacturer's recommendations and ASTM D2657.

.3 Fusion equipment, temperature, interface pressure, and cooling time in accordance with Manufacturer's requirements.

.4 Record date, time, joint number, operator identification, fusion machine make and model, pipe size and SDR, interfacial pressure during fusion and cooling, and fusion temperature of each butt fusion joint using McElroy datalogger or equal.

.5 Butt fusion joint strength shall exceed tensile strength of pipe.

.6 Extrusion welding and hot gas welding shall not be permitted.

.7 Pipe joints shall be by factory trained and certified fusion technicians.

.8 Provide flange joints for connections to different pipe materials, equipment, valves, and other appurtenances unless otherwise specified in the Final Design.

.9 Install electrofusion welds where required for closures and joining HDPE to fixed/installed HDPE pipe or as required by the Final Design. Electrofusion welds shall be in accordance with Manufacturer's instructions and ASTM F1055.

.6 Bedding and Backfill:

.1 Bedding and backfill per the requirements of the Final Design.

.2 Place materials by methods that do not disturb or damage the pipe.

.3 Allow the temperature of HDPE pipe to equalize to the ambient air temperature prior to backfilling and compaction.

.4 Work in and tamp the bedding material in the area under the pipe and up to the spring line before placing and compacting the remainder of the embedment.

.5 Blocking under the pipe shall be prohibited.

.6 Place sufficient backfill to prevent damage, excessive deflections, or other disturbances of the pipe before using heavy compaction or construction equipment directly over the pipe.

.7 Control flotation of pipe when backfilling with flowable materials. Provide sufficient pipe weight, anchor blocks, fill with water, or backfill in lifts.

3.2 Installation (Exposed)

.1 Install piping system in accordance with Chapter 8 of the Plastic Pipe Institute *PE Handbook*, ASTM F2620, AWWA C901 or AWWA C906, and the Manufacturer's recommendations.

.2 Joining:

.1 Join pipe and fittings into continuous lengths at the site.

.2 Butt-fusion welded or flanged, unless otherwise specified in this Section or Section 15055. Butt fusion welds in accordance with the pipe Manufacturer's recommendations and ASTM D2657.

.3 Fusion equipment, temperature, interface pressure, and cooling time in accordance with Manufacturer's requirements.

.4 Record date, time, joint number, operator identification, fusion machine make and model, pipe size and SDR, interfacial pressure during fusion and cooling, and fusion temperature of each butt fusion joint using McElroy datalogger or equal.

.5 Butt fusion joint strength shall exceed tensile strength of pipe.

.6 Extrusion welding and hot gas welding shall not be permitted.

.7 Pipe joints shall be by factory trained and certified fusion technicians.

.8 Provide flange joints for connections to different pipe materials, equipment, valves, and other appurtenances unless otherwise specified on the Final Design.

.9 Install electrofusion welds where required for closures and joining HDPE to fixed/installed HDPE pipe or as required by the Final Design. Electrofusion welds shall be in accordance with Manufacturer's instructions and ASTM F1055.

.10 Install couplings for pipeline disassembly where specified in Section 15055 or as required for the Final Design.

.1 Acceptable Products:

.1 Victaulic Style 995.

.2 Or approved equivalent.

.3 Pipe Support:

.1 Pipe supports shall meet the requirements set out in Section 15096.

.2 Accommodate thermal expansion and contraction movement.

.3 Pipe shall be supported at intervals of 2.5 m or less.

.4 Provide pipe cradles supporting the bottom 120 degrees of pipe circumference.

.5 Cradle length (measured parallel to pipe axis) shall not be less than half of the pipe's outside diameter.

.6 Edges of pipe cradles shall be rounded or rolled to prevent cutting or gouging pipe.

.4 Pressure Testing:

.1 Pressure test pipe per Section 15050.

.2 Perform pressure testing prior to concrete encasement or backfilling of buried pipe.

.3 Retest following repair of leaks.

.4 Apply initial pressure without makeup pressure for one (1) to (2) two hours to allow for diametric expansion or pipe stretching to stabilize.

.5 After the equilibrium period, return the test section to the test pressure.

.6 Makeup water quantities during the pressure test per the Plastic Pipe Institute Technical Report TR 31-88. No visual leaks or pressure drops shall be permitted during the final test period.

.5 Deflection Testing for Buried Pipe:

.1 Perform deflection testing for the entire length of buried pipe, where specified in Section 15055.

.2 Deflection testing shall be performed not less than thirty (30) days after completion of any work adjacent to and over the pipeline, including leakage tests, filling, backfilling, grading, paving, concreting, and any other superimposed loads.

.3 Maximum permissible pipe deflection: 4.0 percent of the average inside diameter of the pipe.

.4 Deflection testing device shall be capable of detecting pipe internal dimensions to within 1 percent of the average internal diameter of the specified pipe dimensions.

.5 Remove, replace, and retest pipe sections that fail the deflection testing.

END OF SECTION

COPPER PIPE AND FITTINGS

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation, testing and commissioning of copper pipe, tube, and fittings.

1.2 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

- .1 Manufacturer's descriptive literature for materials.

1.3 Standards

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

- .1 ASTM B32 - Standard Specification for Solder Metal.
- .2 ASTM B75 - Standard Specification for Seamless Copper Tube.
- .3 ASTM B88 - Standard Specification for Seamless Copper Water Tube (Metric).
- .4 ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
- .5 ASTM A536 - Standard Specification for Ductile Iron Castings.
- .6 ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

.2 American Society of Mechanical Engineers (ASME):

- .1 ASME B16.15 - Cast Bronze Threaded Fittings.
- .2 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.3 American National Standards Institute (ANSI):

- .1 ANSI/NSF 61 - Drinking Water System Components – Health Effects.

2. PRODUCTS

2.1 Materials and Products

.1 Pipe:

- .1 Seamless, ASTM B88.

.2 All materials to meet ANSI/NSF 61.

.3 Type:

.1 Provide Type L within buildings.

.2 Provide Type K for buried service.

.4 Joints: Soldered, flared or grooved joints, as indicated.

.1 Solder: 95 percent tin, 5 percent antimony.

.2 Cored solder is not permitted.

.5 All pipe system materials shall be new, free from defects and conforming to the requirements and standards identified in Section 15055 and this Section.

.2 Fittings:

.1 Wrought Copper, Socket-Type, ASTM B75, ASME B16.22 Standard.

.2 Grooved-End Fittings: ASME B16.22 wrought copper and ASME B16.18 bronze casting.

.1 Acceptable Products:

.1 Victaulic Copper-Connection.

.2 Or approved equivalent.

.3 Provide ends manufactured to copper-tubing dimensions. Flaring tube or fitting ends to accommodate alternate sized couplings is not permitted.

.4 Threaded adapters, bronze ASTM B62, Class 150.

.5 Threaded, ASME B16.15 Standard.

.6 Unions bronze ASTM B62, Class 125 with ground joint seats.

.7 Grooved Joint Couplings: Provide couplings consisting of two ductile iron housing segments to ASTM A536 cast with offsetting angle-pattern bolt pads to provide joint rigidity, pressure responsive grade EHP gasket, suitable for water service to 121°C, and zinc electroplated steel bolts and nuts to ASTM A449. Provide installation ready couplings for direct stab installation without field disassembly.

.1 Acceptable Products:

.1 Victaulic Style 607H.

.2 Or approved equivalent.

.8 Double ferrule compression fittings capable of holding the full bursting strength of connected tubing.

.1 Acceptable Manufacturers:

.1 Swagelok.

.2 Gyrolok.

.3 Or approved equivalent.

.9 Provide tapered piping reducers. Bushing type adapters shall not be permitted.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Use ASTM B32, Alloy Grade Sn95 solder in copper piping.

.1 Acceptable Product:

.2 Silvabrite 100.

.3 Or approved equivalent.

.4 Provide dielectric protection.

.5 Copper tubing or fittings are not permitted to come in contact with steel piping, reinforcing steel, or other steel at any location.

.6 Electrical checks shall be made to confirm no contact is made between copper tubing and steel elements.

.7 Wherever electrical contact is demonstrated by such tests, provide dielectric protection.

END OF SECTION

STAINLESS STEEL PIPE AND FITTINGS

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation, testing and commissioning of stainless steel pipe and fittings.

1.2 Standards

.1 American National Standards Institute (ANSI):

   .1 ANSI B31.3 - Process Piping.

.1 American Society of Mechanical Engineers (ASME):

   .1 ASME Section IX - Boiler and Pressure Vessel Code; Welding and Brazing Qualifications.

.2 American Water Works Association (AWWA):

   .1 AWWA M11 - Steel Water Pipe: A Guide for Design and Installation.

   .2 AWWA C227 - Bolted, Split-Sleeve Restrained and Non-restrained Couplings for Plain-End Pipe.

   .3 AWWA C606 - Grooved and Shouldered Joints.

.3 Canadian Standards Association (CSA):

   .1 CSA W48.3 - Low Alloy Steel Covered Electrodes for Shielded Metal Arc Welding.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

   .1 Manufacturer's descriptive literature for materials.

   .2 Calculations for fabricated fittings documenting the adequacy of any required reinforcement. Calculations shall be in accordance with the procedures presented in AWWA M11.

   .3 Submit calculations for engineered flange face rings in accordance with Appendix D of ASME Section VIII Division 1.

2. PRODUCTS

2.1 Materials

.1 All pipe system materials to be new, free from defects and conforming to the requirements and standards specified in Section 15055 and this Section.

.2 Double ferrule compression fittings:

.1 Acceptable Manufacturers:

.1 Swagelok.

.2 Gyrolok.

.3 Or approved equivalent.

.3 Shop-fabricated stainless steel pipe and fittings.

.1 All shop-fabricated stainless steel pipe and fittings shall be furnished by a single manufacturer who is experienced and qualified in the manufacture and fabrication of the items to be provided.

.2 Manufacture using weld procedure specifications that have been qualified under ASME Section IX. Document qualifications in procedure qualification reports. Use only certified welders who have successfully completed performance qualification tests per ASME Section IX for manufacture of stainless steel pipe.

.4 Pipe:

.1 For shop-fabricated pipe, use only pickled and annealed sheet or plate.

.5 Flanges:

.1 Furnish ductile iron backing flanges with the following thicknesses or greater.

Flange Size, mm	Flange Thickness, mm
75	12.7
100	14.3
150 thru 250	15.9
300 thru 400	19.0
450 thru 550	22.2
600 thru 750	25.4
900	28.6
1050	31.8
1,150 to 1,350	34.9
1,500	38.1

.2 Slip-on rolled angle face rings:

.1 Use with backing flange as specified in individual piping system sheets in Section 15055.

.2 The nominal thickness of the rolled angle shall be equal to or greater than that of the pipe or fitting to which it is welded.

.3 The gasket mating surface shall be clean, free of debris, with welds ground flush and is to have a surface roughness between 3.18 and 12.7 microns RMS.

.4 The rolled angle shall be continuously welded to the pipe or fitting on both ends of the rolled angle with a minimum fillet weld thickness equal to half the thickness of the pipe or fitting wall thickness.

.5 The angle leg shall not interfere with the flange bolt holes.

.3 Engineered face rings:

.1 Use with loose backing flange as specified in individual piping system sheets in Section 15055.

.2 Design to meet the requirements of Mandatory Appendix 2 of the ASME Section VIII Division 1, Boiler and Pressure Vessel Code.

.6 Fittings:

.1 All fittings shall be tested and conform to the industry standards listed in the individual pipe systems listed in Section 15055.

.2 Double ferrule compression fittings shall be capable of holding the full bursting pressure of connected tubing.

.3 Furnish straight tapered reducers. Flanged and flued reducers and bushing type adapters shall not be permitted.

.4 Pressure rating and thickness of elbows, tees, crosses, and wyes shall be equal to or greater than those of the connecting pipe.

.7 Grooved Couplings and Fittings:

.1 Flexible and rigid coupling with pipe grooves compliant with AWWA C606.

.2 When pipe wall thickness does not meet the minimum requirements of AWWA C606 for cut groove joints, shoulder ends in accordance with AWWA C606 shall be used.

.3 Stainless steel fasteners of the same material grade as the specified coupling.

.4 Acceptable Manufacturers:

.1 Victaulic.

.2 Or approved equivalent.

.8 Bolted Split Sleeve Couplings:

.1 AWWA C227 compliant sleeve with single or double arch cross section of the same material. Body thickness shall be equal to or greater than that of connecting pipe wall thickness.

.2 Provide bolts, nuts and hardware of the same stainless steel grade as the coupling body.

.3 Acceptable Products:

.1 Victaulic, Style 231S through 234S.

.2 Or approved equivalent.

.9 Finish:

.1 8-gauge through 16-gauge material: No. 1 or 2B per ASTM A480.

.2 4.76 mm and heavier plate material: No. 1 mill finish per ASTM A480, Hot-Rolled or Cold-Rolled, and Annealed or Heat Treated, and Blast Cleaned or Pickled.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Metal Forming Processes:

.1 Use pinch rolls with a hard chrome finish to form cylinders. Thoroughly clean the rolls using Avesta BlueOneTM 130 Pickling Paste or equal, prior to roll forming the pipe. Alternatively, provide a protective barrier between the stainless steel plate or sheet and the plate rolls during the forming process.

.2 Provide a protective barrier between pipe welding rollers and the stainless steel pipe cylinder. Alternately, new rollers or rollers that have been turned down on a lathe to provide a new and clean working face may be used.

.3 All saws, drills, files, wire brushes, and grinding wheels shall be free of carbon contamination and designated for stainless steel use only.

.4 Provide nonferrous, stainless steel, or rubber-lined pipe storage and fabrication racks.

.5 Use nylon slings or straps for handling stainless steel piping.

.6 Preparation of surfaces shall be welded.

.1 Surfaces of joints to be welded shall be free from mill scale, slag, grease, oil, paint, rust, and other foreign material.

.2 Use only stainless wire wheels and grinding wheels that have not come into contact with carbon steel.

.3 Flame cutting: use of oxy-acetylene gas cutting tools shall not be permitted. Use plasma arc torch with a nitrogen or argon-hydrogen carrier gas, laser or waterjet processes for cutting and plate beveling.

.4 Air arc back gouging shall not be permitted. Use grinding and plasma gouging methods to achieve full penetration welds.

.4 Welding:

.1 Welding and production processes shall conform to ASME B31.3.

.2 Use of Solar Flux shall not be permitted.

.3 Use of flux-cored arc welding (FCAW) welding shall not be permitted.

.4 Weld pipe and fittings with wall thickness up to 11-gauge (3.05 mm) using the gas tungsten arc welding (GTAW) process.

.5 Pipe and fittings with wall thicknesses greater than 6.35 mm may be welded using an automated submerged arc welding (SAW) process.

.6 Pipe and fittings with wall thickness greater than 11-gauge (3.05 mm): unless otherwise specified, properly bevel and complete root pass using the GTAW process, followed by subsequent passes with the GTAW, gas metal arc welding (GMAW), or Metallic Arc shielded metal arc welding (SMAW) process.

.7 Filler material:

.1 Add only ELC wire grades to provide a cross section at the weld equal to or greater than the parent metal.

.2 SMAW electrodes to conform to CSA W48.3.

.3 Make weld deposit smooth and evenly distributed and with a crown of no more than 1.6 mm on the I.D. and 2.4 mm on the O.D. of the piping. Concavity, undercut, cracks, or crevices shall not be permitted.

.4 Full penetration butt welds: provide inert gas shielding to the interior and exterior of the joint.

.5 Remove excessive weld deposits, slag, spatter, and projections by grinding. Grind welds smooth on gasket surfaces.

.5 Tack Welds, Clips, and Other Attachments:

.1 Repair nicks, gouges, notches, and depressions in the base metal in the area before the joint weld is made.

.2 Remove tack welds, clips, and other attachments and repair defects, except where the tack welds occur within the weld area and these tack welds do not exceed the size of the completed weld. Remove cracked tack welds.

.3 Grind those areas to be repaired down to clean metal and then repair by building up with weld metal. Grind the repaired areas smooth to form a planar surface with the base metal.

.6 Defects and Repairs:

.1 Welds with cracks, slag inclusions, porosity, undercutting, incomplete penetration, or which are otherwise deficient in quality or non-compliant to any provisions of these specifications, shall be removed by chipping or grinding throughout their depth to clean base metal.

.2 Do not perform calking or peening of welds to correct defects.

.3 Enlarge welds found deficient in dimension but not in quality by additional welding after thoroughly cleaning the surface of previously deposited metal and the adjoining plate.

.4 Weld deposits, slag, weld spatter, and projections into the interior of the pipe shall be removed by grinding.

.7 Finish:

.1 Treat all welded joints with pickling paste and rinse with clean water.

.1 Acceptable Products:

.1 AvestaBlueOne TM 130.

.2 Or approved equivalent.

.2 If rusting of embedded iron occurs, pickle the affected surface with pickling paste.

.1 Acceptable Products:

.1 AvestaBlueOne TM 130.

.2 Or approved equivalent.

.3 Rinse clean using passivating agent.

.1 Acceptable Products:

.1 Avesta FinishOne Passivator 630.

.2 Or approved equivalent.

.8 Field Welding:

.1 Use couplings and prefabrication of pipe systems at the factory to minimize field welding to the greatest extent possible. Pipe butt welds may be performed at the job site, providing the butt welds are performed only with an inert gas shielded process and that the welding requirements of this Section are rigidly adhered to.

.2 On the interior and exterior of the pipe, remove all residue, oxide, and heat stain from any type of field weld and the affected areas adjacent by the use of stainless steel wire brushes, followed by cleaning with an agent followed by complete removal of the agent.

.1 Acceptable Products:

.1 AvestaBlueOne TM 130.

.2 Or approved equivalent.

.3 Use wooden scaffolding or ladders to access work areas. If use of metallic scaffolding or ladders is unavoidable, tape or otherwise shield the contact points between the stainless steel and the scaffold or ladders.

.4 After installation, wash and rinse all foreign matter from the piping surface. Adhere to the passivation manufacturer’s recommendations and local regulations for safety and disposal of any waste chemicals.

END OF SECTION

MECHANICAL PIPE COUPLINGS

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation, testing and commissioning of mechanical pipe couplings and specialty pipe couplings.

1.2 Standards

.1 American National Standards Institute (ANSI):

  .1 ANSI B31.1 – Power Piping.

.1 American Society of Mechanical Engineers (ASME):

  .1 ASME Section IX – Boiler and Pressure Vessel Code; Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators Qualifications.

.2 American Society for Testing and Materials (ASTM):

  .1 ASTM A36 – Standard Specification for Carbon Structural Steel.

  .2 ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

  .3 ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

  .4 ASTM A194 – Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

  .5 ASTM A536 – Standard Specification for Ductile Iron Castings.

  .6 ASTM F593 – Stainless Steel Bolts, Hex Cap Screws, and Studs.

  .7 ASTM F594 – Standard Specification for Stainless Steel Nuts.

.3 American Water Works Association (AWWA):

  .1 AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.

  .2 AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

  .3 AWWA C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.

  .4 AWWA C153 – Ductile-Iron Compact Fittings.

  .5 AWWA C206 – Field Welding of Steel Water Pipe.

.6 AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.

.7 AWWA C219 – Bolted, Sleeve-Type Couplings for Plain-End Pipe.

.8 AWWA C550 – Protective Epoxy Coatings for Valves and Hydrants.

.9 AWWA C606 – Grooved and Shouldered Joints.

.10 AWWA M11 – Steel Pipe-A Guide for Design and Installation.

.4 National Sanitation Foundation (NSF):

.1 NSF 61 – Drinking Water System Components - Health Effects.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Mechanical Couplings

.1 Sleeve-Type Couplings:

.1 Acceptable Products:

.1 Dresser Style 38.

.2 Or approved equivalent.

.2 Reducing Couplings:

.1 Acceptable Products:

.1 Dresser Style 62.

.2 Or approved equivalent.

.3 Sleeve-type Flanged Coupling Adapters:

.1 Acceptable Products:

.1 Romac FCA 501.

.2 Dresser Style 128.

.3 Or approved equivalent.

.4 Insulating Couplings:

.1 Acceptable Products:

.1 Dresser Style 39.

.2 Or approved equivalent.

.5 Gaskets: As specified in Section 15055.

.6 Plain End Couplings:

.1 Acceptable Products:

.1 Pipe sizes 150 and smaller:

.1 Victaulic Style 99.

.2 Or approved equivalent.

.2 Pipe sizes 200 and larger:

.1 Victaulic Style 99.

.2 Or approved equivalent.

.2 Bolts and nuts: 316 stainless steel.

.3 Gaskets: As specified in Section 15055.

.7 Grooved End Couplings:

.1 Acceptable Products:

.1 Flexible Grooved End Coupling:

.1 Victaulic Style 177.

.2 Or approved equivalent.

.2 Rigid Grooved End Coupling:

.1 Victaulic Style 107 Zero-Flex.

.2 Or approved equivalent.

.3 Flanged Grooved End Coupling Adapter:

.1 Victaulic Style 741.

.2 Or approved equivalent.

.4 Snap-joint Grooved End Coupling:

.1 Victaulic Style 78.

.2 Or approved equivalent.

.2 Gaskets: As specified in Section 15055.

.8 Equipment Connection Fittings:

.1 Equipment connection fittings provide both lateral and angular misalignment adjustment between equipment connection flanges and the connection to field piping systems by providing individually adjustable flexible joints at each connection. In addition, equipment connection fittings provide full pressure thrust restraint between the field piping connection and equipment connection flanges.

.1 Equipment connection fittings consist of two flanged coupling adapters, a plain end section of pipe and thrust restraint rods and associated fittings designed to transmit thrust without transmitting shear to the thrust restraint rods and without compromising provisions for accommodating angular and parallel misalignment.

.2 Materials and features are to conform to the requirements established in this Section. Standard “dismantling joints” incorporate only one flanged coupling adapter and are not permitted substitutes.

.3 Acceptable Manufacturers:

.1 Romac ECF Series.

.2 Baker Coupling Company.

.3 Or approved equivalent.

.2 Single sleeve of plain end piping conforming to the requirements of the specified piping system and of sufficient length to span the gap between the connection at the equipment and the connection at the field piping with gasket flange adapters at each end.

.3 Provide thrust restraint by means of all-thread rod spanning between flanges and male rod nuts and spherical washers to provide a ball-joint type self-aligning feature. Project the all-thread restraint rod through the flange and mating flange coupling adapter bolt holes or through holes in the restraint lug plates that extend above the flanges. Secure all thread restraint rod to the flanges with a minimum of two flange bolts.

.4 Where the all-thread rods project through the flange bolt holes, provide ball joint type nut and washer combinations with lock washers at each face and at each end. Where restraint lug plates are employed, provide ball joint type nuts and washers only on the outside faces of the plates with nuts that have a self-locking feature that prevents nut movement due to vibration or other operational or environmental causes. Double nutting with non-locking nuts shall not be a permitted method of providing a self-locking feature.

.5 Select thrust rod diameter and material to provide sufficient freedom of movement through all bolt holes to allow unrestricted maximum adjustment of equipment connection fittings to accommodate piping misalignment without transmitting any shear to the thrust rods and also to permit full development of thrust restraint at all thrust rod tension take-ups.

.6 Design equipment connection fittings per the requirements of AWWA C219.

.7 Select ASTM A193 grade B7, B8, or B8M thrust rods, ASTM A194 grade 2H, 8, or 8M nuts, with matching washers and lock washers to develop full rated piping system pressure thrust forces. For pump applications, select thrust rod quantities and diameters such that the thrust rod stretch under the piping system's operating pressure does not exceed 50 microns.

.8 Factory apply dry film molybdenum disulfide anti-galling compound to ends of thrust rods, covering all threads subject to nut travel and tightening.

.9 Gaskets:

.1 Flange gaskets: nitrile full face.

.2 Follower gaskets: nitrile compression wedge.

.10 Provide schedule 40 ASTM A53 Grade B pipe sleeves with ASTM A536 Grade 65-45-12 or ASTM A36 flange bodies and end rings. The pressure ratings of the flange adapters are to meet or exceed the pressure rating of the mating flanges. All metal portions of equipment connection fittings, with the exception of Type 316 stainless steel components, are to be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61.

.9 Dismantling Joints:

.1 Dismantling joints may be used as takedown couplings in accordance with this Section.

.2 Dismantling joints: fully restrained double flange fittings consisting of a flange coupling adapter and flanged spool piece that allows for longitudinal adjustment.

.3 Provide thrust restraint by means of all threaded rod spanning between flanges and secured to the flanges with a minimum of two flange bolts.

.4 Design dismantling joints in accordance with AWWA C219.

.5 Provide Schedule 40 ASTM A53 Grade B pipe sleeves with ASTM A536 Grade 65-45-12 or ASTM A36 flange bodies and end rings. The pressure ratings of the flange adapters are to meet or exceed the pressure rating of the mating flanges. All metal portions of the fittings, with the exception of Type 316 stainless steel components, are to be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61.

.6 Acceptable Products:

.1 Romac DJ-400.

.2 Smith Blair 975.

.3 Crane-Viking Johnson.

.4 Or approved equivalent.

.10 Force Balanced Double Ball and Single Ball Expansion Joints:

.1 Install ball expansion joints in the locations specified on the Final Design.

.2 Provide foundry certification of material upon request. Materials are to be as follows:

.1 Ductile iron joints conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53.

.2 Type 410 stainless steel lock rings.

.3 EPDM molded watertight construction for ring gasket, casing, ball and cover.

.3 Pressure test each expansion joint prior to shipment to a minimum of 1,720 kPa (250 PSI).

.4 Flexible expansion joints consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, providing a minimum deflection of 25 degrees per ball for 100 mm - 200 mm expansion joints; 20 degrees per ball for 250-300 mm expansion joints, and 15 degrees per ball for 350 mm and larger expansion joints. Two (2) ball and socket joints required for each double ball expansion joint.

.5 Provide 250 mm minimum axial elongation capability with each single or double ball expansion joint. Furnish additional expansion sections as necessary to provide the specified minimum axial elongation capability.

.6 Provide force balance ball expansion joint fittings that do not expand or exert an axial thrust under internal water pressure.

.7 Line all metal surfaces, including the stainless steel lock rings, with a minimum of 381 microns of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Provide EPDM sealing gaskets. Provide ANSI/NSF 61 compliant coatings and gaskets.

.8 Coat exterior surfaces with a minimum of 152 microns of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

.9 For buried installations, install polyethylene sleeve, meeting per ANSI/AWWA C105/A21.5, in accordance with the Manufacturer’s instructions.

.10 Acceptable Products:

.1 Romac FJ Restraint.

.2 Starflex Series 5000.

.3 EBAA Iron, Flex-Tend.

.4 Or approved equivalent.

2.2 Flange Adaptors

.1 Provide restrained flange adaptors for pipe consisting of multiple individual gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

.2 Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.

.3 Provide restraint devices listed by Underwriters Laboratories 80 mm through 300 mm size and certified by Factory Mutual 100 mm through 300 mm size.

.4 Gland body, wedges and wedge-actuating components to be North American manufacture.

.5 Joint Deflection Capability:

.1 80 mm thru 200 mm: 5 degrees.

.2 250 mm and 300 mm: 3 degrees.

.3 350 mm and 400 mm: 2 degrees.

.4 450 mm and 500 mm: 1.5 degrees.

.5 600 mm thru 1200 mm: 1 degree.

.6 Provide flange adaptor to maintain seal with and 0.6 in (15 mm) gap between end of pipe and mating flange.

.7 Working Pressure Rating:

.1 400 mm and Smaller: 24 bar.

.2 450 mm: 20.7 bar.

.3 500 mm: 17.3 bar.

.4 600 mm: 13.8 bar.

.5 750 mm thru 1200 mm: 10 bar.

.6 Minimum safety factor of 2 to 1.

.8 Materials:

.1 Gland body, wedges and wedge-actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.

.2 Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.

.3 Provide three (3) test bars incrementally poured per production shift as per UL Specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.

.4 Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.

.5 Provide an identification number consisting of year, day, plant and shift (YYDDD) (plant designation) (Shift number) cast into each gland body.

.6 Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the material traceability records (MTRs) available, in hard copy.

.7 Provide coating for restraint devices consisting of the following:

  .1 Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.

  .2 Coating: A minimum of two (2) coats of liquid thermoset epoxy coating with heat cure to follow each coat.

  .3 Surface pre-treat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating is to be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.

.8 Coating system:

  .1 Acceptable Product:

    .1 MEGA-BOND by EBAA Iron, Inc.

    .2 Or approved equivalent.

2.3 Unions

.1 50 mm and Smaller: Ground joint screwed pattern unions.

.2 65 mm and Larger: Ground joint flange unions.

.3 Dielectric Unions: Match the pipe material except bronze may be used with copper piping.

.4 Acceptable Products:

  .1 EPCO, Capitol Manufacturing.

  .2 Or approved equivalent.

2.4 Coatings

.1 Field coat mechanical couplings in buried exposure areas with M-1 Advanced Mildew Treatment.

.2 Field coat mechanical couplings in indoor dry, indoor wet, outdoor, submerged, chemical corrosive, headspace, and process corrosive exposure areas in accordance with Section 09905.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Pipe Cutting, Threading, and Jointing:

.1 Pipe cutting, threading and jointing are to conform to the requirements of ANSI B31.1.

.4 Flexibility:

.1 Unless otherwise specified, piping passing from concrete to earth shall be provided with two (2) pipe couplings or flexible joints (or a double ball expansion joint) as specified on the Final Design. Locate pipe couplings within 600 mm of the structure for 50 mm through 150 mm diameter pipe; within 1,000 mm of the structure for 200 through 600 mm diameter pipe; and within one and one-half pipe diameters of the structure for larger pipe. Where required for resistance to pressure, mechanical couplings shall be restrained in accordance with Chapter 13 of AWWA M11, including Tables 13-4, 13-5 and 13-5A, and Figure 13-20.

.2 Install single and double ball expansion joints with 6 mm elongation/extension of the minimum axial elongation capability specified in this Section.

.5 Dielectric Connections:

.1 Provide an insulating section of rubber or plastic pipe where a copper pipe is connected to steel or cast iron pipe. The insulating section shall have a minimum length of 12 pipe diameters.

.2 Dielectric unions as specified in this Section may be used instead of the specified insulating sections.

END OF SECTION

PIPE WELDING

1. GENERAL

1.1 Summary

.1 This Section specifies the general requirements for pipe welding.

1.2 Standards

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

.1 ANSI/ASME - B31.1 Power Piping.

.2 ANSI/ASME - B31.3 Process Piping.

.3 ANSI/ASME Boiler and Pressure Vessel Code:

.1 BPVC Section I: Power Boilers.

.2 BPVC Section V: Non-destructive Examination.

.3 BPVC Section IX: Welding and Brazing Qualifications.

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

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

.3 American Welding Society (AWS):

.1 AWS C1.1M/C1.1 - Recommended Practices for Resistance Welding.

.2 AWS Z49.1 - Safety in Welding, Cutting and Allied Process.

.3 AWS W1 - Welding Inspection Handbook.

.4 Canada Green Building Council (CaGBC):

.1 LEED Canada 2009 for Design and Construction, LEED Canada 2009 for Design and Construction Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.

.2 LEED Canada for Existing Buildings, Operations and Maintenance, LEED Canada 2009 Leadership in Energy and Environmental Design Green Building Rating System Reference Guide.

.5 Canadian Standards Association (CSA):

.1 CSA W47.2 - Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48 - Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51 - Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2 - Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1 - Certification of Welding Inspection Organizations.

.6 CSA W178.2 - Certification of Welding Inspectors.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

1.4 Quality Assurance

.1 Qualifications:

.1 Welders:

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Submit welder's qualifications to the City.

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

.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:

.1 Inspectors qualified to CSA W178.2.

.3 Certifications:

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

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

2. PRODUCTS

2.1 Electrodes

.1 Electrodes: in accordance with CSA W48 Series.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Welding shall be done in accordance with ASME B31.3, ASME Boiler and Pressure Vessel Code, Sections I and IX and AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified in the individual Specification.

3.2 Installation

.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: install welding tees or forged branch outlet fittings.

3.3 Inspection and Tests

.1 Review weld quality requirements and defect limits of applicable codes and standards before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with the City.

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

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

3.4 Specialist Examinations and Tests

.1 General:

- .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by the City.
- .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test magnetic particle (hereinafter referred to as "particle") tests.

.2 Hydrostatically test welds to ANSI/ASME B31.1.

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

.4 Failure of visual examinations:

.1 Upon failure of welds by visual examination, perform additional testing as directed by the City of total of up to 10 particle tests.

.5 Any defects rejected by the City shall be repaired as described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

.6 Re-inspect and re-test repaired or re-worked welds at no cost to the City.

3.5 Cleaning

.1 Clean in accordance with Section 01741 - Final Cleaning.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation, testing and commissioning of piping expansion joints and flexible hose including:

.1 Flexible, ball-joint packed expansion joints.

.2 Slip-joint, packed expansion joints.

.3 Metal, compensator packless expansion joints.

.4 Rubber union connector packless expansion joints.

.5 Flexible-hose packless expansion joints.

.6 Metal-bellows packless expansion joints.

.7 Externally pressurized metal-bellows packless expansion joints.

.8 Rubber packless expansion joints.

.9 Grooved-joint expansion joints.

1.2 Standards

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

.1 ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.

.2 ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

.4 ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

.5 ASTM F1007 - Standard Specification for Pipeline Expansion Joints of the Packed Slip Type for Marine Application.

.6 ASTM F1120 - Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications.

.7 ASTM F1123 - Standard Specification for Non-Metallic Expansion Joints.

.2 American Water Works Association (AWWA):

.1 AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.

.2 AWWA C221- Fabricated Steel Mechanical Slip-Type Expansion Joints.

.3 Expansion Joint Manufacturers Association (EJMA):

.1 EJMA STDS-80 - Standards of Expansion Joint Manufacturers' Association, Edition No. 5.

.2 EJMA-85 - A Practical Guide to Expansion Joints, Copyright 1985, Expansion Joint Manufacturers Association, Inc.

.3 EJMA-93 - Standards of the Expansion Joint Manufacturers Association, Inc.

.4 Fluid Sealing Association (FSA):

.1 FSA-PSJ-703 - Guidelines for Elastomers Used in Piping Systems Non-Metallic Expansion Joints.

.2 Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors.

1.3 Definitions

.1 Expansion Joint: Any device used to absorb dimensional changes and/or misalignment.

.2 Pipe Section: the portion of pipe between two (2) anchors.

.3 Lateral: perpendicular to the pipe axis.

.4 Longitudinal: parallel to the pipe axis.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Percent elongation over range of design temperatures.

.3 Design and construction details of formed metal bellows type expansion joints.

.4 Pressure thrust force and spring rate data for formed bellows expansion joints.

2. PRODUCTS

2.1 Performance Criteria

.1 Provide control units (tie rods or restraints) to prevent excessive axial elongation and to accept the pressure thrust in the piping system. Number and sizes of control rods or restraints are to be as determined by Manufacturer.

.2 Service Conditions:

.1 Provide expansion joints designed in accordance with EJMA Standards for pressure, temperature and service as specified.

.2 Provide flexible metal hose with pressure rating specified in this Section.

.3 Design Requirements:

.1 Provide lengths of flexible metal hose based upon the service conditions listed in this Section and a design life of 50,000 full displacement cycles.

.2 Supply bellows type expansion joints suitable for a minimum of 10,000 pressure, temperature and deflection cycles (non-concurrent).

2.2 Expansion Joints

.1 Metal Construction:

.1 Formed bellows type for service up to 425°C:

.1 Furnish formed bellows that provide the amount and kind of movement (axial, lateral, angular, torsional) scheduled in this Section. Set control units/tie rods/restraints to allow specified movements.

.2 Design tie-rods to withstand the pressure and pressure thrust of the expansion joint as well as the spring rate of the joint and any itemized external loads specified.

.3 Provide ASTM A-240 Type 321 stainless steel bellows and liners and A-312 Type 316 stainless steel flanges.

.4 Design spring rate values for metallic construction, formed bellows are specified in the following table. Furnish formed bellows with spring rates within plus or minus 25 percent of the values specified in the table below.

Nominal Size X Pressure Rating (mm @ kPag)	Spring Rates			
	Axial (kg/mm)	Lateral (kg/mm)	Angular (N-m/grad)	Torsional (N-m/grad X 10^{5})
150 @ 1034	2	4	1.5	0.0283
200 @ 344	2	4	2.6	0.0511
250 @ 413	5	5	8.0	0.1194
250 @ 206	3	2	5.8	0.0849
300 @ 413	4	7	10.4	0.1943
350 @ 448	5	9	13.5	0.2574
450 @ 344	5	12	24.5	0.4768
600 @ 448	6	26	45.7	1.1137
900 @ 344	7	67	116.0	3.4902

.5 Acceptable Manufacturers:

.1 U.S. Bellows.

.2 Senior Flexonics.

.3 Hyspan Precision Products.

.4 American BOA.

.5 Or approved equivalent.

.2 Tied Universal Expansion Joint:

.1 Determine expansion joint design by the amount and kind of movement specified.

.2 Acceptable Manufacturers:

.1 U.S. Bellows.

.2 Flexible Compensators.

.3 Hyspan Precision Products.

.4 Senior Flexonics.

.5 Or approved equivalent.

.3 Steel Expansion Compensator Type:

.1 Use two-ply stainless steel bellows, with carbon steel shroud and end fittings.

.2 Acceptable Manufacturers:

.1 Unisource Series EP.

.2 Senior Flexonics.

.3 Hyspan Series 8500.

.4 Or approved equivalent.

.4 Bronze Expansion Compensator Type:

.1 Use multi-ply phosphor bronze or stainless steel bellows and copper tube end fittings.

.2 Acceptable Manufacturers:

.1 Senior Flexonics Model HB.

.2 Hyspan Series 8500.

.3 American BOA Inc.

.4 Or approved equivalent.

.5 Fabricated Steel Pipe Coupling:

.1 Use plain end coupling to allow for angular displacements.

.2 Provide couplings that meet AWWA C219 and have a maximum working pressure of 3447 kPa.

.3 Acceptable Manufacturers:

.1 Romac Industries, Style “400” Steel Coupling.

.2 Or approved equivalent.

.6 Slip Sleeve Linear Expansion Joint:

.1 Provide slip sleeve style linear expansion joint that allows 254 mm linear movement and meets the requirements of AWWA C221.

.2 Provide nitrile packing and limit rods.

.3 Acceptable Manufacturers:

.1 Romac Industries.

.2 Or approved equivalent.

.2 Elastomer and Fabric Construction:

.1 General requirements:

.1 Standard spool arch type or the precision molded spherical design type as specified.

.2 Single arch and sphere type expansion joints, unless otherwise indicated, have 150 mm face-to-face dimension for pipe up to 200 and 200 mm face-to-face dimension for pipe 250 and 300. Not approved for use with larger diameters.

.3 Cover elastomer constructed of chlorobutyl, neoprene, or EPDM.

.4 Tube elastomer constructed of chlorobutyl or EPDM for temperatures between 80°C and 115°C. Neoprene or Buna N liners are acceptable for temperatures up to 80°C.

.2 Spool Type requirements:

.1 Resilient arch type and standard or tapered as specified. Unless otherwise specified, all tapered connectors are to be eccentric.

.2 Constructed of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body.

.3 Provide retaining or backup rings for standard arch type expansion joints suitable for the specified temperature and pressure. Rings are to be 10 mm thick steel, split, either galvanized or zinc shield coated.

.4 Use filled arch type expansion joints on all piping systems carrying fluids containing solids.

.5 Acceptable Manufacturers for single, multiple, or filled arch:

.1 Unisource Series 1200.

.2 Garlock Style 204.

.3 Mercer Style 500.

.4 Or approved equivalent.

.6 Acceptable Manufacturers for high-pressure couplings suitable for 115°C operating temperatures:

.1 Unisource Series 1500.

.2 Mercer Style 510.

.3 Garlock Style 204-HP.

.4 General Rubber Style 1015.

.5 Or approved equivalent.

.3 Spherical Molded type requirements:

.1 Precision molded of multiple plies of nylon tire cord fabric and elastomer suitable for specified temperature and pressure.

.2 Have steel or ductile iron floating flanges, with no metal parts in contact with the fluid.

.3 Acceptable Manufacturer for single sphere molded connectors:

.1 Unisource Series 301.

.2 General Rubber Type 1010.

.3 Garlock Style 8100.

.4 Or approved equivalent.

.4 Provide double sphere or triple sphere connectors where required to provide for the specified movement.

.3 Polymer Expansion Joints:

.1 Provide expansion joints for PVC or CPVC piping that are EPDM elastomer flexible double-bellows. Attach expansion joints to pipe using union-type couplings.

.2 PVC/CPVC Acceptable Manufacturers:

.1 Spears.

.2 Flexicraft.

.3 Or approved equivalent.

.3 Provide polytetrafluoroethylene (PTFE) expansion joint with external stainless steel reinforcing rings, limit rods, and flanges. Expansion joints are to be designed to the Fluid Sealing Association (FSA) design standard. Use polymer-coated tie rods or grommets between the tie rods and flanges; metal-to-metal contact between the rods and flanges are not permitted. Flanges to be completely isolated from the chemical by the molded PTFE bellows.

.4 Provide safety shields over PTFE joints and connections.

.5 Molded PTFE expansion joints Acceptable Manufacturers:

.1 Garlock Style 214/215.

.2 Crane Resistoflex R-series.

.3 Flexicraft Teflex Series.

.4 Or approved equivalent.

2.3 Flexible Metal Hose

.1 Unless otherwise specified, corrugated stainless steel in accordance with Section 15055 with stainless steel fittings and stainless steel single braid.

.2 Attach end connections by helical crest welding.

.3 Provide bronze flexible metal hose for copper and brass systems.

.4 Acceptable Manufacturers:

.1 American BOA Series B.

.2 Unisource.

.3 Metraflex.

.4 Or approved equivalent.

2.4 Flexible Teflon Hose

.1 Provide Teflon tube, supported by double steel-wire helix.

.2 Connections to be completely isolated from the chemical by PTFE.

.3 Acceptable Manufacturers:

.1 Jackson Industrial.

.2 Crane Resistoflex.

.3 Or approved equivalent.

2.5 Externally Pressurized Expansion Joint

.1 Packless, externally pressurized type where system line pressure is external to the bellows. Multiple-ply bellows design.

.2 Provide with drain connection and lifting lug.

.3 Furnish externally pressurized expansion joints that provide the amount and kind of movement (axial, lateral, angular, torsional) scheduled in this Section.

.4 Materials: stainless steel, Type 316.

.5 Flanged connections.

.6 1034 kPa working pressure and 2250 kPa testing pressure.

.7 370°C design temperature.

.8 Acceptable Manufacturers:

.1 Metraflex products.

.2 Or approved equivalent.

2.6 Flexible Metal Hose Loop

.1 Flexible metal hose loops consist of two parallel sections of corrugated stainless steel metal hose and single braid with 180 degrees return bend, flanged inlet and outlet connections.

.2 Furnish flexible metal hose loops that provide the amount and kind of movement (axial, lateral, angular, torsional) scheduled in this Section. Provide supports at 180 degrees return bend per Manufacturer's recommendations.

.3 For loops using hanger supports, provide seismic break-away coupling to allow separation during seismic event.

.4 Acceptable Manufacturers:

.1 Metraflex.

.2 Flexicraft.

.3 Anvil International.

.4 Or approved equivalent.

2.7 Hardware

.1 Hardware shall be 316 stainless steel.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 For piping services operating at less than 80°C, do not install expansion joints during times of extreme temperature or in a fully compressed or fully expanded condition.

.4 For piping services operating at over 80°C, install expansion joints at percent elongation corresponding to installation temperature as a percent of maximum operating temperature.

.5 Whenever possible, install the expansion joint close to an anchor. Locate the anchor or first pipe alignment guide no more than 4 pipe diameters from the expansion joint. The second guide should be located no more than 14 pipe diameters from the first guide. Additional pipe guides should be installed in accordance with Manufacturer's recommendations.

3.2 Expansion Joint Installation

.1 Install expansion joints of sizes matching sizes of piping in which they are installed.

.2 Install rubber packless expansion joints according to FSA-PSJ-703.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation, testing and commissioning of hangers and supports for piping and foul air duct specified in Section 15055.

.2 This Section does not specify hangers and supports for fire sprinkler systems.

.3 Expansion control anchors are as indicated, and as specified in Section 15098.

1.2 Standards

.1 American Institute of Steel Construction (AISC):

  .1 AISC Manual of Steel Construction - Allowable Stress Design, 9th Edition.

.2 American Society of Mechanical Engineers (ASME):

  .1 ASME Boiler and Pressure Vessel Code, Section IX.

  .2 ASME B31.3 - Process Piping.

  .3 ASME B31.9 - Building Services Piping.

.3 American Society for Testing and Materials (ASTM):

  .1 ASTM A36 - Standard Specification for Structural Steel.

  .2 ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

  .3 ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

  .4 ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

  .5 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

  .6 ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

  .7 ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

  .8 ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

.9 ASTM D635 - Standard Test Method for Rate of Burning and/or Extent of Burning of Plastics in a Horizontal Position.

.10 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

.4 American Welding Society (AWS):

.1 AWS D1.1: Structural Welding Code.

.5 FEDSPEC WW-H-171e - Hangers and Supports, Pipe.

.6 Metal Framing Manufacturer's Association (MFMA):

.1 MFMA 4: Metal Framing Standards.

.2 MFMA 102: Guidelines for the Use of Metal Framing.

.7 Manufacturers' Standardization Society (MSS):

.1 SP-58: Pipe Hangers and Supports – Materials, Design and Manufacture.

.2 SP-69: Pipe Hangers and Supports – Selection and Application.

.3 SP-89: Pipe Hangers and Supports – Fabrication and Installation Practices.

1.3 Definitions

.1 Longitudinal: parallel to the pipe axis.

.2 Lateral perpendicular to the pipe axis.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Performance Criteria

.1 Service Requirements:

.1 Provide expansion control provisions as required to accommodate expansion and contraction of pipe materials as a result of changes between ambient temperature and operating temperature conditions. Install pipe hangers and supports to accommodate expansion and contraction without interfering with expansion control functions. Following commissioning of piping systems, adjust pipe supports and hangers as necessary for proper function of expansion control systems at operating temperatures.

.2 Hanger and Support Selection:

.1 Selection:

.1 Manufacture pipe support elements and structural attachments in accordance with the requirements of MSS SP 58 and ASME B31.3, employing AISC Manual of Steel Construction – Allowable Stress Design.

.2 Select pipe hangers and supports as specified within this Section based on the DBA and piping insulation thickness specified in Section 15261.

.3 Review the piping layout in relation to the surrounding structure and adjacent piping and equipment before locating each support or hanger point.

.4 Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. At a minimum include the following loads and other loads as required by the Technical Requirements:

.1 Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.

.2 Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

.3 Reaction forces due to the operation of safety or relief valves.

.4 Wind, snow and ice loadings on outdoor piping, foul air ducts, cable tray and conduit. Wind, snow and ice loadings as required for the Final Design.

.5 Reaction forces due to operational conditions and test conditions.

.6 Supports shall be positioned to prevent transfer of pipe support loads to pipe connections on equipment.

.5 Provide hangers and supports to fit the outside of pipe, tubing, and the outside of insulation where piping is insulated.

.6 Provide rod hangers for suspended lines, wherever practical, in hanger locations with negligible movement. Provide bases, brackets or cross members for piping supported from below.

.7 Hangers for the suspension of size 60 mm and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.

.8 The supporting systems are to provide for the free or intended movement of the piping including its movement in relation to that of connected equipment.

.9 Provide hanger components that allow for swing where there is horizontal movement in suspended hanger location. Do not exceed vertical angle of 4 degrees for hanger rods.

.10 Do not allow for any contact between a pipe and hanger or support component of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by use of copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.

.11 Do not use existing pipe to support new piping, unless Final Design specifies otherwise. Modify existing supports if needed before reuse.

.12 Do not attach pipe support components to pressure vessels.

.13 Use stock hanger and support components wherever practical.

2.2 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Cooper B-Line.

.2 Carpenter & Patterson.

.3 Anvil International.

.4 Pipe Shields Incorporated.

.5 Thomas & Betts, Superstrut.

.6 Unistrut.

.7 Or approved equivalent.

2.3 Metal Pipe Hangers and Supports

.1 Carbon-Steel Pipe Hangers and Supports:

.1 Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

.2 Galvanized Metallic Coatings: Pre-galvanized, hot-dip galvanized, or electro-galvanized.

.3 Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.

.4 Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

.5 Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

.2 Stainless-Steel Pipe Hangers and Supports:

.1 Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

.2 Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

.3 Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

.3 Copper Pipe and Tube Hangers:

.1 Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.

.2 Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.4 Trapeze Pipe Hangers

.1 Engage a qualified professional engineer to design trapeze pipe hangers and supports.

.2 Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.5 Metal Framing Systems

.1 MFMA Manufacturer Metal Framing Systems:

.1 Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

.2 Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

.3 Channels: Continuous slotted carbon-steel channel with inturned lips.

.4 Channel Width: Selected for applicable load criteria.

.5 Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

.6 Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

.7 Metallic Coating: Hot-dip galvanized.

2.6 Thermal Pipe Hanger Shield

.1 General:

.1 Provide thermal shields at hangers, supports and guides on pipe requiring insulation.

.2 Shields shall consist of insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer.

.3 Provide thermal shields the same thickness as the piping system insulation specified in Section 15261.

.4 Provide standard shield for hot systems and a vapour barrier shield for cold systems.

.5 Use stainless steel band clamps where specified to prevent slippage between the pipe wall and the thermal shield.

.2 Standard Shield:

.1 Insulation:

.1 Hydrous calcium silicate, high density, waterproof.

.2 Compressive strength: 700 kPa average.

.3 Flexural strength: 520 kPa average.

.4 K factor: 0.38 at 38°C mean.

.5 Temperature range: minus 7°C to 260°C.

.2 Steel Jacket: Provide galvanized steel. Gauge shall be Manufacturer’s standard for the given pipe size.

.3 Connection: Provide shield with butt connection to pipe insulation. Steel jacket and insulation shall be flush with end.

.3 Vapour Barrier Shield:

.1 Insulation:

.1 Hydrous calcium silicate, high density, waterproof.

.2 Compressive strength: 700 kPa average.

.3 Flexural strength: 520 kPa average.

.4 K factor: 0.38 at 38°C mean.

.5 Temperature range: minus 7°C to 260° C

.2 Jacket: Provide galvanized steel. Gauge shall be Manufacturer’s standard for the given pipe size.

.3 Connection: Provide shield with butt connection to pipe insulation. Extend insulation 25 mm each side of steel jacket for vapour tight connection to pipe insulation vapour barrier.

2.7 Fastener Systems

.1 Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

.2 Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 Pipe Stands

.1 General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

.2 Compact Pipe Stand:

.1 Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

.2 Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.

.3 Hardware: Galvanized steel or polycarbonate.

.4 Accessories: Protection pads.

.3 Low-Profile, Single Base, Single-Pipe Stand:

.1 Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.

.2 Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.

.3 Vertical Members: Two, galvanized steel, continuous-thread 13 mm rods.

.4 Horizontal Member: Adjustable horizontal, galvanized steel pipe support channels.

.5 Pipe Supports: Strut clamps.

.6 Hardware: Galvanized steel.

.7 Accessories: Protection pads.

.8 Height: 300mm inches above roof.

.4 High-Profile, Multiple-Pipe Stand:

.1 Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

.2 Bases: Two or more; vulcanized rubber.

.3 Vertical Members: Two or more, galvanized steel channels.

.4 Horizontal Members: One or more, adjustable height, galvanized steel pipe support.

.5 Pipe Supports: Strut clamps.

.6 Hardware: Galvanized steel.

.7 Height: 900 mm above roof.

.5 Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 Materials

.1 General: Pipe hangers, supports, structural attachments, fittings, and accessory materials in accordance with the following table. Section 01450 designates area exposures.

Exposure	**Pipe Support Materials**	
	Hangers, supports, structural attachments, fittings, and accessories	**Nuts, bolts, washers, and fasteners**
Indoor, dry	Steel, hot dip galvanized after fabrication	Zinc plated steel
Indoor, wet and outdoor	Steel, hot dip galvanized after fabrication	Zinc plated steel
Submerged	Type 316 stainless steel	Type 316 stainless steel
Headspace	Type 316 stainless steel or FRP	Type 316 stainless steel
Chemical corrosive	FRP	Type 316 stainless steel

.2 Pipe Hangers and Supports: Pipe support components shall conform to the requirements of MSS SP-69, FEDSPEC WW-H-171e. Pipe hanger and support materials and manufacture shall conform to the requirements of MSS SP-89. Metal framing system components shall conform to the MFMA Standard MFMA-2 and MFMA-101.

.3 Materials:

.1 Select material based on the Corrosion Study as specified in Schedule 18 Technical Requirements and as minimum the following:

.1 Carbon Steel: ASTM A1011.

.2 Structural Steel: ASTM A36, carbon-steel plates, shapes, and bars; galvanized.

.3 Stainless Steel: ASTM A240.

.4 Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

.5 Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and non-metallic grout; suitable for interior and exterior applications.

.1 Properties: Non-staining, non-corrosive, and non-gaseous.

.2 Design Mix: 34.5 MPa (5000-psi), 28-day compressive strength.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install structural attachments for pipe hangers to beams, structural framing, girders, or embedded framing channel. Structural attachments for pipe hangers in roof decking shall not be permitted.

.4 Install pipe hangers hung below elevated slabs at regular intervals not exceeding 2.0 m when structural attachments for pipe hangers are set in the slab between beams (hung between beams, structural framing, girders, or embedded framing channel).

.5 Install hangers and supports as near as possible to concentrated loads such as valves, flanges, changes of direction of pipe and tees and branches. Space hangers, supports and accessories within the maximum span lengths specified in this Section.

.6 Install at least one (1) hanger or support within 600 mm from a pipe change in direction.

.7 For any valve 150 mm in size and larger, install at least one (1) hanger or support within 600 mm in either direction of the valve.

.8 Install hangers and supports to ensure that connections to equipment, tanks and other systems are substantially free from loads transmitted by the piping.

.9 Where piping is connected to equipment, a valve, piping assembly, and other system which requires removal for maintenance, provide piping support in such a manner that temporary supports are not necessary for this procedure.

.10 Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings. Maximum mid-span deflection shall not exceed 2.5 mm.

.11 Support spacing not to exceed 2.0 m for HDPE or other plastic pipe. Support spacing not to exceed 2.5 m for copper pipe. Support spacing not to exceed 3 m for FRP ductwork. Support spacing not to exceed 3.5 m for all other pipes.

.12 Ensure pipe system does not interfere with the function of pipe system flexibility and expansion components or features.

.13 Precast walls shall not be used to support pipe. Support pipe from the floor or roof in facilities with precast walls.

.14 Pipe and cable tray supports shall not obstruct operation and maintenance access to equipment, valves, and other appurtenances.

.15 Maximum loads imposed on structures from supports for pipe, ductwork, cable trays and conduits, and associated appurtenances shall conform to the following table and as required for the Final Design, whichever is greater. In some instances, greater point loads may be applied to beams and girders. Consult the Engineer of Record to ascertain and certify the maximum allowable point load in circumstances where the proposed load would exceed the values in the following table:

	Foundation, Slab on Grade[(b)]	**Elevated Floor Beams (Steel or Concrete) and Concrete Slabs[(b)]**	**Roof Beams (Steel or Concrete) and Concrete Slabs[(b)]**
General Process Area: Pipe, foul air duct, cable tray and conduit loads[1], maximum, kPa	5.0	2.0	1.0
Utilidor: Pipe, foul air duct, cable tray and conduit loads[(a)], maximum, kPa	7.0	--	2.5
Load at structural attachment, maximum, structural attachments at 2.0 m centres, kg	4,500	630	320
Load at structural attachment, maximum, structural attachments at 3.5 m centres, kg	4,500	1,400	900

(a) Uniform Loads based on design allowance for pipe and duct, cable tray, and conduit loads
(b) Loading criteria are for process facilities only.

.16 Moments applied to walls and columns from cantilevered pipe supports and cable tray shall not exceed 1,300 N-m/m of wall or column.

.17 Maximum allowable pipe and cable tray loads applied to walls and columns shall not exceed 250 N-m/m of wall or column.

.18 All pump suction piping and equipment connections less than 2 m above the floor or local grade shall be provided with stanchion-type supports.

.19 Pipe supports shall not span structure expansion joints.

.20 Provide pipe supports to support the termination of any pipe that is truncated for future connection to piping.

.21 Provide welded and bolted attachments to building structural components in accordance with the requirements of AISC Manual. Do not drill or burn holes in the structural steel.

.22 Do not use hanger components for purposes other than that for which they were designed. Do not use hanger components for rigging and erection purposes.

.23 Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

.24 Use embedded anchor bolts or adhesive anchors instead of concrete inserts for support installations in areas below water surface or areas normally subject to submerging.

.25 Install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Make butt joint connections to pipe insulation at the time of insulation installation in accordance with Manufacturer's recommendations.

.26 Provide hanger and support components in contact with plastic pipe free of burrs and sharp edges.

.27 Provide rollers that roll freely without binding.

.28 Prior to grouting, roughen finished floor beneath structural attachments and post bases. Provide grout between base plate and floor free of voids and foreign material.

.29 Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

.30 Provide plastic or rubber end caps at the exposed ends of all framing channels and struts that are within 2.1 m of a floor, walkway, or other accessible platform.

.31 Structural attachments for pipe and cable tray hangers that extend above roof decks or floors are not permitted. Provide through bolt structural attachments where specified for reinforced concrete slab construction.

.32 Adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material compatible with the piping material may be used. Adjust stanchions prior to grouting their baseplates.

.33 Anchor bolts as specified in Section 05501.

END OF SECTION

EXPANSION CONTROL FOR PIPING

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation, testing and commissioning of expansion control for the piping systems listed within this Section. This Section includes pipe anchorage, pipe guides, and expansion control by either expansion joints or pipe deflection.

1.2 Standards

.1 American Institute of Steel Construction (AISC) Manual of Steel Construction, Allowable Stress Design, 9th Edition.

.2 Expansion Joint Manufacturers Association (EJMA):

.1 EJMA-93 - Standards of the Expansion Joint Manufacturers Association, Inc.

.2 EJMA-85 - A Practical Guide to Expansion Joints, Copyright 1985, Expansion Joint Manufacturers Association, Inc.

1.3 Definitions

.1 Expansion Joint: Any device containing one or more bellows used to absorb dimensional changes.

.2 Main Anchor: An attachment between a structure and a pipe to withstand the full pipeline thrust due to pressure, pipe bending, momentum change at bends, spring forces, pipe and contents weight and other pipe support system friction forces.

.3 Intermediate Anchor: An attachment between a structure and a pipe that withstands the same forces as a main anchor, except for the pressure forces.

.4 Sliding Anchor: An attachment between a structure and a pipe that absorbs forces (limits movement) in one direction while permitting motion in another.

.5 Pipe Guide: A device fastened to a structure that permits the pipeline to move freely in only one (1) direction, along the axis of the pipe.

.6 Pipe Section: the portion of pipe between two (2) anchors.

.7 Planar Pipe Guide: A device fastened to a structure that permits transverse movement or bending of the pipeline in one plane.

.8 Lateral: perpendicular to the pipe axis.

.9 Longitudinal: parallel to the pipe axis.

.10 Thrust Tie: Attachments to expansion joints that allow joint to accommodate axial thrust due to internal pressure.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Performance Criteria

.1 Operating Conditions:

.1 Expansion control as specified in this Section and as indicated controls pipe movements and loads occurring as a result of pipeline temperature changes.

.2 Provide expansion control as specified. Where anchors and expansion joints are not specified, expansion control shall be provided through deflection of the piping and pipe fittings. Where expansion control is provided through deflection of the piping and pipe fittings, support and brace piping such that thermal expansion movement is accommodated without application of excessive loads to piping, supports and bracing. Where expansion "U" loops are specified, weld all "U" loop elbows and piping connections. Weld piping connections at elbows within 10 diameters from an anchor.

.3 Expansion control provisions are specified as necessary to accommodate expansion and contraction of pipe materials as a result of changes between ambient and operating temperatures. Install pipe hangers and supports to accommodate expansion and contraction without interfering with expansion control functions. Following commissioning of piping systems, adjust pipe supports and hangers as necessary for proper installation at operating temperatures.

.4 This Section covers minimum operating temperatures for piping services designed to operate at temperatures below ambient conditions and specifies maximum operating temperatures for piping services designed to operate at temperatures above ambient conditions. Piping services not listed in this Section operate within ambient temperature range. For the purposes of installing pipe hangers, supports, bracing, and expansion control components, ambient temperature conditions are defined as 15ºC to 60ºC.

Piping System Service Designation	**Minimum Operating Temperature (if below ambient temp.) or Maximum Operating Temperature (if above ambient temp.), °C**
PA	110
SA	65
FPS, C1, C2, C7	0
HRR, HRS, GR, GS	100
Freeze Protected Piping, See Section 15265	0

.2 Protect pipe systems against damage resulting from expansion or contraction of pipe materials exposed to temperatures outside the temperature range between ambient temperature conditions and operating temperature conditions.

.3 Coordination with Pipe Supports, Hangers, and Restraints:

.1 Design:

.1 Coordinate expansion control systems indicated with hanger and support systems.

.2 The piping system specified in Section 15050 show the anchor and expansion control locations as well as the details of the supports and hangers.

.3 Locate and provide piping supports required for final piping layout, coordinated with expansion control systems specified.

.2 Installation Guidelines:

.1 Install expansion control and pipe supports to provide maximum flexibility for maintenance access to equipment, and other appurtenances such as valves, and to the pipe itself.

.2 Metal-to-metal contact between a pipe and pipe anchor of dissimilar metals shall not be permitted.

.3 Where pipe guides are specified, furnish and place as specified and fasten to structures to provide the maximum vertical and lateral load capacity of the specified pipe guides.

2.2 Materials

.1 Provide expansion control components fabricated from materials conforming to materials requirements specified in Section 15096.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Weld and bolt attachments to the building structural steel in accordance with the requirements of the AISC Manual of Steel Construction (allowable stress design). No drilling or burning of holes in the building structural steel is permitted.

.4 Provide embedded anchor bolts instead of concrete inserts, wedge anchors, expansion anchors, adhesive, or other non-embedded type of anchor for expansion control installations in areas below water surface or normally subject to submergence. Anchor bolt material and installation as specified in Section 05501.

.5 Install thermal pipe hanger shields on insulated piping at required locations during guide installation. Butt joint connections to pipe insulation at the time of insulation installation in accordance with the Manufacturer's recommendations.

.6 Connect anchors directly to the pipe as indicated.

.7 Provide roller assemblies for pipe hangers and supports for HRR, HRS, GR, and GS piping services. Rollers are to roll freely without binding.

.8 Provide plastic or rubber end caps at the exposed ends of all framing channels within 2.1 m of a floor, walkway, or accessible platform.

END OF SECTION

BUILDING MECHANICAL VALVES

1. GENERAL

1.1 Summary

.1 This Section specifies the supply and equipment specific installation and testing of manually operated valves used for isolation, throttling, and bypass.

.2 This Section shall be applied in conjunction with Sections 15055 and 15105 and the Final Design.

.3 Valve Specification Requirements:

  .1 Final Design specifies the general valve types used in each piping system.

  .2 Section 15055 specifies the piping system materials and components in the PIPESPEC System, including valve requirements, for the pipeline or piping system conveying the commodity indicated on the Final Design.

  .3 Section 15055 reference the detailed valve Specification Sheets in Section 15105 that specify detailed valve requirements for each general valve type used in the pipeline or piping system.

  .4 Provide valves conforming to the valve types listed in the piping system Specification Sheets in Section 15055 that are consistent with the valve/line size, commodity, and valve type specified in the Final Design. Example: The Final Design specifies a 25 mm ball valve. The PIPESPEC SYSTEM sheets in Section 15055 for the commodity specified by the Final Design lists BV01 for 12 through 65 mm ball valves. Provide the subject ball valve per the requirements specified for BV01 in Section 15105.

  .5 The detailed valve Specification Sheets are provided in Section 15105.

.4 Section 15180 specifies the supply and installation of electric powered and pneumatic powered control valves complete with valve body, actuator, position indicator, and other ancillaries.

.5 Manufacturer shall inspect and pressure test valves prior to shipment in accordance with relevant AWWA, ANSI or ASME standards. Design Builder shall pressure test valves in conjunction with the pipes in which the valves are installed as specified in Section 15050.

1.2 Standards

.1 Canadian Gas Association (CGA).

.2 Manufacturers' Standardization Society (MSS):

  .1 MSS SP-25: Standard Marking System for Valves, Fittings, Flanges, and Unions.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

1.4 Quality Assurance

.1 Certifications:

.1 A CRN designated by the Province of Manitoba is required for each valve type.

.2 Affidavits from the Manitoba Labour and Immigration Office of the Fire Commissioner indicating compliance with CGA requirements are required for all valves in hazardous gas services.

.3 Mark all valves in accordance with MSS SP-25.

2. PRODUCTS

2.1 Performance Criteria

.1 Provide valves of the same type, size range and service from a single Manufacturer.

.2 Provide new, unused valves for the work.

.3 Provide valve materials free from defects or flaws, with true alignment and bores.

.4 Provide valves that open counter-clockwise unless otherwise specified in the valve Specifications Sheets in Section 15105.

.5 Provide lockout tagout lockout feature on all valves.

.6 Manual Operators:

.1 Provide valves with manual operators as specified in 15105 unless specified otherwise.

.2 For hand wheels, clearly show the direction of opening in raised lettering and symbols.

.3 The maximum rim pull on a hand wheel shall not exceed 177 N when one (1) side of the valve is at test pressure and the other side is at atmospheric pressure. Where a shaft mounted hand wheel would require greater force to operate, provide a gear operator which conforms to the following minimum requirements, unless operators are scheduled or specified otherwise.

.4 Provide six (6) eight-point operating wrenches for use on all the valves with square nut operators.

.5 Quarter-turn lever operators shall be perpendicular to the pipe runs when the valves are closed.

.6 Lever operators on ball valves shall be two-position. Provide butterfly valves with ten-position latching levers except where used to balance air flows. Where used to balance air flows provide infinite position, screw down levers.

.7 The maximum pull at the end of the lever arm shall not exceed 177 N when one (1) side of the valve is at test pressure and other side is at atmospheric pressure. Where greater force would be required to operate the valve with a lever, provide a gear operator which conforms to the following minimum requirements, unless operators are scheduled or specified otherwise.

.8 Provide grease lubricated, worm gear type operators, equipped with a hand wheel and a visual indicator of the valve position. Provide gear operators with adjustable mechanical stop-limiting devices to prevent over travel of the disk/ball in the open and closed positions and which are self-locking and designed to hold the valve in any intermediate position between full open and full closed. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.

.9 For manual valves on lines 75 mm and greater, mounted over 2.5 m above the operating floor, provide chain wheel gear operators. Design the operator so that a force of 150 N is sufficient to open the valve when one side of the valve is at test pressure and the other side is at atmospheric pressure. Provide chain pulley that meshes positively with the chain. The chain is to extend from the valve operator to an operating height of 1.2 m above the floor or as directed by the Design Builder. The exact dimensions shall be field determined. Provide approved chain hooks with safety whip where required to prevent chain from hanging within traffic paths.

.10 Where manual operators are installed over 2.5 m above the operating floor and the Final Design specifies a vertical shaft for the chain wheel, revise the gear operator or chain wheel position to provide a horizontal chain wheel shaft. Retain the valve orientation specified.

.11 Provide ductile iron chain wheels. Provide galvanized steel operating chains.

.7 Valve Stem Extensions:

.1 Provide valve stem extensions in manholes, and where additional clearance is required for pipe insulation or where valve operation without the extension is difficult.

.2 Where angle-valve stem extensions are used, they shall be angle-geared. Universal joint types shall not be permitted.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Prior to installation of valves, field measure and check all equipment locations, pipe alignments, and structural installations. The valve location and orientation shall provide suitable access to manual operators and sufficient space and accessibility shall be available for pneumatic and electric actuators.

.4 Install valves in conjunction with the piping described in Section 15055 and with control valves and their appurtenances specified in Section 15180.

.5 In horizontal pipe runs other than where space does not permit, install all valves (except butterfly valves, eccentric plug valves, and trunnion ball valves) with a vertical operating shaft with the actuator at the top. A valve shall not be installed with the operator below the valve.

.6 Unless otherwise specified on the drawings, install butterfly valves, eccentric plug valves, and trunnion ball valves with the shaft in a horizontal orientation. Install eccentric plug valves with the plug above the valve shaft centreline when the valve is full open.

.7 Support valves in position using temporary supports. Do not remove supports until valve installation is complete.

.8 Permanently support valves to prevent transmission of loads to adjacent pipework and equipment.

.9 Where valves are installed in plastic piping systems greater than 100 mm diameter, support valves independent of the piping and brace valves against operating loads and torque to prevent transmission of stresses to the adjacent pipework.

.10 Install gate valves in the closed position.

.11 Install valves which are bubble-tight in one direction to provide bubble-tight seal of flow in normal direction of flow.

.12 Protect valves installed below grade with a shrink sleeve or polyethylene sheath attached to the pipe with tape wrap.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies materials, performance, and reference Specifications for valves in the piping systems.

.2 This Section shall be used in conjunction with Section 15055 and Section 15100.

1.2 Standards

.1 American National Standards Institute (ANSI):

.1 ANSI 16.10 - Face-to-Face and End-to-End Dimensions of Valves.

.2 ANSI B1.20.1 - Pipe Threads, General Purpose.

.3 ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250.

.4 ANSI B16.5 - Pipe Flanges and Flanged Fittings.

.5 ANSI B16.34 - Valves—Flanged, Threaded, and Welding End.

.2 American Petroleum Institute (API):

.1 API 607 - Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A48 - Gray Iron Castings.

.2 ASTM A108 - Steel Bars, Carbon, Cold-Finished, Standard Quality.

.3 ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.4 ASTM A216/A216M - Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.

.5 ASTM A276 - Stainless and Heat Resisting Steel Bars and Shapes.

.6 ASTM A351 - Castings, Austenitic, for Pressure-Containing Parts.

.7 ASTM A516 - Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.

.8 ASTM A536 - Ductile Iron Castings.

.9 ASTM A571 - Austenitic Ductile Iron Castings.

.10 ASTM A995/A995M-13 - Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts.

.11 ASTM B124 - Copper and Copper Alloy Forging Rod, Bar, and Shapes.

.12 ASTM B148 - Aluminum-Bronze Sand Castings.

.13 ASTM C283 - Resistance of Porcelain Enameled Utensils to Boiling Acid.

.14 ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

.15 ASTM D5162 - Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates.

.4 American Water Works Association (AWWA):

.1 AWWA C500 - Gate Valves for Water and Sewerage Systems.

.2 AWWA C504 - Rubber-Seated Butterfly Valves.

.3 AWWA C507 - Standard for Ball Valves.

.4 AWWA C508 - Swing Check Valves for Waterworks Service, 2 – 24 Inches NPS.

.5 AWWA C512 - Standard for Air-Release, Air/Vacuum and Combination Air Valves for Waterworks Service.

.6 AWWA C517 - Resilient-Seated Cast Iron Eccentric Plug Valves.

.7 AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

.5 Manufacturers’ Standardization Society (MSS):

.1 MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.

.2 MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

.3 MSS SP-81 - Stainless Steel, Bonnetless, Flanged, Knife Gate Valves.

.4 MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

.6 National Sanitation Foundation (NSF):

.1 NSF 61 - Drinking Water System Components - Health Effects.

.7 UL Standards:

.1 UL 429 - Electrically Operated Valves.

.2 UL 1002 - Electrically Operated Valves for Use in Hazardous Locations, Class I Groups A, B, C, and D, and Class II Groups E, F, and G.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 General

.1 If any commodities included in the Final Design are not listed in the following detailed valve Specification Sheets, select a valve Specification that most closely matches the process commodity and service conditions and refine the Specification to suit the Final Design and include in the blacklined Specification submitted for review. The quality of products and scope of execution for any such commodities not to be lower than the minimum standards set out in this Section.

.2 Detailed valve Specification Sheets follow.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

BF01

<table>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="3">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td colspan="2">PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Butterfly Valve</td><td>BF01</td><td>50 to 900</td><td>100 to 900 cwp</td><td>5 to 115</td><td colspan="2">1,000 cwp</td><td>120</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Stainless Steel (316)</td><td></td><td>Valve End/Connections</td><td>Lugged</td><td>1</td></tr>
<tr><td>Disk</td><td>Stainless Steel (316)</td><td></td><td>Type of Disk</td><td>High Performance/Single, Double, or Triple Offset/Eccentric mount</td><td></td></tr>
<tr><td>Seats</td><td>Inconel</td><td>4</td><td>Manual Operator</td><td>Lever/Handwheel</td><td>2, 3</td></tr>
<tr><td>Shaft</td><td>Stainless Steel (316)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Packing</td><td>Graphite</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bearings</td><td>316 SS Backed TFE</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">NOTES</td></tr>
<tr><td colspan="6">1. Full lug, wafer style for placement between two flanges.
2. Provide geared operators for valves 150 mm and larger with a handwheel for valves up to 500 mm and a square nut for valves 600 mm and larger.
3. Valves 100 mm and less are to have lever operators.
4. Provide valves with seats bonded to a rigid reinforcing ring.</td></tr>
</table>

<table>
<tr><td colspan="4">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td>Crane FLOWSEAL</td><td>Valtek Valdisk</td><td>Durco Big Max</td><td>Keystone Butterfly Valves</td></tr>
<tr><td>Or approved equivalent.</td><td></td><td></td><td></td></tr>
</table>

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

BF02

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Butterfly Valve	**BF02**	50 to 900	100 to 900 cwp	5 to 115	1,000 cwp	150

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Cast Iron or Ductile Iron	1	Valve End/Connections	Lugged	2
Disk	Stainless Steel (316)		Type of Disk	High Performance/Single, Double, or Triple Offset/Eccentric mount	
Seats	Viton	5	Manual Operator	Lever/Handwheel	3, 4
Shaft	Stainless Steel (316)				
Packing	Graphite				
Bearings	316 SS Backed TFE				

NOTES

1. Cast Iron ASTM 126 Class B or Ductile Iron ASTM A536.
2. Full lug, wafer style for placement between two Class 125 flanges.
3. Provide geared operators for valves 150 mm and larger with a handwheel for valves up to 500 mm and a square nut for valves 600 mm and larger.
4. Valves 100 mm and less are to have lever operators.
5. Provide valves with seats bonded to a rigid reinforcing ring.

ACCEPTABLE MANUFACTURERS			
Dezurik	Watts	Clow	Crane
Keystone Butterfly Valves	Or approved equivalent.		

BF03

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Butterfly Valve	**BF03**	50 to 750	0 to 750 cwp	5 to 30	1,200 cwp	35

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Cast Iron		Valve End/Connections	Lug Wafer	1
Disk	Ductile Iron with Nylon 11 Coating or Aluminium Bronze.	4	Type of Disk		
Disk Trim	Not Mandatory		Manual Operator	Lever/Handwheel	2, 3
Seats	Buna-N				
Shaft	Stainless Steel				

NOTES

1. Full lug, wafer style for placement between two flanges.
2. Provide geared operators for valves 150 mm and larger with a handwheel for valves up to 500 mm and a square nut for valves 600 mm and larger.
3. Valves 100 mm and less are to have lever operators.
4. Aluminum bronze disk for valves below 200 mm only.

ACCEPTABLE MANUFACTURERS			
Keystone	Bray	DeZurik	Kitz
Or approved equivalent.			

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

BV01

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Ball Valve	**BV01**	10 to 65	850 cwp	5 TO 115	1,000 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Bronze or Forged Brass		Valve End/Connections	THD, Female	2
Ball	Bronze or Chrome Plated Brass - floating		Pattern	1 piece or 2 piece	3
Seats	PTFE or Reinforced PTFE		Manual Operator	Lever	
Shaft	Bronze, Brass, or Stainless Steel (304)	1	Reference Std.	MSS SP-110	

NOTES

1. Blowout-proof stem.
2. Provide threaded end cap and chain in drain pipes.
3. Regular port.

ACCEPTABLE MANUFACTURERS			
Kitz	Flow-Tek (Bray)	Nibco	Velan
Or approved equivalent.			

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

BV03

<table>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td colspan="2" rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td colspan="2" rowspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td colspan="2">Ball Valve</td><td>BV03</td><td colspan="2">10 to 65</td><td>910 cwp</td><td>5 TO 120</td><td>1,400 cwp</td><td>120</td></tr>
<tr><td colspan="5">VALVE MATERIALS</td><td colspan="4">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td colspan="3">MATERIAL</td><td>NOTES</td><td>ITEM</td><td colspan="2">CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td colspan="3">Stainless Steel (304 or 316)</td><td>1</td><td>Valve End/Connections</td><td colspan="2">THD, Female</td><td></td></tr>
<tr><td>Ball</td><td colspan="3">Stainless Steel (304 or 316) - floating</td><td></td><td>Pattern</td><td colspan="2">Compact</td><td>3</td></tr>
<tr><td>Packing</td><td colspan="3">Reinforced PTFE</td><td></td><td>Manual Operator</td><td colspan="2">Lever</td><td></td></tr>
<tr><td>Seats</td><td colspan="3">Reinforced PTFE</td><td></td><td></td><td colspan="2"></td><td></td></tr>
<tr><td>Shaft</td><td colspan="3">Stainless Steel (304 or 316)</td><td>2</td><td></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="9">NOTES</td></tr>
<tr><td colspan="9">1. ASTM A351.
2. Blowout-proof stem.
3. Regular port.</td></tr>
<tr><td colspan="9">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td colspan="2">Velan</td><td colspan="3">Flo-Tek (Bray)</td><td colspan="2">Or approved equivalent.</td><td colspan="2"></td></tr>
</table>

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

BV08

<table>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td rowspan="2" colspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2" colspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td colspan="2">Ball Valve</td><td>BV08</td><td colspan="2">50 to 450</td><td>100-900 cwp</td><td>5 TO 100</td><td>1,000 cwp</td><td>50</td></tr>
<tr><td colspan="4">VALVE MATERIALS</td><td colspan="5">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td colspan="2">MATERIAL</td><td>NOTES</td><td>ITEM</td><td colspan="3">CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td colspan="2">Stainless Steel (316)</td><td></td><td>Valve End/Connections</td><td colspan="3">Split Body, FLG</td><td>2</td></tr>
<tr><td>Ball</td><td colspan="2">Stainless Steel</td><td>5</td><td>Pattern</td><td colspan="3">Full Port</td><td></td></tr>
<tr><td>Packing</td><td colspan="2">Reinforced PTFE</td><td></td><td>Manual Operator</td><td colspan="3">Lever/Handwheel</td><td>3, 4</td></tr>
<tr><td>Seats</td><td colspan="2">Reinforced PTFE</td><td></td><td>Special</td><td colspan="3">See note</td><td>5</td></tr>
<tr><td>Shaft</td><td colspan="2">Stainless Steel</td><td>1</td><td></td><td colspan="3"></td><td></td></tr>
<tr><td colspan="9">NOTES</td></tr>
<tr><td colspan="9">1. Blowout-proof stem.
2. Provide trunnion mounted ball on all valves 250 mm diameter and greater.
3. Provide geared operators with handwheels for valves 150 mm and larger.
4. Valves 100 mm and less to have lever operators.
5. Gas service valves to comply with CGA requirements, submit to the Manitoba Labour & Immigration Office of the Fire Commissioner.</td></tr>
<tr><td colspan="9">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td colspan="2">Velan</td><td colspan="2">Kitz</td><td colspan="3">Or approved equivalent.</td><td colspan="2"></td></tr>
</table>

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

BV09

<table>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2" colspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="3">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td colspan="2">PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Ball Valve</td><td>BV09</td><td colspan="2">75 to 300</td><td>100-900 cwp</td><td>5 TO 30</td><td colspan="2">1,000 cwp</td><td>50</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Steel</td><td></td><td>Valve End/Connections</td><td>Split Body, FLG</td><td>2</td></tr>
<tr><td>Ball</td><td>Stainless Steel (304 or 316)</td><td></td><td>Pattern</td><td>Full Port</td><td></td></tr>
<tr><td>Packing</td><td>Reinforced PTFE or AFE</td><td></td><td>Manual Operator</td><td>Lever/Handwheel</td><td>3, 4</td></tr>
<tr><td>Seats</td><td>Reinforced PTFE</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Shaft</td><td>Stainless Steel (304 or 316)</td><td>1</td><td></td><td></td><td></td></tr>
</table>

NOTES

1. Blowout-proof stem.
2. Provide trunnion mounted ball on all valves 250 mm diameter and greater.
3. Provide geared operators with handwheels for valves 150 mm and larger.
4. Valves 100 mm and less to have lever operators.

ACCEPTABLE MANUFACTURERS

Kitz	Flo-Tek (Bray)	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

BV17

GENERAL

TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Ball Valve	**BV17**	13 to 150	50 cwp	30	100 cwp	40

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	CPVC	1	Valve End/Connections	SLV, True Union	
Ball	CPVC - floating	2	Manual Operator	Lever/Handwheel	3, 4
Packing	O-ring, EPDM				
Seats	PTFE backed with Viton				
Shaft	CPVC				

NOTES

1. ASTM D1784 (Grade A).
2. Blowout-proof ball (vented) and stem required.
3. Valves 100 mm and less to have lever operators.
4. Provide geared operators with handwheels for valves 150 mm.

ACCEPTABLE MANUFACTURERS

Asahi	Nibco	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

CB01

<table>
<tr><th colspan="9">GENERAL</th></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2" colspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="3">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td colspan="2">PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Circuit Balancing Valve</td><td>CB01</td><td colspan="2">10 to 50</td><td>300 cwp</td><td>-5 TO 115</td><td colspan="2">1,720 cwp</td><td>120</td></tr>
<tr><th colspan="4">VALVE MATERIALS</th><th colspan="5">VALVE CONFIGURATION</th></tr>
<tr><td>ITEM</td><td colspan="2">MATERIAL</td><td>NOTES</td><td>ITEM</td><td colspan="3">CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td colspan="2">Bronze copper alloy</td><td></td><td>Valve End/Connections</td><td colspan="3">THD, female</td><td>1</td></tr>
<tr><td>Disk</td><td colspan="2">Bronze copper alloy</td><td></td><td>Pattern</td><td colspan="3">Y globe, multifunction</td><td>2</td></tr>
<tr><td>Disk Ring</td><td colspan="2">Teflon</td><td></td><td>Manual Operator</td><td colspan="3">Handwheel</td><td>2</td></tr>
<tr><td>Shaft</td><td colspan="2">Bronze copper alloy</td><td></td><td>Special</td><td colspan="3">See note</td><td>3</td></tr>
<tr><th colspan="9">NOTES</th></tr>
<tr><td colspan="9">1. Two 6 mm NPT connections on each side of the valve seat, complete with EPT check valve.
2. Provide valves capable of four full 360 degree turns from full open to full closed for Vernier-type settings; 20 mm NPT drain connections with protective cap; memory stop feature to allow return to balance point after shut-off; provision for connecting a portable differential pressure meter.
3. Ship valve in polyurethane container to be used for insulating valve after installation.</td></tr>
<tr><th colspan="9">ACCEPTABLE MANUFACTURERS</th></tr>
<tr><td colspan="2">Tour and Andersson</td><td colspan="2">Armstrong</td><td colspan="2">Or approved equivalent.</td><td colspan="3"></td></tr>
</table>

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

CB02

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Circuit Balancing Valve	**CB02**	65 to 200	300 cwp	-5 TO 115	1,720 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Cast Iron		Valve End/Connections	FLG	
Disk	Bronze		Pattern	Y globe, multifunction	
Disk Ring	Teflon		Manual Operator	Lever/Handwheel	2, 3
Shaft	Stainless Steel (304)		Special	See note	1

NOTES

1. Provide valves capable of four full 360 degree turns from full open to full closed for Vernier-type settings; 20 mm NPT drain connections with protective cap; memory stop feature to allow return to balance point after shut-off; provision for connecting a portable differential pressure meter.
2. Valves 100 mm and less to have lever operators for quarter turn valves and direct acting hand wheels/chain wheels for multi-turn valves.
3. Provide geared operators with handwheels for valves 150 mm and larger.

ACCEPTABLE MANUFACTURERS			
Tour and Andersson	Armstrong	Or approved equivalent.	

CV01

<table>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td colspan="2" rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td colspan="2" rowspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td colspan="2">Check Valve</td><td>CV01</td><td colspan="2">10 to 65</td><td>600 cwp</td><td>-5 to 115</td><td>850 cwp</td><td>120</td></tr>
<tr><td colspan="4">VALVE MATERIALS</td><td colspan="5">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td colspan="2">MATERIAL</td><td>NOTES</td><td>ITEM</td><td colspan="3">CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td colspan="2">Bronze</td><td>1</td><td>Valve End/Connections</td><td colspan="3">THD, Female,</td><td></td></tr>
<tr><td>Disk</td><td colspan="2">Bronze</td><td></td><td>Check Mechanism</td><td colspan="3">Swing Check, T or Y Pattern</td><td>2</td></tr>
<tr><td>Seats</td><td colspan="2">Bronze</td><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td>Hinge pin</td><td colspan="2">Stainless steel</td><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td colspan="9">NOTES</td></tr>
<tr><td colspan="9">1. ASTM B62.
2. Regular Port.</td></tr>
<tr><td colspan="9">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td colspan="2">Kitz</td><td colspan="3">Crane</td><td colspan="2">Hattersley</td><td colspan="2">Or approved equivalent.</td></tr>
</table>

CV02

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Check Valve	**CV02**	10 to 65	910 cwp	5 to 120	1,400 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Bronze	1, 2	Valve End/Connections	THD, Female,	
Disk	Bronze		Check Mechanism	Swing Check	3
Seats	Bronze				
Hinge pin, trim	Brass or copper				

NOTES

1. ASTM B62.
2. MSS-SP-80.
3. Regular Port.

ACCEPTABLE MANUFACTURERS			
Kitz	Crane	Hattersley	Or approved equivalent.

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

CV06

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Check Valve	**CV06**	75 to 250	800 cwp	-5 to 115	1,400 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Cast Iron		Valve End/Connections	Wafer	1
Disk or Plug	Bronze		Check Mechanism	Plug, silent check	
Seats	Bronze				
Screw	Stainless Steel (304 or 316)				
Spring	Stainless Steel (304 or 316)				
Bushing	Bronze				

NOTES

1. Provide wafer style valves between flanges.

ACCEPTABLE MANUFACTURERS			
Val-Matic	APCO	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

CV07

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Check Valve	**CV07**	13 to 100	600 cwp	5 to 30	850 cwp	40

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	CPVC		Valve End/Connections	See note	1
Disk	CPVC ball		Check Mechanism	Ball Check, Single Union	
Seats	PTFE		Pattern	Full Port	
Packing	EPDM or Viton				

NOTES

1. Valves 13 mm to 65 mm; Female THD, true union; Valves greater than 65 mm FLG, true union.

ACCEPTABLE MANUFACTURERS			
Hayward	Chemline	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

CV08

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Check Valve	**CV08**	75 to 250	910 cwp	5 to 100	1,300 cwp	150

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Carbon Steel		Valve End/Connections	FLG	
Disk	Chromium Steel		Check Mechanism	Swing check	
Seats	Stellite or Chromium Steel	1			
Hinge pin, trim	Manufacture standard				

NOTES

1. 13 percent chrome stainless steel.

ACCEPTABLE MANUFACTURERS

Kitz	Velan	Or approved equivalent.	

CV10

<table>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td rowspan="2" colspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2" colspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td colspan="2">Check Valve</td><td>CV10</td><td colspan="2">75 to 400</td><td>600 cwp</td><td>5 to 70</td><td>850 cwp</td><td>70</td></tr>
<tr><td colspan="5">VALVE MATERIALS</td><td colspan="4">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td colspan="3">MATERIAL</td><td>NOTES</td><td>ITEM</td><td colspan="2">CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td colspan="3">Cast Iron</td><td></td><td>Valve End/Connections</td><td colspan="2">FLG</td><td></td></tr>
<tr><td>Disk</td><td colspan="3">See note</td><td>1</td><td>Check Mechanism</td><td colspan="2">Ball Check</td><td>1</td></tr>
<tr><td colspan="9">NOTES</td></tr>
<tr><td colspan="9">1. Hollow steel ball with elastomeric coating.</td></tr>
<tr><td colspan="9">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td colspan="2">Flygt</td><td colspan="3">Or approved equivalent.</td><td colspan="2"></td><td colspan="2"></td></tr>
</table>

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

CV11

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Check Valve	**CV11**	75 to 750	100 to 600 cwp	5 to 110	850 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Cast Iron		Valve End/Connections	FLG, Lugged	1
Disk	Stainless Steel (316)		Check Mechanism	Split disk/Double leaf	
Seals	Viton		Special	See note	2
Hinge pin, trim	Stainless Steel (304)				
Spring	Inconel X-750				

NOTES

1. Provide lifting lugs on valves greater than 50 kg.
2. Gas service valves to comply with CGA requirements; submit to the Manitoba Labour & Immigration Office of the Fire Commissioner in accordance with Sections 01300 and 15100.

ACCEPTABLE MANUFACTURERS

APCO	Valmatic	Crispin	ITT
Or approved equivalent.			

CV12

<table>
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<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2" colspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Check Valve</td><td>CV12</td><td colspan="2">75 to 600</td><td>1,050 cwp</td><td>5 to 30</td><td>1,575 cwp</td><td>50</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Cast Iron</td><td></td><td>Valve End/Connections</td><td>FLG</td><td></td></tr>
<tr><td>Disk</td><td>Bronze</td><td></td><td>Check Mechanism</td><td>Plug, Silent Check</td><td></td></tr>
<tr><td>Seals</td><td>Bronze</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Spring</td><td>Stainless Steel (304)</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">NOTES</td></tr>
<tr><td colspan="6"></td></tr>
</table>

<table>
<tr><td colspan="4">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td>APCO</td><td>Val-Matic</td><td>Or approved equivalent.</td><td></td></tr>
</table>

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

CV14

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Check Valve	**CV14**	75 to 150	600 cwp	5 to 30	850 cwp	40

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	CPVC		Valve End/Connections	FLG, FF	
Disk	CPVC		Check Mechanism	Swing Check	
Seats, gasket	EPDM		Pattern	Swing Check, Regular Port	
Hinge pin, swing arm	CPVC				
Fasteners	Stainless Steel (316)				

NOTES

ACCEPTABLE MANUFACTURERS			
Hayward	Chemline	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

CV15

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Check Valve	**CV15**	50 to 1200	1,500 cwp	30	1,720 cwp	30

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body and Cover	Ductile Iron, ASTM A536, 65-45-12	1	Valve End/Connections	FLG	
Disk	Buna-N w/ Alloy Steel Reinforcement	2	Check Mechanism	Swing Check	
Seats	Welded Nickel		Reference Std.	AWWA C508 NSF 61 Certified	
Hinge pin, trim	Manufacturer's Standard		Operator	See note	3

NOTES

1. Fusion bonded epoxy lined and coated.
2. Furnish disk with integral O-ring type sealing surface.
3. Equipped with backflow actuator and mechanical disk position indicator.

ACCEPTABLE MANUFACTURERS			
Valmatic	Or approved equivalent.		

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

DG01

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Degassing Valve	**DG01**	13		15-30	650	30

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	CPVC		Valve End/Connections	THD	
Float	Polypropylene				
Linkage	CPVC				
Seals	Viton				

NOTES

ACCEPTABLE MANUFACTURERS			
Plast-o-matic	Chemline	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

GA01

<table>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Gauge/Root Valve</td><td>GA01</td><td>Less than 65</td><td>800 cwp</td><td>5 TO 100</td><td>1000 cwp</td><td>140</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Stainless Steel (316)</td><td></td><td>Valve End/Connections</td><td>See note</td><td>1</td></tr>
<tr><td>Stem</td><td>Stainless Steel (316)</td><td></td><td>Type of Body</td><td>Multiport, Gauge</td><td></td></tr>
<tr><td>Disk Trim</td><td>Stainless Steel (316 or 317)</td><td></td><td>Manual Operator</td><td>Lever/Handwheel</td><td>2, 3</td></tr>
<tr><td>Seats/Packing</td><td>PTFE</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Handle</td><td>Stainless Steel</td><td></td><td></td><td></td><td></td></tr>
</table>

NOTES

1. Provide 12 mm female gauge port, male thread process connection to suit piping.
2. Valves to have lever operators for quarter turn valves and direct acting hand wheels/chain wheels for multi-turn valves.
3. Rising Stem, OS.

ACCEPTABLE MANUFACTURERS

Anderson, Greenwood M5K	Or approved equivalent.		

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

GL01

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Globe Valve	**GL01**	Less than 65	750 cwp	-5 to 115	1,000 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Bronze		Valve End/Connections	THD, Female	
Disk	Polyurethane or PTFE				
Seats	Bronze		Operator	Handwheel	1
Shaft	Stainless Steel (316) or Bronze				

NOTES

1. Rising stem.

ACCEPTABLE MANUFACTURERS			
Kitz	Newman Hattersley	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

GL04

<table>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="3">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td colspan="2">PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Globe Valve</td><td>GL04</td><td>75 to 150</td><td>300 cwp</td><td>5 to 100</td><td colspan="2">1,000 cwp</td><td>120</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Cast Iron</td><td></td><td>Valve End/Connections</td><td>FLG</td><td></td></tr>
<tr><td>Disk</td><td>Manufacturer’s Standard</td><td></td><td>Operator</td><td>Handwheel</td><td>1</td></tr>
<tr><td>Seats</td><td>Bronze Ring</td><td></td><td>Reference Std.</td><td>MSS SP-85</td><td></td></tr>
<tr><td>Shaft</td><td>Copper Alloy 864</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">NOTES</td></tr>
<tr><td colspan="6">1. Rising stem.</td></tr>
</table>

<table>
<tr><td colspan="4">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td>Crane</td><td>Kitz</td><td>Or approved equivalent.</td><td></td></tr>
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DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

GV01

<table>
<tr><td colspan="9">GENERAL</td></tr>
<tr><td rowspan="2" colspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2" colspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td colspan="2">Gate Valve</td><td>GV01</td><td colspan="2">10 to 65</td><td>600 cwp</td><td>5 to 100</td><td>1,000 cwp</td><td>120</td></tr>
<tr><td colspan="4">VALVE MATERIALS</td><td colspan="5">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td colspan="2">MATERIAL</td><td>NOTES</td><td>ITEM</td><td colspan="3">CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td colspan="2">Bronze</td><td>1</td><td>Valve End/Connections</td><td colspan="3">THD, Female</td><td></td></tr>
<tr><td>Disk</td><td colspan="2">Bronze</td><td>1</td><td>Type of Disk</td><td colspan="3">Solid Wedge</td><td></td></tr>
<tr><td>Seats</td><td colspan="2">Bronze</td><td></td><td>Operator</td><td colspan="3">Handwheel</td><td>2</td></tr>
<tr><td>Seals/Packing</td><td colspan="2">Manufacturer Standard</td><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td>Stem</td><td colspan="2">Bronze</td><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td></td><td colspan="2"></td><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td colspan="9">NOTES</td></tr>
<tr><td colspan="9">1. ASTM B62.
2. Rising stem.</td></tr>
<tr><td colspan="9">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td colspan="2">Kitz</td><td colspan="2">Nibco</td><td colspan="2">Or approved equivalent.</td><td colspan="3"></td></tr>
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DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

GV04

<table>
<tr><td colspan="7">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Gate Valve</td><td>GV04</td><td>75 to 600</td><td>600 cwp</td><td>5 to 30</td><td>850 cwp</td><td>50</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Cast or Ductile Iron</td><td></td><td>Valve End/Connections</td><td>FLG</td><td></td></tr>
<tr><td>Disk</td><td>Bronze, Cast Iron, or Ductile Iron</td><td></td><td>Type of Disk</td><td>Solid Wedge</td><td></td></tr>
<tr><td>Seats</td><td>Bronze</td><td></td><td>Operator</td><td>Handwheel</td><td>1</td></tr>
<tr><td>Seals/Packing</td><td>O-Rings, Manufacturer Standard</td><td></td><td>Reference Std.</td><td>MSS SP-70 Type 1</td><td></td></tr>
<tr><td>Shaft</td><td>Brass</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">NOTES</td></tr>
<tr><td colspan="6">1. Rising stem, OS&Y.</td></tr>
</table>

<table>
<tr><td colspan="4">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td>Crane</td><td>Kitz</td><td>Terminal City</td><td>Or approved equivalent.</td></tr>
</table>

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

GV05

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Gate Valve	**GV05**	50 to 300	1,050 cwp	5 to 20	1,575 cwp	30

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body & Bonnet	Cast Iron	1	Valve End/Connections	FLG	
Disk	Cast Iron or Ductile Iron	2	Type of Disk	Solid Wedge	6
Disk Coating	Urethane Rubber	3	Operator	Hand Wheel, Closed Bonnet	7
Seals/Packing	O-Rings, Manufacturer Standard		Special	Ground level position indicator	8
Shaft	Bronze or Stainless Steel		Reference Std.	AWWA C509	
Bonnet Gasket	Rubber	4			
Stem Nut	Bronze				
Operating Nut	Cast Iron	1			
Wiper Ring	Rubber	4			
Bonnet Bolt & Nut	Zinc-Coated Steel Sealed with Hot Melt	5			
Gland Bolts	Zinc-Coated Steel	5			

NOTES

1. ASTM A126, Class B.
2. ASTM A536.
3. ASTM D429.
4. ASTM D2000.
5. ASTM A164.
6. Resilient seat.
7. Non-rising stem.
8. Below grade service to have valve box with stem extension.

ACCEPTABLE MANUFACTURERS			
CLOW	American	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

GV06

<table>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="3">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td colspan="2">PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Gate Valve</td><td>GV06</td><td>150 to 1050</td><td>600 cwp</td><td>5 to 30</td><td colspan="2">850 cwp</td><td>50</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Cast Iron</td><td></td><td>Valve End/Connections</td><td>FLG</td><td></td></tr>
<tr><td>Disk</td><td>Bronze</td><td></td><td>Type of Disk</td><td>Flexible Wedge</td><td>1</td></tr>
<tr><td>Disk Coating</td><td>Bronze</td><td></td><td>Operator</td><td>Handwheel / Square Nut</td><td>2, 3</td></tr>
<tr><td>Seals/Packing</td><td>Manufacturer Standard</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Shaft</td><td>Carbon Steel</td><td></td><td></td><td></td><td></td></tr>
</table>

NOTES

1. Flexible wedge disk for valve sizes 600 mm and less; fusible or double wedge disk for valve sizes greater than 600 mm.
2. Rising stem, OS&Y.
3. Provide handwheels for valves up to 500 mm and geared operators with square nuts for valves 600 mm and larger.

ACCEPTABLE MANUFACTURERS

Kitz	Fabri-Valve	Terminal City	Or approved equivalent.

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

GV07

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Gate Valve	**GV07**	150 to 1050	600 cwp	5 to 30	850 cwp	50

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Cast Iron		Valve End/Connections	FLG	
Disk	Bronze		Type of Disk	Solid Wedge	
Disk Coating	Bronze		Operator	Handwheel / Square Nut	1, 2, 3
Seals/Packing	O-Ring, Buna-N				
Shaft	Carbon Steel				

NOTES

1. Non-rising stem, closed bonnet.
2. Below grade services to have valve box with stem extension.
3. Provide handwheels for valves up to 500 mm and geared operators with square nuts for valves 600 mm and larger.

ACCEPTABLE MANUFACTURERS			
Kitz	Fabri-Valve	Terminal City	Or approved equivalent.

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

KV01

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Knife Gate Valve	**KV01**	75 to 1000	1,050 cwp	5 to 30	1,375 cwp	50

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Cast Iron	1	Valve End/Connections	Lugged	
Disk	Stainless Steel (316)				
Seats	Buna N		Operator	Handwheel, Bonnetless, except for raw sewage applications	1, 2, 3
Seals	Buna N		Pattern	Full port	
Shaft	Stainless Steel (316)				
Wiper Ring	Reinforced PTFE				
Pillars	Stainless Steel (316)				

NOTES

1. Rising stem.
2. Provide geared operators for valves 150 mm and larger with a handwheel for valves up to 500 mm and a square nut for valves 600 mm and larger.
3. Valves 100 mm and less to have direct acting hand wheels/chain wheels.

ACCEPTABLE MANUFACTURERS			
DeZurik	Fabri-Valve	Red Valve	Velan
Trueline	Or approved equivalent.		

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

NV01

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Needle Valve	**NV01**	≤ 65	900 cwp	5 to 100	1,100 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Stainless Steel (304 or 316)		Valve End/Connections	THD, Female	
Stem	Stainless Steel (304 or 316)		Type of Disk	Needle	
Seats	Stainless Steel (304 or 316)		Operator	Screwed Bonnet, bar handle	
Seals/Packing	PTFE or Reinforced PTFE				
Handle	Stainless Steel or Phenolic				

NOTES

ACCEPTABLE MANUFACTURERS		
Swagelok/Nupro	Anderson, Greenwood & Co.	Or approved equivalent.

NV02

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Needle Valve	**NV02**	10 to 65	910 cwp	5 to 100	1,300 cwp	150

VALVE MATERIALS			VALVE CONFIGURATION		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Stainless Steel (316)	1	Valve End/Connections	THD, Female FLG	2
Seats	Stainless Steel (304 or 316)		Type of Stem	Needle, Plug Tip	
Seals/Packing	PTFE		Operator	Bar Handle	3
Handle	Stainless Steel (304)		Type of Body	Three-way or Two-way Valve Manifold	
Flange Seal	Viton				

NOTES

1. ASTM A479.
2. FLG for connection to instruments or THD for ends.
3. Outside Screw, rising stem.

ACCEPTABLE MANUFACTURERS		
Whitey	Anderson, Greenwood & Co.	Or approved equivalent.

.1 Or approved equivalent.

PD01

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Pump Discharge Valve	**PD01**	65 to 300	300 cwp	-5 to 115	1,720 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Ductile Iron or Cast Iron	1	Valve End/Connections	THD, Female	
Disk	Bronze Plug				
Seats	High Strength Resin		Operator	Handwheel	
Shaft	Stainless Steel (304)				
Spring	Stainless Steel (304)				

NOTES

1. Two 6 mm NPT connections on each side of the valve seat, complete with EPT check valve.

ACCEPTABLE MANUFACTURERS		
Bell and Gossett	Armstrong	Or approved equivalent.

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

PSV01

<table>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2">MAIN
LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="3">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE
(kPa)</td><td>TEMP.
(°C)</td><td colspan="2">PRESSURE
(kPa)</td><td>TEMP.
(°C)</td></tr>
<tr><td>Sewage Combination Air Valve</td><td>PSV01</td><td>25 to150</td><td>50</td><td>5 to 30</td><td colspan="2">1,000</td><td>50</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Cast Iron</td><td></td><td>Valve End/Connections</td><td>THD/FLG</td><td>1</td></tr>
<tr><td>Bonnet</td><td>Cast Iron</td><td></td><td>Reference Std.</td><td>AWWA C512</td><td></td></tr>
<tr><td>Needle & Seat</td><td>Nitrile</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Float</td><td>Stainless Steel (304 or 316)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Stem</td><td>Stainless Steel (304 or 316)</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">NOTES</td></tr>
<tr><td colspan="6">1. Provide backflushing kit and attachments including inlet and blow off valves, quick disconnect coupling and minimum 2 m hose for flushing.</td></tr>
</table>

<table>
<tr><td colspan="4">ACCEPTABLE MANUFACTURERS</td></tr>
<tr><td>Vent-o-mat</td><td>APCO</td><td>Val-Matic</td><td>Or approved equivalent.</td></tr>
</table>

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

PSV02

GENERAL						
TYPE OF VALVE	SYMBOL	MAIN LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Sewage Combination Air Valve	**PSV02**	200 to 1,500	50	5 to 30	1,000	50

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Stainless Steel (316)		Body	Single body	
Bonnet	Stainless Steel (316)		Valve End/Connections	THD/FLG	1
Needle & Seat	Nitrile		Reference Std.	AWWA C512	
Float	Stainless Steel (316)				
Stem	Stainless Steel (316)				

NOTES

1. Provide backflushing kit and attachments including inlet and blow off valves, quick disconnect coupling and minimum 2 m hose for flushing.

ACCEPTABLE MANUFACTURERS			
APCO	Val-Matic	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

TW01

<table>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2" colspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Two-way Multiport Valve</td><td>TW01</td><td colspan="2">10 to 200</td><td>300 cwp</td><td>-5 to 115</td><td>1,720 cwp</td><td>120</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>Bronze (THD)</td><td>2</td><td>Valve End/Connections</td><td>THD, Female
FLG</td><td>1</td></tr>
<tr><td>Disk</td><td>See note</td><td>3</td><td>Type of Stem</td><td>Needle, Plug Tip</td><td></td></tr>
<tr><td>Packing</td><td>PTFE</td><td></td><td>Pattern</td><td>Two-Way</td><td></td></tr>
<tr><td>Seats</td><td>See note</td><td>4</td><td></td><td></td><td></td></tr>
<tr><td>Shaft</td><td>Stainless Steel (304)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Plug</td><td>See note</td><td>5</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

NOTES

1. Valves less than 50 mm to be threaded, valves greater than 50 mm to be flanged.
2. Flanged bodies to be cast iron.
3. Threaded valves to be teflon disks and brass disk holder.
4. Threaded valves to have replaceable brass seats; flanged valves to have replaceable bronze seats.
5. Threaded valves to be contoured brass plug; flanged valves with cast iron plug.

ACCEPTABLE MANUFACTURERS

Honeywell	Fisher Baumann	Or approved equivalent.

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

TW02

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Three-way Multiport Valve	**TW02**	10 to 200	300 cwp	-5 to 115	1,720 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Bronze (THD)	2	Valve End/Connections	THD, Female FLG	1
Disk	See note	3	Type of Stem	Needle, Plug Tip	
Packing	PTFE		Pattern	Three-Way	
Seats	See note	4			
Shaft	Stainless Steel (304)				
Plug	See note	5			

NOTES

1. Valves less than 65 mm to be threaded, valves greater than 65 mm to be flanged.
2. Flanged bodies to be cast iron.
3. Threaded valves to be Teflon disks and brass disk holder.
4. Threaded valves to have replaceable brass seats; flanged valves to have replaceable bronze seats.
5. Threaded valves to be contoured brass plug; flanged valves with cast iron plug.

ACCEPTABLE MANUFACTURERS		
Honeywell	Bray	Or approved equivalent.

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

SV01

<table>
<tr><td colspan="8">GENERAL</td></tr>
<tr><td rowspan="2">TYPE OF VALVE</td><td rowspan="2">SYMBOL</td><td rowspan="2" colspan="2">LINE SIZE (mm)</td><td colspan="2">OPERATING LIMITS</td><td colspan="2">DESIGN LIMITS</td></tr>
<tr><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td><td>PRESSURE (kPa)</td><td>TEMP. (°C)</td></tr>
<tr><td>Solenoid Valve: 2-way/2 position</td><td>SV01</td><td colspan="2">4 to 25</td><td>750 cwp</td><td>-15 to 115</td><td>1,030 cwp</td><td>120</td></tr>
</table>

<table>
<tr><td colspan="3">VALVE MATERIALS</td><td colspan="3">VALVE CONFIGURATION</td></tr>
<tr><td>ITEM</td><td>MATERIAL</td><td>NOTES</td><td>ITEM</td><td>CONFIGURATION</td><td>NOTES</td></tr>
<tr><td>Body</td><td>304 Stainless Steel</td><td></td><td>Valve End/Connections</td><td>THD</td><td></td></tr>
<tr><td>Seal</td><td>Buna N or PTFE</td><td></td><td>Operator</td><td>Solenoid</td><td></td></tr>
<tr><td>Disk</td><td>Buna N or PTFE</td><td></td><td>Lining</td><td>None</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Pattern</td><td>2-way/2 position, direct acting and internal pilot type.</td><td>3, 4</td></tr>
<tr><td></td><td></td><td></td><td>Solenoid Coil</td><td>Fully encapsulated Class F or Class H coil.</td><td>1</td></tr>
<tr><td></td><td></td><td></td><td>NEMA Enclosure, type</td><td>4X/7</td><td>2</td></tr>
</table>

NOTES

1. Continuous duty rating, 120 VAC.
2. Explosion –Proof, Dual Rated.
3. Capable of sealing or unsealing the pressurized (supply) port when mounted in any position or orientation.
4. Capable of opening or closing with a minimum operating pressure differential of 35 kPa.

ACCEPTABLE MANUFACTURERS

Automatic Switch Company (ASCO)	Honeywell Skinner	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

SV02

GENERAL

TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS PRESSURE (kPa)	OPERATING LIMITS TEMP. (°C)	DESIGN LIMITS PRESSURE (kPa)	DESIGN LIMITS TEMP. (°C)
Solenoid Valve: Globe Style External Pilot	**SV02**	4 to 65	750 cwp	-15 to 115	1,030 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	Cast Iron, ASTM A48 or Ductile Iron, ASTM A536		Valve End/Connections	THD, 50 mm or less FLG, 65 mm or greater	
Trim	Stainless Steel		Operator	Solenoid	
Disk	Buna N or PTFE		Lining	Epoxy, NSF 61 certified.	
Pilot control body	Brass		Pattern	2-way/2 position, external pilot actuated type. Globe style main valve body.	3, 4, 5
Pilot Seal	Buna N or PTFE		Solenoid Coil	Fully encapsulated Class F or Class H coil.	1
Pilot Disk	Buna N or PTFE		NEMA Enclosure, type	4X/7	2

NOTES

1. Continuous Duty Rating, 120 VAC.
2. Explosion–Proof, Dual Rated.
3. Capable of sealing or unsealing the pressurized (supply) port when mounted in any position or orientation.
4. Furnish flow restriction on exhaust port to limit actuation speed to the “Open/Close Time”.
5. Capable of opening or closing with a minimum operating pressure differential of 35 kPa

ACCEPTABLE MANUFACTURERS

Singer Valve	Cla-Val Co.	Golden Anderson	Or approved equivalent.

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

SV03

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Solenoid Valve: 3-way/2 position	**SV03**	4 to 25	850 cwp	-15 to 115	1,030 cwp	120

VALVE MATERIALS			VALVE CONFIGURATION		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	304 Stainless Steel		Valve End/Connections	THD	
Seal	Buna N or PTFE		Operator	Solenoid	
Disk	Buna N or PTFE		Lining	None	
			Pattern	3-way/2 position, direct acting and internal pilot type.	3, 4, 5
			Solenoid Coil	Fully encapsulated Class F or Class H coil.	1
			NEMA Enclosure, type	4X/7	2

NOTES

1. Continuous Duty Rating, 120 VAC.
2. Explosion–Proof, Dual Rated.
3. Capable of sealing or unsealing the pressurized (supply) port when mounted in any position or orientation.
4. Furnish flow restriction on exhaust port to limit actuation speed to the “Open/Close Time”.
5. Capable of opening or closing with a minimum operating pressure differential of 35 kPa.

ACCEPTABLE MANUFACTURERS

Automatic Switch Company (ASCO)	Honeywell Skinner	Or approved equivalent.	

DETAILED BUILDING MECHANICAL VALVE SPECIFICATION SHEETS

SV04

GENERAL						
TYPE OF VALVE	SYMBOL	LINE SIZE (mm)	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	TEMP. (°C)
Solenoid Valve: 4-way/2 position	**SV04**	4 to 25	850 cwp	-15 to 115	1,030 cwp	120

VALVE MATERIALS			**VALVE CONFIGURATION**		
ITEM	MATERIAL	NOTES	ITEM	CONFIGURATION	NOTES
Body	304 Stainless Steel		Valve End/Connections	THD	
Seal	Buna N or PTFE		Operator	Solenoid	
Disk	Buna N or PTFE		Lining	None	
			Pattern	4-way/2 position, direct acting and internal pilot type.	3, 4, 5
			Solenoid Coil	Fully encapsulated Class F or Class H coil.	1
			NEMA Enclosure, type	4X/7	2

NOTES

1. Continuous duty rating, 120 VAC.
2. Explosion–Proof, Dual Rated.
3. Capable of sealing or unsealing the pressurized (supply) port when mounted in any position or orientation.
4. Furnish flow restriction on exhaust port to limit actuation speed to the “Open/Close Time”.
5. Capable of opening or closing with a minimum operating pressure differential of 35 kPa.

ACCEPTABLE MANUFACTURERS			
Automatic Switch Company (ASCO)	Honeywell Skinner	Or approved equivalent.	

END OF SECTION

RADIANT SLAB HEATING - SNOWMELT

1. GENERAL

1.1 Summary

.1 This Section specifies radiant slab heating system components which includes exterior snow melt systems.

.2 Complete radiant slab system to include, but not be limited to, the following system components:

   .1 Cross-linked polyethylene (PEX) piping with oxygen barrier.

   .2 Approved pipe fastening system to the structural rebar.

   .3 Supply and return manifolds for individual radiant loops with all accessories and recessed manifold enclosure.

   .4 Approved piping adapters and compression type connection couplings.

   .5 Straight and 90-degree piping protection conduits and bend supports.

   .6 Thermal break and control/expansion joint stripping (high density closed cell insulation).

   .7 Control, balancing and drain valves, air vents.

1.2 Standards

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

   .1 ASTM E84 - Standard Test method for Surface Burning Characteristics of Building Materials.

   .2 ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

   .3 ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems.

   .4 ASTM F2080 - Standard Specification for Cold-Expansion Fittings with Metal Compression Sleeves for Crosslinked Plyethylene (PEX) Pipe.

.2 Canadian Standards Association (CSA):

   .1 CSA B137.5 - Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.

   .2 CSA B214 – Installation Code for Hydronic Heating Systems.

.3 Deutsches Institut für Normung (DIN):

.1 DIN 4726 - Warm water surface heating systems and radiator connecting systems - Plastics piping systems and multilayer piping systems.

.4 UL Solutions of Canada:

.1 CAN/ULC S101 – Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.5 National Sanitation Foundation (NSF).

.6 Plastic Pipe Institute (PPI) TR-3 – Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Shop Drawing Submittals:

.1 Submit computer-generated system design indicating pipe sizing, spacing, flow rates and temperatures. Design calculations to be performed on pipe Manufacturer’s software or equivalent.

.2 Indicate design, schematic layout of system, including equipment, critical dimensions, and piping/slab penetration details as well as details for protecting exposed PEX piping.

.3 The design to be certified by a qualified professional engineer, as being complete and accurate.

2. PRODUCTS

2.1 Manufacturers and Products

.1 All radiant slab system components shall be provided by one Manufacturer.

.2 Acceptable Manufacturers:

.1 Heat Link.

.2 Rehau.

.3 Uponor.

.4 Watts.

.5 Or approved equivalent.

2.2 Performance Requirements

.1 Provide radiant slab heating to facilitate even slab temperature control for melting snow and drainage off the surface.

.2 Heating system shall be with propylene glycol recirculation.

2.3 Piping Materials and Products

.1 Radiant slab piping to be in accordance with ASTM F876 and CSA B137.5 manufactured from flexible high molecular cross-linked polyethylene piping (PEX) complete with oxygen diffusion barrier, and to have the PPI TR-3 certification. Maximum operating pressure and temperature; 600 kPa and 95°C, respectively.

.2 PEX piping to be manufactured in accordance with the Engel method. Oxygen diffusion barrier to comply with DIN 4726 requirements and to limit oxygen diffusion through PEX piping walls to less than 0.04g/(m^3/day) at 40°C.

.3 Fittings:

.1 Fittings are only permitted outside of the concrete slab. All tubing within the slab to be continuous unless a repair has been approved by the Professional of Record and/or Manufacturer’s representative.

.2 Fitting to be certified to applicable standards with independent listings from NSF and/or CSA as applicable.

.3 Compression nut manifold fittings to be manufactured of brass with a barbed insert and a split compression ring.

.4 Compression-sleeve fittings to be manufactured of brass and to be approved by the piping manufacturer to be part of a proven catalogued system.

.5 Fittings encased behind walls or ceilings to be cold-expansion compression-sleeve fittings certified to ASTM F2080. Where required by the manufacturer, fittings to be protected from external environmental conditions.

.4 The radiant slab piping to be installed within structural concrete slabs as set out in with the Specifications.

.5 Install slab surface temperature sensors to facilitate for even slab temperature control.

2.4 Supply and Return Manifolds

.1 Provide modular supply and return balancing manifolds of stainless steel construction as used in typical in-floor heating systems complete with wall support brackets, end caps, manual air vents, hose bibs, thermometers; supply module with built in shut off valves, and return module with flow regulating and balancing valves with flow meters for each circuit.

.2 Manifolds to be placed in an accessible manifold housing. Housing to be a pre-manufactured metal access box. Doors are to be hinged to allow for unobstructed access.

.3 All loop numbers to be marked on PEX pipe before connecting to manifold. Space identification and loop number is to be printed and placed on each pipe end where it connects to the supply and return header. All loops to be clearly identified to allow for future balancing.

.4 Manifolds to be protected during construction from dirt, dust or concrete during the pour by using a plastic wrap or other effective method.

2.5 Frost Protection

.1 The heat transfer fluid shall be solution of 50 percent glycol and 50 percent water.

.2 Glycol Type: Propylene Glycol.

2.6 Controls

.1 Snow-Melting Control: Snow-Melting control shall be able to perform the following functions:

  .1 Automatically turn on the snow-melting system when snow or ice is forming on the slab in the locations as specified in the Final Design.

  .2 Automatically turn off the snow-melting system when snow or ice has been melted.

  .3 Idle the slab to minimize slab temperature ramp up times.

  .4 Control the heating up of the slab from cold starts to minimize thermal shock.

  .5 Protect heating source from freezing.

  .6 Integrate with the Plant Control System.

.2 Standard of acceptance: Uponor Climate Control Multifunction (CCM) with modulating valve control, Slab Sensor, snowmelt control and Auto Snow/Ice Sensor.

2.7 Signage

.1 Provide signage at all locations with radiant heating snowmelt systems.

.2 Provide coloured 1.6 mm thick, minimum 400 mm x 300 mm square warning sign, with 75 mm high text. Signage will meet the requirements for aluminum signboards and posts in Section 10440 - Signage.

  .1 Text:

CAUTION: RADIANT TUBING IN SLAB DO NOT DRILL

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Snow-Melting Installation:

  .1 Install hydronic snow-melting tubing loops in accordance with tubing Manufacturer's recommendations. Installation shall follow Shop Drawings for tube layout, tube spacing, manifold configuration, manifold location, and controls. Comply with notes on Shop Drawings.

  .2 Install all sensors associated with the systems operation in the location, position and manner recommended by Manufacturer.

.4 Radiant slab piping embedded in concrete slab to be secured to the underside of the structural rebar by nylon zip-ties or other fastening method approved by piping Manufacturer maintaining the minimum and maximum depth coverage as required by Manufacturer.

.5 Piping that passes through expansion joints to be covered in protective polyethylene corrugated sleeving (flexible conduit) extending 38 cm on each side of the joint. Sleeving to be secured on pipe to prevent movement during installation of thermal mass.

.6 Piping loop connections at the supply and return manifolds to be made with compression type fittings supplied and approved by the piping manufacturer. Provide tube bent supports where loops are connected to the manifolds.

.7 Piping to be fully enclosed in a protective elbow or straight conduit where it penetrates into the slab, or where it penetrates control or expansion joints in the concrete slab as per Manufacturer's recommendations.

.8 Install slab sensors as per Manufacturer's recommendation.

.9 Install PEX tube with tracer wire wrapped around pipe to allow identification of tubing on x-ray. Wire should be diagonally wrapped to complete one pipe circumference every 200 mm. Fix tracer wire with nylon zip-ties. Do not secure tracer wire to rebar.

.10 Testing:

  .1 Perform the following additional testing:

    .1 Pressure test radiant slab PEX piping to 690 kPa water pressure. Maintain continuous 345 kPa air or water pressure on pipework during placing of concrete topping and maintain pressure until topping is set.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of pre-insulated heating pipe with factory applied jacket for use in buried glycol heating/cooling systems.

1.2 Standards

.1 American National Standards Institute (ANSI):

.1 ANSI/AWWA C111/A21.11 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

.2 ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

.3 ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.

.4 ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1 - Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Lobed Head and Lag Screws (Inch Series).

.6 ASME B18.2.2 - Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A47/A 47M - Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536 - Standard Specification for Ductile Iron Castings.

.4 ASTM C272 - Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.

.5 ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.6 ASTM D638 - Standard Test Method for Tensile Properties of Plastics.

.7 ASTM D1000 - Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.

.8 ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

.9 ASTM D1622 - Standard Test for Apparent density of Rigid Cellular Plastics.

.10 ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

.11 ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

.12 ASTM D4883 - Standard Test Method for Density of Polyethylennnnne by the Ultrasound Technique.

.13 ASTM D6226 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics.

.14 ASTM E202 - Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 Canadian Standards Association (CSA):

.1 CSA W48 - Filler Metals and Allied Materials for Metal Arc Welding.

.4 International Organization for Standardization (ISO) - ISO 9001 Standards.

1.3 Submittals

.1 Submit product data in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Performance Criteria

.1 Factory installed pre-insulated pipe, and 1.27 mm to 2.54 mm black polyethylene jacket with UV inhibitor. Jacket thickness to be dependent on the insulated pipe diameter and its intended function. The insulation of associated joints, fittings, and accessories to be as per Manufacturer’s recommendations. Manufacture the product in accordance with International Organization for Standardization (ISO) - ISO 9001 Standards.

2.2 Pipes

.1 Steel pipe: to ASTM A53/A 53M, Grade B, as follows:

.1 To 150 mm: Schedule 40.

.2 200 mm and over: Schedule 10.

.3 300 mm and over, 10 mm wall thickness.

2.3 Pipe Joints

.1 50 mm and under, indoor, above grade:

- .1 Screwed fittings with PTFE tape.
  - .1 Pipe thread: taper.

.2 65 mm and over, indoor, above grade:

- .1 Welding fittings and flanges to CSA W48.
- .2 Flanges: raised face, slip-on to ANSI/AWWA C111/ A21.11.
  - .1 Flange gaskets: to ANSI/AWWA C111/ A21.11.
  - .2 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

2.4 Fittings

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

- .1 Cast iron: to ASME B16.1, Class 125.
- .2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A 47M and ASME B16.3.

2.5 Insulation

.1 Material: rigid PUF, factory applied.

.2 Thickness: minimum 50 mm then to Manufacturer’s standards.

.3 Density: ASTM D1622 35 to 48 kg/m^3.

.4 Closed cell content: ASTM D6226 90 percent, minimum.

.5 Water absorption: ASTM D2842 maximum 4.0 percent by volume.

.6 Thermal conductivity: ASTM C518 0.020 to 0.025 W/m°C.

.7 Temperature range: Cryogenic to 93.3°C.

2.6 Outer Jacket

.1 Extruded outer protective jacket to consist of black high density polyethylene copolymer, UV inhibited, and factory applied as per the following specifications:

.1 Minimum cell classification 435560A for PE as per ASTM D3350.

.2 Minimum 2 percent carbon black, well dispersed.

.3 Density 0.953 g/cm3 ASTM D4883.

.4 Tensile Strength at yield 50.8 mm/min 26 MPa, ASTM D638.

2.7 Joints

.1 Insulated pipe joints to be completed using prefabricated rigid polyisocyanurate or urethane foam half-shells and sealed with the application of suitable wrap around adhesive lined heat shrink sleeves. The heat shrink sleeves to overlap the insulation jacket by a minimum of 75 mm on either side of the joint.

2.8 Insulated Fittings Kits

.1 Rigid polyisocyanurate or urethane foam half-shells insulation with a fully bonded polymer protective coating on all exterior and interior surfaces, including ends. Supply all insulation kits with silicone caulking for seams, stainless steel bands and gear clamps.

.2 Rigid polyisocyanurate or urethane foam insulation:

.1 Density: ASTM D1622 32 kg/m³.

.2 Compressive strength: ASTM D1621 124 to 186 kPa.

.3 Closed cell content: ASTM D6226, 90 percent, minimum.

.4 Water absorption: ASTM C272, 2.0 percent by volume.

.5 K factor: ASTM C518, 0.027 W/m°C.

.6 Thickness: 50.8 mm, other thicknesses upon request, match pipe insulation thickness.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Bury at sufficient depth such that the top of pipe insulation is 100 mm below the frost line.

.4 Perform the following additional testing activities:

.5 Verification of Conditions: verify that conditions of substrate installed are acceptable for hydronic systems installation in accordance with Manufacturer's written instructions.

.6 Perform verification of electric tracing system.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the following for a circulating hot water/glycol system:

.1 Air separators.

.2 Pump Discharge Valves.

.3 Pump Suction Diffusers.

.4 Balancing Valves.

.5 Flow Sensors.

.6 Automatic Air Vent Valves.

.7 Manual Air Vent Valves.

.8 Pipe Line Strainers.

.2 Expansion Tanks and Glycol Feed Tanks: Refer to Section 15130.

1.2 Standards

.1 American National Standards Institute (ANSI):

.1 ANSI B16.1 - Pipe Flanges and Flanged Fittings.

.2 American Society of Mechanical Engineers (ASME):

.1 ASME Section VIII - Boiler and Pressure Vessel Code, Rules for Construction of Pressure Vessels.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A516 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.

.2 ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A536 - Standard Specification for Ductile Iron Castings.

.4 ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

.5 ASTM A582 - Standard Specification for Free-Machining Stainless Steel Bars.

.6 ASTM A302 - Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel.

.7 ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.8 ASTM A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

.9 ASTM A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.10 ASTM B176 - Standard Specification for Copper-Alloy Die Castings.

1.3 Submittals

.1 Submit product data in accordance with Sections 01300, 15010 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Products:

.1 Air Separator:

.1 Amtrol, Series AS.

.2 Armstrong, Model VAS.

.3 Bell & Gossett, Rolairtrol Series, Model R.

.4 Taco, Model ACTXXF.

.5 Or approved equivalent.

.2 Pump Discharge Valve:

.1 Armstrong Flo-Trex Series.

.2 Bell & Gossett Series B830, B831, or B832.

.3 Mueller Series TDV.

.4 Taco, Model PMPV.

.5 Or approved equivalent.

.3 Pump Suction Diffuser:

.1 Armstrong, SG Series.

.2 Bell & Gossett, figure B, C, or D.

.3 Grundfos, SD Series.

.4 Taco, Model RSP.

.5 Or approved equivalent.

.4 Balancing Valve:

.1 Armstrong, Model CBV.

.2 Bell & Gossett, Circuit Setter.

.3 Watts/Illinois, CSM Series.

.4 Taco, Accu-Flo Series.

.5 Or approved equivalent.

.5 Flow Sensor:

.1 Bell & Gossett, Circuit Setter.

.2 Taco, Accu-Flo Series.

.3 Watts/Illinois, CSM Series.

.4 Or approved equivalent.

.6 Automatic Air Vent Valve:

.1 Hoffman, Series 78.

.2 Bell & Gossett, Number 87.

.3 Armstrong, AV Series.

.4 Or approved equivalent.

.7 Manual Air Vent Valve:

.1 Bell & Gossett No. 4v.

.2 Hoffman No. 508.

.3 Watts, Model 238C.

.4 Or approved equivalent.

.8 Pipe Line Strainer:

.1 Bell & Gossett.

.2 Watts.

.3 Or approved equivalent.

2.2 Materials

Component	Material
Air Separator	
Body	ASTM A516 Gr. 70, carbon steel
Strainer	ASTM A240 Type 304, stainless steel
Pump Discharge Valve	
Body	ASTM A536, ductile iron
Disk and Seat	ASTM B584, bronze
Stem	ASTM A582 Type 416, stainless steel
Spring	ASTM A302, stainless steel
Pump Suction Diffuser	
Body	ASTM A126, cast iron
Cover	ASTM A126, cast iron
Inlet Vanes	ASTM A126, cast iron
Strainer	ASTM A302, stainless steel
Start-up Strainer	ASTM A568M / ASTM A153M, galvanized steel
Balancing Valve	
Body	ASTM B176, B584, or A126, brass, bronze, or cast iron
Seat	Teflon
Flow Sensor	
Body	ASTM A126, cast iron
Orifice	ASTM A240 Type 304, stainless steel
Gauge Fittings	ASTM B176, brass
Automatic Air Valve	
Body	Brass
Internals	Non-ferrous
Manual Air Valve	Chrome-plated brass
Pipe Line Strainer	
Body (NPS 13 to 50)	Bronze to ASTM B 62
Body (NPS 65 to 300)	Cast steel to ASTM A 278/A278M
Screen	Stainless steel

2.3 Configuration, Components and Features

.1 Air Separator:

.1 Construct the air separator in accordance with the ASME code and code stamped for 860 kPa design pressure. The inlet and outlet connections are to be either flanged or threaded as per Manufacturer's standard for the unit size specified. Provide an air separator without a strainer. Provide a blowdown or drain connection in the bottom of the unit and a threaded, air outlet connection in the top of the unit. Provide support legs for the air separator if supported from the floor.

.2 Balancing Valves:

.1 Balancing valve shall be a calibrated valve equipped with an integral, precision machined orifice. A gauge connection shall be provided on each side of the orifice for connecting to the portable differential pressure meter specified in paragraph 2.5. Each gauge connection shall have an integral check valve and a threaded protection cap. The balancing valve shall have an external, calibrated nameplate to indicate the degree of valve closure.

.3 Flow Sensor:

.1 Flow sensor shall be a wafer-type fitting, suitable for installation between standard ANSI flanges. An accurate, corrosion resistant orifice shall be retained within the flow sensor body. The flow sensor body shall have a pressure tap complete with gauge fitting on each side of the orifice. The gauge fitting shall have an integral check valve and a threaded protection cap. The gauge fitting shall be suitable for connecting to the portable differential pressure meter specified below. A calibrated nameplate detailing the flow range through a range of differential head pressures shall be provided for each flow sensor.

.4 Automatic Air Vent Valve:

.1 Automatic air vent valve shall be the float operated type, designed for 1034 kPa working pressure. The float shall be stainless steel, the seat and stem shall be noncorrosive material. An integral check valve shall prevent leakage of air into the hydronic system. The connection size shall be 19 mm male pipe thread.

.5 Manual Air Vent Valve:

.1 Manual air vent valve shall be a screwdriver operated, low projection type air vent for willow height clearance installations. The valve shall be designed for 860 kPa working pressure and maximum 116°C operating temperature. The connection size shall be 3 mm male pipe thread.

.6 Pipe Line Strainer:

.1 NPS 13 to 50: screwed connections, Y pattern.

.2 NPS 65 to 300: flanged connections.

.3 Blowdown connection: NPS 25.

.4 Working pressure: 860 kPa.

2.4 Accessories

.1 A device for indicating pressure differential across the balancing valves and flow sensors shall be provided. The meter shall be complete with hoses, shutoff and vent valves, fittings and carrying case.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install suction diffuser on the suction connection of each pump where specified. The adjustable support foot shall be mounted on the pump base and adjusted to support the suction diffuser. The start-up strainer shall be removed after system start-up is complete.

.4 Balancing valves and flow sensors shall be installed with at least the minimum length, recommended by the manufacturer, of straight unrestricted pipe upstream and downstream of the specified valve or sensor location. Balancing valves shall not be used as isolation valves for leak-proof shutoff.

.5 Install automatic air vents at system high points where specified. Air vent outlets shall be piped to the nearest drain, unless otherwise specified.

.6 Install manual air vent valves at all accessible high points in the system where automatic air vent valves are not specified.

.7 Air separators, pump discharge valves, suction diffusers and balancing valves shall be insulated as specified in Section 15261.

END OF SECTION

TANKS

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of new expansion tanks, domestic hot water storage tanks, blowdown tanks, and glycol feed tanks.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

.1 ASME Section IV – Rules for Construction of Heating Boilers.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A515: Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.

.3 Canadian Standards Association (CSA):

.1 C22.2 NO. 68: Motor-operated appliances (household and commercial).

.2 CSA B51: Boiler, pressure vessel, and pressure piping code.

.4 Food and Drug Administration (FDA).

.5 Society for Protective Coatings (SSPC):

.1 SP2: Surface Preparation Standard No. 2 - Hand Tool Cleaning.

.6 Underwriters Laboratories of Canada (ULC).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Manufacturer's Certification: The tank Manufacturer is to certify the following:

.1 The products and systems furnished are in strict compliance with the Specifications.

.2 ASME Certification in the form of ASME Stamp on the product and completed and signed data sheet.

.3 CRN number where required for pressure vessels.

.4 CSA or ULC Certification in the form of an affixed label to the equipment.

.5 The specified factory tests have been satisfactorily performed.

.6 The specified field tests have been satisfactorily performed.

1.4 Quality Assurance

.1 The equipment is to, as a minimum, be in strict compliance with the requirements of this Specification and is to be the Manufacturer's standard commercial product unless specified otherwise. Additional equipment features, details, accessories, or appurtenances which are not specifically identified but which are a part of the Manufacturer's standard commercial product, are to be included in the equipment being furnished.

.2 The equipment is to be of the type, design, and size that the Manufacturer currently offers for commercial sale and appears in the Manufacturer's current catalogue. The equipment is to be new and fabricated from new materials and is to be free from defects in materials and workmanship.

.3 The equipment is to fit within the allocated space, leaving ample allowance for maintenance and cleaning. Design the tank layout and building/site design to allow for future removal and replacement of the tanks.

.4 All units of the same classification are to be identical to the extent necessary to ensure interchangeability of parts, assemblies, accessories, and spare parts wherever possible.

2. PRODUCTS

2.1 Domestic Hot Water Storage Tanks

.1 Tank is to be glass lined with heavy gauge steel jacket with baked enamel finish.

.2 Construct tank with necessary tapping for installation of accessories. Include tank drain, bottom water inlet and top outlet, thermometer (range 5°C to 93°C) and pressure relief valve suitable for maximum working pressure.

.3 Tank insulation is to have a maximum U value of 0.45 $W/(m^2 \cdot K)$.

.4 Construction in accordance with ASME Section IV.

2.2 Expansion Tanks

.1 Domestic Water:

.1 Steel dome pressurized diaphragm type expansion tank.

.2 Suitable for potable water and horizontal or vertical installation.

.3 Capacity: as required for the Final Design.

.4 FDA approved heavy-duty butyl diaphragm with polypropylene liner suitable for maximum 93°C operating temperature.

.5 Working pressure: 1034 kPa or as required for the Final Design with ASME stamp and certification.

.6 Air precharged to 379 kPa (initial fill pressure of system).

.7 Finish to be Manufacturer's standard air-dry enamel.

.8 Acceptable Manufacturers:

.1 Amtrol, Thermxtrol.

.2 XYLEM Inc. Bell & Gossett Series "PTA" (ASME).

.3 Or approved equivalent.

.2 Hydronic Systems:

.1 Vertical, replaceable bladder type, factory pressurized expansion tank with permanent separation of air and water, sized as required for the Final Design and complete with:

.1 A steel pressure tank suitable for a working pressure of 870 kPa (125 psi) at 115°C (240°F) constructed and stamped in accordance with the ASME Code for Unfired Pressure Vessels and complete with a steel base ring or skirt for mounting, system connection, drain connection, air charging valve, and a red oxide primer finish.

.2 A heavy-duty butyl rubber (EDPM) bladder.

.2 Acceptable Manufacturers:

.1 Amtrol, Extrol L Series.

.2 Armstrong Fluid Technology. Series "L".

.3 XYLEM Inc. Bell & Gossett Series "B" (ASME).

.4 HG Specialties Inc. AL Series "Expanflex".

.5 Or approved equivalent.

2.3 Blowdown Tank

.1 Vertical or horizontal type with welded drop tube connections.

.2 The tank shall be designed in accordance with CSA B51 code and ASME Code Section VIII, Div 1.

.3 Shell:

.1 ASME code rated welded tank of ASTM A515 black steel plate, safety factor of 5.

.2 Steel shall have an SSPC-SP2 finish with two (2) coats of enamel paint.

.3 Provide certificate of registration required by Provincial Authorities.

.4 The tank shall be designed with all required openings to meet the requirements of CSA B51 including the following:

.1 Manhole flange.

.2 Blow-off inlet.

.3 Outlet.

.4 Vent connection.

.5 Drain connection.

.6 Cooling water inlet and outlet.

.7 Vacuum breaker connection.

.5 Accessories:

.1 A thermometer graduated in both °C and °F, up to 121°C (250°F), installed with a well.

.2 A pressure gauge graduated in both kPa and psi to the maximum boiler pressure, with isolation valve.

.3 A ball valve for the drain.

.4 Provide and install an automatic water cooling system, by thermostatic valve or temperature controller and solenoid valve.

.6 Lifting lugs shall be welded to the tank for easy handling.

.7 Support on vertical legs or saddles.

.8 Acceptable Manufactures:

.1 Simoneau.

.2 Or approved equivalent.

2.4 Glycol Feed Tank

.1 Pre-mix solution in mixing tank and charge system using feed pump. After system has been filled, check specific gravity of solution in each system. Leave mixing tank filled with specified glycol solution. Secure cover lid.

.2 Glycol Feed System: Automatic feed system, comprising the following:

.1 Pump: 3.8 L/min. at 345 kPa, 115/1/60 VAC, with thermal cut-out, plug, and cord, capable of running dry without damage.

.2 Tank: polyethylene tank with level gauge, cover, pump suction hose with strainer, low level pump cut-out, diverter valve for air purging and agitation, and all required connections. Mount on platform with casters.

.3 Pressure Regulating Valve: Glycol addition is to be controlled by an adjustable pressure reducing valve, range 35-380 kPa, complete with pressure gauge, strainer, check valve, union connection and 12 mm x 900 mm flexible outlet hose with check valve.

.4 Accumulator Tank: Pre-charged accumulator tank with EPDM diaphragm.

.5 Alarm Panel: Low level alarm panel, complete with remote monitoring contacts and selectable audio alarm, and dry contact for remote alarm monitoring.

.3 Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No.68.

.4 Acceptable Manufactures:

.1 Axiom Industries Ltd.

.2 A&F Machine Products Co.

.3 Armstrong.

.4 Bell and Gossett.

.5 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install per code requirements, the authority having jurisdiction, tank Manufacturer’s installation instruction, and environmental regulations.

.4 To protect tanks from corrosion, the following installation method is to be used:

.1 Provide grounding as required.

.2 Electrically isolate the piping from the tank by using isolation gasket on flanged connections; and isolation bushing on threaded connections. Use isolation unions, and dielectric nipples.

.3 Any attachments of electrical wiring, temperature sensors, to be isolated from tank fittings with dielectric bushings.

.4 Provide dielectric pads between the tank and the saddle.

.5 Provide dielectric pads between welded-on legs and floor, and isolation washers and sleeves for the bolts.

.6 Verify appropriate CRN numbers are in place for pressure vessels.

END OF SECTION

STEAM SYSTEMS

1. GENERAL

1.1 Summary

.1 This section specifies the steam and condensate systems with steam pressure in excess of 103 kPa (15 psi) and below 1035 kPa (150 psi).

1.2 Quality Assurance

.1 The Design Builder shall apply for registration and obtain approval prior to construction, for the design of the pressure piping system from the authority having jurisdiction.

.2 Where required, all fittings used for the boilers and pressure piping system shall be registered with the authority having jurisdiction.

.3 Where required, the Design Builder shall register quality control manuals for pressure piping system with the authority having jurisdiction.

.4 The Design Builder will apply for design registration of the steam boiler plant, including all pipe stress analyses required for registration.

1.3 Standards

.1 American Society of Mechanical Engineers (ASME):

  .1 ASME Boiler and Pressure Vessel Code.

.1 American National Standards Institute (ANSI):

  .1 ANSI/ASME B31.3 - Power Piping Code, for Steam Systems.

  .2 ANSI/ASME Section IX - Welding Qualifications.

  .3 ANSI B16.25 - Buttweld Ends.

  .4 ANSI B16.34 - Steel Flange and Buttweld Valves.

  .5 ANSI B16.5 - Steel Pipe Flanges and Flange Fittings.

  .6 ANSI B16.9 - Steel Long Radius Buttweld Fittings.

  .7 ANSI B16.11 - Forged Steel Socket Weld & Threaded Fittings.

.2 American Society for Testing and Materials (ASTM):

  .1 ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

  .2 ASTM A105 - Forgings, Carbon Steel, for Piping Components.

  .3 ASTM A234 - Piping Fittings for Wrought Carbon-Steel and Alloy Steel for Moderate and Elevated Temperatures.

.4 ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

.5 ASTM A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

1.4 Design Conditions

.1 Pressure and temperature referred to throughout this Specification are design conditions; each service class shall only be used within the pressure temperature range specified.

1.5 Corrosion Allowance

.1 Nominal corrosion allowance of 1.6 mm (1/16 inch) be used.

.2 Refer to the requirements of Corrosion Study – Appendix 18K.

1.6 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Pipe

	Service	Material
.1	Steam to 1035 kPa (150 psi)	Steel Sch. 80, ASTM A53, Grade B, Seamless or ERW for sizes 15 mm to 40 mm. Steel Sch. 40, ASTM A53, Grade B, Seamless or ERW for sizes 50 mm and over.
.2	Condensate	Steel Sch. 80, ASTM A53, Grade B, Seamless or ERW, all sizes.

2.2 Fittings and Joints

	Service	Material	Joint
.1	Steam and Condensate to 860 kPa (125 psi)	Class 300, ASTM A105, Sizes up to 40 mm	Screwed
		Buttweld Fittings, ASTM A234 Weldolet fittings ASTM A105 Pipe sizes 50 mm and over	Welded

	Service	Material	Joint
.2	Steam and Condensate to 860 kPa (125 psi) to 1035 kPa (150 psi)	Class 300, socket welded fittings ASTM A105, pipe sizes up to 40 mm Buttweld fittings, ASTM A234 Weldolet fittings ASTM A105, pipe sizes 50 mm and over	Welded

.3 The wall thickness of reducing fittings shall equal to the thicker wall of the connecting pipe.

.4 The nominal wall thickness of Buttweld fittings shall be the same as the pipe.

.5 Long radius elbows shall be used for change of direction. Short radius elbows many only be used where the space is limited and with the written consent of the City's Representative.

2.3 Flanges

.1 Forged steel weld neck flanges, as per ANSI B16.5.

.2 Alloy steel stud bolts ASTM A193-B7. Semi-finished heavy hex nuts ASTM A194-2H.

.3 Gaskets shall be spiral wound type. Gasket design temperature shall be same as flange design temperature.

2.4 Steam and Condensate Systems to 860 kPa (125 psi)

.1 Gate Valves up to 40 mm: Bronze body, inside screw, travelling stem, solid wedge, screw-in bonnet, threaded ends rating 860 kPa (125 psi) steam.

.2 Gate Valves 50 mm and Over: Cast iron body, flanged ends, O.S. and Y, rising stem, bronze trim, solid wedge, rating 860 kPa (125 psi) steam.

.3 Globe Valves up to 40 mm: Bronze body, screw over bonnet, threaded ends, rating 1035 kPa (150 psi) steam.

.4 Globe Valves 50 mm and Over: Cast iron body, flanged ends, O.S. and Y, renewable bronze seat ring, renewable composition disk. Rating 860 kPa (150 psi) steam.

.5 Swing Check Valves up to 50 mm: Bronze body and disk, regrinding swing check, screw-in cap, threaded ends, rating 860 kPa (125 psi) steam.

.6 Swing Check Valves 50 mm and Over: Cast iron body regrind - renew swing check, bolted cover, flanged ends, bronze disk and seat ring, rating 860 kPa (125 psi) steam.

.7 Silent Check Valves for Pump Discharge:

.1 Up to 50 mm: Bronze body, stainless steel stem, stainless steel spring, Teflon disk and seat ring, 430 stainless steel seat screw, threaded ends. 1380 kPa (200 psi) water.

.2 50 mm and Over: Wafer style, cast iron body, 316 stainless steel seat, plug, spring and bushing. ANSI Class 125.

2.5 Steam and Condensate System to 1035 kPa (150 psi)

.1 Gate Valves up to 50 mm: Glass 300, forged steel body, flanged ends, O.S. and Y, bolted bonnet, stainless steel wedge disk, replaceable seat rings.

.2 Gate Valves 50 mm and Over: Class 300, cast steel body, flanged ends, O.S. and Y, bolted bonnet, flexible stainless steel wedge, stainless steel stem and bonnet bushing.

.3 Globe Valves up to 50 mm: Class 300, forged steel body, flanged ends, O.S. and Y, bolted bonnet, stainless steel disk, stellite seat.

.4 Globe Valves 50 mm and Over: Class 300, cast steel body, flanged ends, O.S. and Y, bolted bonnet, stainless steel disk, seat rings, stem and bonnet bushing.

.5 Check Valves up to 50 mm: Class 300, swing check, forged steel body, flanged ends, bolted cover, stainless steel disk, stellite seat.

.6 Check Valves 50 mm and Over: Class 300, swing check, cast steel body, flanged ends, bolted cover, stainless steel disk, and seat ring.

2.6 Valve Operators

.1 Provide suitable handwheel operators for valves.

.2 Provide gear operators for valves 250 mm and over.

.3 Provide valves larger than 100 mm located more than 2100 mm from floor, in equipment rooms, with chain operated sheaves and safety whip. Extend chains to 1500 mm above floor, and hook to clips to clear walking aisles.

2.7 Strainers

.1 Steam and Condensate to 860 kPa (125 psi):

  .1 Size to 50 mm: 1720 kPa (250 psi) rating, screwed, cast iron casting, Y-pattern sediment separator with 0.8 mm (20 ga) 304 stainless steel screen. Provide minimum 12 mm drain cock.

  .2 Size 50 mm and Over: 1720 kPa (250 psi) flanges, cast iron, Y-pattern, sediment separator with 1.6 mm (14 ga) 304 stainless steel screen. Provide minimum 12 mm drain cock.

.2 Steam and Condensate 860 kPa (125 psi) to 1035 kPa (150 psi):

  .1 Size up to 50 mm: Class 300, flanged ends, cast carbon steel, Y-pattern, sediment separator with 0.8 mm (20 ga) 304 stainless steel screen. Provide minimum 12 mm drain cock.

  .2 Size 50 mm and Over: Class 300, flanged ends, cast carbon steel, Y-pattern, sediment separator with 304 stainless steel screen. 1.2 mm (18 ga) screen for sizes up to 100 mm, 1.6 mm (14 ga) screen for sizes over 100 mm. Provide minimum 12 mm drain cock.

2.8 Steam Traps

.1 Inverted Bucket (IB) Traps:

.1 Cast iron body and cap. Stainless steel bucket, seat, head, operating mechanism and strainer. Integral vacuum breaker. Service pressure rating: 1035 kPa (150 psi) steam, temperature rating 230°C (450°F).

.2 Float and Thermostatic (F & T) Traps

.1 Cast iron body and cap. Stainless steel float, air vent, head, seat and valve mechanism. Integral vacuum breaker. Maximum operating pressure 1205 kPa (175 psi) steam, maximum temperature 230°C (450°F).

Service	**Sizing Safety Factor**	**Type of Trap**
Boiler Header	2:1	Inverted Bucket Large Vent
Steam Mains	3:1	Inverted Bucket
Branch Lines	3:1	Inverted Bucket
Steam Separators	3:1	Inverted Bucket Large Vent

2.9 Steam Pressure Reducing Stations

.1 Provide one (1) or two (2) stage steam pressure reducing stations, as indicated, complete with pilot operated pressure reducing valve(s), valved bypass, strainer and pressure gauge on upstream side, relief valve and pressure gauge on downstream side.

.2 Pressure reducing valves shall be selected to produce flat reduced pressure curve for all ranges of capacity.

.3 Pressure reducing valves: Steel body and body flange, stainless steel valve plug, cast iron cage, Type 316L SST/graphite spiral wound gasket. Steel or plated-steel spring, lower stem, retaining ring and bolts. Heat treated Type 416 SST pistons, seat ring and gaskets. TFE/glass stem seal. Pilot: steel body and spring case, stainless steel trim.

.1 Class 150 flanged ends. Outlet control pressure range 35 to 1035 kPa (5 to 150 psi). Maximum temperature rating: 260°C (500°F). Pressure registration: external through downstream control line.

.2 Provide with noise reducing "whisper trim" noise attenuator.

.4 Connect pilot operator control line downstream far enough to sense true pressure.

.5 Set valve to relieve at not more than 20 percent above reduced pressure.

2.10 Steam Pressure Relief Valves

.1 ASME rated, Code Section VIII.

.2 Steel, flat seat, top guided, high capacity, stainless steel trim. Class 150, temperature rating 232°C (450°F). Closed bonnet with screwed cap over adjusting screw.

.3 Terminate vent lines from relief valves outdoors. Provide drip pan elbow with drain connection to nearest floor drain.

.4 When several relief valve vents connect to one vent header, the header cross sectional area shall equal the sum of individual vent outlet areas.

2.11 Expansion Compensation

.1 Expansion Joints: Refer to Section 15090.

.2 Pipe Guides: Refer to Section 15014.

.3 Expansion Loops:

.1 Size loops/joints based on the following:

.1 Install temperature: 10°C (50°F).

.2 System operating temperature:

.1 Steam and Condensate pressure up to 860 kPa (125 psi): 180°C (350°F).

.2 Steam and Condensate 860 kPa to 1035 kPa (125 psi to 150 psi): 200°C (400°F).

.3 Cold spring all expansion loops, ‘Z’ bends, by min. 50% of total expansion.

2.12 Flash Tank

.1 Vertical/Horizontal type with threaded/welded/Flanged drop tube connections.

.2 Construct shell to ASME Code.

.3 Maximum Working Pressure: 1035 kPa (150 psi).

.4 Connections: 50 mm and Under - Screwed, 50 mm and Over - Flanged.

.5 Finish: Prime coated.

.6 Supports: Vertical legs for vertical tank; saddles for horizontal tank.

2.13 Pipe Insulation

.1 Refer to Section 15261.

2.14 Pipe Hangers and Supports

.1 Refer to Section 15096.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Flat turns at change in direction shall be avoided.

.4 Dead ends and pockets in piping shall be avoided.

.5 Slope steam piping 0.5 percent in direction of flow and condensate return piping 0.75 percent. Provide drip trap assembly at all low points and in front of controls valves. Run condensate lines from traps to nearest condensate receiver. Where condensate lines form a trap, provide vent loop over the trapped section.

.6 Make reductions in condensate and steam pipes with eccentric reducing fittings installed to provide drainage and venting. Top flat for condensate, bottom flat for steam.

.7 Pipe the discharge from steam safety relief valves and vents to the outside.

.8 Pipe discharge from equipment blowdowns, and overflows to the nearest building drain.

.9 Provide clearance for proper installation of insulation, for access of valves, air vents, drains and unions.

3.2 Branch Connections

.1 Refer to the following branch connection table.

Legend:
T: Forged tee or reducing tee where applicable.
S: Socolet or threadolet where applicable.
W: Weldolet or approved equal.

	15 mm	T												
	20 mm	T	T											
	25 mm	T	T	T										
	30 mm	T	T	T	T									
	40 mm	T	T	T	T	T								
	50 mm	S	S	S	T	T	T							
	65 mm	S	S	S	S	T	T	T						
	75 mm	S	S	S	S	S	T	T	T					
	100 mm	S	S	S	S	S	T	T	T	T				
	150 mm	S	S	S	S	S	W	T	T	T	T			
	200 mm	S	S	S	S	S	W	W	W	T	T	T		
	250 mm	S	S	S	S	S	W	W	W	W	T	T	T	
	300 mm	S	S	S	S	S	W	W	W	W	W	T	T	T
BRANCH		15 mm	20 mm	25 mm	30 mm	40 mm	50 mm	65 mm	75 mm	100 mm	150 mm	200 mm	250 mm	300 mm

3.3 Welding

.1 All welds shall have 100 percent penetration to the root of the joints. Projection of weld metal into pipe shall not exceed 1.5 mm. Welds having lack of penetration or excessive projection shall be cut and rewelded.

3.4 Pipe Testing and Inspection

.1 Radiographic Examination:

.1 A minimum of 10 percent of the welded joints, selected by the City's Representative shall be examined by radiography, at the Design Builder's expense, as specified below:

.1 Pipe joints selected for examination shall be 100 percent radiographed.

.2 Examination method shall be a per ASME Code Section V, Article 2.

.3 Acceptable Criteria shall be per ASME Code Section VIII Par UW-51. The standard of weld quality shall meet the applicable Standard ANSI/ASME B31.1.

.4 Where a radiograph discloses defects, two additional joints shall be examined.

.2 Hydrostatic Testing:

.1 All piping shall be hydrostatically tested with water at 1.5 times the design pressure and temperature compensated as per ASNI/ASME B31.1.

3.5 Valves and Strainer Installation

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

.2 Provide drain valves at low points of piping.

.3 Provide valved drain and hose connection off the bottom of all strainers.

3.6 Trap Assemblies

.1 Install trap with union or flanged connection at both ends.

.2 Provide gate valve and strainer at inlet, gate valve and check valve at discharge.

.3 Provide minimum 250 mm long dirt pocket of same pipe sizes as apparatus return connection.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for product selection, installation and testing of steam boiler accessories including but not limited to:

.1 Condensate tank and pump packages.

.2 Deaerators and boiler feed pumps.

.3 Boiler feed tank and pumps.

.4 Blowdown tanks.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

.2 Canadian Standards Association (CSA).

.3 National Electrical Manufacturers Association (NEMA).

.4 Society for Protective Coatings (SSPC):

.1 SSPC SP2: Surface Preparation Standard No. 2 - Hand Tool Cleaning.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Condensate Tank and Pump Package

.1 Provide condensate receiver and pump as a package.

.2 Units to consist of two (2) pumps, steel receivers, electric controls and accessories. One (1) pump will provide 100 percent standby capacity.

.3 Tank:

.1 Horizontal, carbon steel with flat heads.

.2 The walls of the shell and heads shall be a minimum of 4.8mm (3/16 inch) thick.

.3 The tank shall be mounted on a structural steel support including all instruments. Steel to have an SSPC-SP2 finish with two (2) coats of enamel paint.

.4 The water supply available to the boiler shall be equivalent to 10 minutes of boiler operation at full load.

.5 Receiver equipped with water level gauge, dial thermometer, pressure gauges for pump discharge, all bronze isolation valves, and high-water alarm float switch.

.6 The tank shall include openings for vent connection, overflow connection, pump connections, condensate return connections, inlet of chemical connection, and for inspection and cleaning.

.7 Lifting lugs shall be provided on the heads to facilitate installation.

.4 Pumps:

.1 Pumps to be controlled from pump controls mounted on receivers to water level change in the receiver.

.2 Provide electric pump alternating control to automatically alternate pumps after each cycle.

.3 Centrifugal water pumps to be flanged mounted on the receiver. Pumps to be close coupled vertical design, bronze fitted. Vertical drip proof high efficiency motor.

.4 Each suction line to the pump will have an isolation ball valve and screen of the same size as the pump inlet.

.5 Pump outlets shall include return (recirculation) piping with pump flow control device to maintain the minimum flow required by the pump manufacturer.

.6 A low water cut-off shall be connected to the factory control panel to stop the operation of the pumps when the water falls below the preset level.

.5 Acceptable product:

.1 SIMONEAU NovaFeed.

.2 Or approved equivalent.

2.2 Deaerator and Boiler Feed Pumps

.1 Pressurized spray jet type deaerator, single tank.

.2 Deaerator must be designed in accordance with ASME Section VIII of the Pressure Vessel Code at 345 kPa (50 psig) pressure and 176.7°C (350°F).

.3 All interior surfaces that come into contact with non-deaerated water must be made of Type 316 stainless steel.

.4 Provide all necessary connections for admission of various water, steam, vent, instruments, controls and other accessories.

.5 Provide adequate access openings for inspection and maintenance.

.6 Stand must raise the deaerator tank to provide the net positive suction height required by the pump(s) in its nominal condition to prevent cavitation, plus a minimum safety factor of 0.6 m (2 feet).

.7 Deaerated Water Storage Tank:

.1 Storage capacity of 10 minutes measured at the normal operating water level.

.2 A manhole must be provided for access.

.3 24-gauge aluminum exterior casing.

.4 Tank to be field insulated with 50 mm (2 inch) thick fibreglass insulation, 64 kg/m^3 (4 lbm/ft^3) density.

.5 Components external to the cladding to be painted with two coats of an enamel-based paint.

.8 Feed Water Valve and Level Control:

.1 Motorized water inlet control valve with steel body and NPT threaded connections.

.2 Bi-directional motor with a permanently lubricated gear train, directly coupled to the valve stem.

.3 The valve must be sized for a flow rate equivalent to the make-up water.

.4 Pressure drop in the valve not to exceed 69 kPa (10 psi).

.5 Valve to be electronically controlled. Controller must be able to set the desired level point and the acceptable deviation. It must include a selection for automatic and manual operation mode and limit levels for water level alarms.

.6 Control valve must include a three-valve bypass with a Type Y cast iron strainer at the inlet with removable stainless steel screen.

.7 Overflow trap to evacuate full capacity at the operating pressure of the deaerator. The overflow must be a float trap type.

.9 Steam Pressure Reduction Station:

.1 Steam pressure reduction valve with cast iron body and fittings.

.2 Valve must be ANSI 250 Class with stainless steel gasket and adjustable pilot.

.3 Steam pressure reduction valve must include a three-valve bypass with a Type Y cast iron strainer at the inlet with a removable stainless steel screen.

.4 ASME approved safety valves sized to release the full capacity of the pressure regulator in the event of failure. Set pressure of 345 kPa (50 psi).

.10 Boiler Feed Pumps:

.1 Provide N+1 multistage centrifugal boiler feed pumps. One (1) pump shall provide standby capacity. Motors shall be high efficiency non overloading drip proof.

.2 Sealing and/or cooling water shall be provided in accordance with Manufacturer's recommendations.

.3 Pump impellers must be made of stainless steel.

.4 The pump and motor to be factory adjusted.

.5 Stainless steel recirculation port to be supplied with the pump and installed on the pump outlet to ensure a minimum flow rate when the boiler water inlet valve is closed.

.6 Pump suction piping to consist of a shut-off valve, a type Y cast iron strainer with replaceable stainless steel screen and a fitting or flexible hose. Complete with vortex breaker located in the tank.

.11 Control Panel:

.1 Control panel must be in a NEMA 1 enclosure and wired in accordance with the Canadian Electrical Code.

.2 The assembly must contain individual motor starters with 120-volt holding coil and fuse protection.

.12 Accessories:

.1 150 mm dia. compound gauge with coil, syphon cock and piping.

.2 Two (2) adjustable angle thermometers with pipe well, separable sockets and extension necks.

.3 ASME approved relief valve.

.4 Set of gauge glasses with compression stops and guard, long enough to cover storage tank within 50 mm of top and bottom. Maximum length of each glass 600 mm.

.5 Level control switches.

.6 Welded steel mounting saddles and stand.

.13 Performance: Reduce free oxygen in water to maximum 0.005 mL/L under all loading conditions. Reduce free carbon-dioxide to zero. Designed to operate at a pressure of 34.5 kPa (5 psi), but capable of operating between 13.8 and 103.4 kPa (2 and 15 psi).

.14 Acceptable product:

.1 Novatherm DeOxy.

.2 Or approved equivalent.

2.3 Blowdown Tanks

.1 Refer to Section 15130.

2.4 Boiler Feed Tank and Pumps

.1 Tank: Provide feed water tank with necessary connections, gauge glass, gauge cocks, thermometer, internal baffle. Support tank on welded structural steel stand assembly. Tank must be elevated to create positive head on feed water pumps.

.2 Make-up Water Assembly: Water level control float switch, motorised make-up valve, Y strainer with bypass assembly.

.3 Heater Assembly: Direct acting thermostatic steam valve, with sensing element in tank. Y strainer upstream of steam valve, bypass assembly. Perforated steam diffuser tube in tank. Steam pressure reducing valve upstream of steam control valve for high pressure steam.

.4 Boiler Feed Pumps: Centrifugal type feed water pumps of capacity indicated. One (1) pump shall provide 100 percent capacity. Motors shall be non-overloading, drip proof. Sealing and/or cooling water shall be provided in accordance with manufacturer's recommendations.

.5 Control Panel: Dust proof control panel containing motor starters, selector switch, indicator lights, circuit breakers, pump alternating controls, alarm lights and horn. Provide automatic pump alternating after each cycle.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Vent condensate receivers and boiler feed tanks to outdoors.

.4 Support deaerator inside building on welded structural steel stand. Provide a permanent platform and ladder for access to the preheater section.

.5 Provide suction and discharge valve and a check valve for each boiler feed pump.

.6 When boiler feed tanks are higher than boiler water line, provide a spring-loaded check valve to prevent boiler from flooding after shutdown.

.7 Provide water meter on make-up water lines.

.8 Provide drain valves on all strainers.

.9 Install steam exhaust heads on deaerator vents, and blow-off tank vents. Pipe exhaust head drains through roof to sanitary sewer.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies vibration isolation and special inspections for HVAC ductwork, piping, and equipment, seismic restraint for mechanical ductwork, piping, and equipment, seismic certification for equipment, hangers and systems, and special inspections for systems.

.2 This Section includes the provision of materials, installation and testing of:

- .1 Vibration isolation.
- .2 Seismic bracing.
- .3 Equipment bases and bedplates.
- .4 Factory finishes.

1.2 Standards

.1 American Society of Civil Engineers (ASCE):

- .1 ASCE/SEI 7-05 - Minimum Design Loads for Buildings and Other Structures.

.2 National Association of Pipe Fabricators (NAPF):

- .1 NFPA 13 - Standard for Installation of Sprinkler Systems.

.3 American Society for Testing and Materials (ASTM):

- .1 ASTM A 36/A 36M - Standard Specification for Carbon Structural Steel.

.4 American Architectural Manufacturers Association (AAMA):

- .1 AAMA 605.2 - Aluminum Extrusions and Panels, Architectural, High Performance Organic Coatings on.

.5 Manitoba Building Code.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

- .1 Manufacturer's descriptive literature for materials.
- .2 Vibration Isolation:
  - .1 Product data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.

.2 Shop Final Design: Showing complete details of construction for steel and concrete bases including:

.1 Fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

.3 Equipment mounting holes.

.4 Dimensions.

.5 Size and location of concrete and steel bases and curbs.

.6 Isolation selected for each support point.

.7 Details of mounting brackets for isolator.

.8 Weight distribution for each isolator.

.9 Code number assigned to each isolator.

.3 Design calculations if required: Provide calculations for selecting vibration isolators and for designing vibration isolation bases. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure and spring deflection changes and seismic loads. Include certification that riser system has been examined for excessive stress and that none exist.

.4 Submittals for interlocking snubbers: Include load deflection curves up to 13 mm deflection in x, y, and z planes.

.5 Welding certificates.

.6 Equipment Certification:

.1 Provide seismic certification for equipment.

1.4 Performance Requirements

.1 Design Requirements:

.1 Vibration Isolation:

.1 Except for packaged equipment with integral isolators, single Manufacturer selects and furnishes isolation required.

.2 Deflections indicated on detailed design are minimum actual static deflections for specific equipment supported.

.3 Isolator Stability: Size springs of sufficient diameter to maintain stability of equipment being supported. Spring diameters not less than 0.8 of compressed height at rated load. Springs have minimum additional travel to solid equal to 50 percent of rated defection. Springs support 200 percent of rated load, fully compressed, without deformation or failure.

.2 Maximum Allowable Vibration Levels: Peak vibration velocities to not exceed 2 mm/sec.

2. PRODUCTS

2.1 Vibration Isolation

.1 Equipment Bases and Bedplates:

.1 General: refer to Section 11002.

.2 Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Round or chamfer and grind smooth all corners. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. Mount all equipment bases and baseplates on reinforced concrete pads at least 75 mm high.

.3 Steel Base (Type B-1): Factory-fabricated, welded, structural-steel bases and rails.

.1 Design Requirements: Lowest possible mounting height with not less than 25 mm clearance above floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

.2 Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases have shape to accommodate supported equipment.

.3 Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

.4 Type 3 spring mounts.

.4 Inertia Base (Type B-2): Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

.1 Design Requirements: Lowest possible mounting height with not less than 25 mm clearance above floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

.2 Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases have shape to accommodate supported equipment.

.3 Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

.4 Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment Manufacturer.

.5 Type 3 spring mounts.

.2 Factory Finishes:

.1 Manufacturer's standard prime-coat finish ready for field painting. Units mounted outdoors exposed to weather be epoxy powder coated. For high levels of corrosion protection utilize:

.1 Fluoropolymer Coating:

.1 Conform to AAMA 605.2.

.2 Apply coating following cleaning and pretreatment.

.3 Cleaning: AA-C12C42R1X.

.4 Dry system before final finish application.

.5 Total Dry Film Thickness: Approximately 30 microns (1.2 mils), when baked at 232°C for ten (10) minutes.

.3 Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

.1 Powder coating on springs and housings.

.2 Hardware to be electrogalvanized. Hot-dip galvanize metal components for exterior use.

.3 Baked enamel for metal components on isolators for interior use.

.4 Color-code or otherwise mark vibration isolation devices to indicate capacity range.

.4 Corrosive Environments: Review Sections 01450 and 15096 and adjust materials accordingly to provide appropriate corrosion resistance.

.5 General Requirements for Restraint Components: Rated strengths, features, and applications should be as defined in reports by agency acceptable to authorities having jurisdiction.

.6 Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components should be at least four times maximum forces to which they are to be subjected.

.7 Anchor bolts for attaching to concrete to be drill-in, and stud-wedge or female-wedge type.

.8 Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

.9 Maximum 6.4 mm air gap and minimum 6.4 mm thick resilient cushion.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Provide seismic restraint and bracing per the requirements of the WSTP Process Mechanical Design Guideline.

.3 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.4 Complete the following additional testing activities:

.1 Vibration isolators and seismic restraint systems to be installed in strict accordance with Manufacturer's written instructions and certified submittal data.

.2 Set floor-mounted equipment with steel base rails on minimum 102 mm concrete housekeeping pads. Extend pad minimum 152 mm beyond footprint of equipment in each direction.

.3 Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, and other elements.

.4 Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances is isolation efficiency to be destroyed when bolting isolators to floor.

.5 Building Penetrations: Isolate water piping and ductwork penetrating wall, ceilings, floors or shafts from structure by piping isolator or by 8 mm thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe or duct at equipment room wall.

.6 Provide roof curbs, equipment supports, and roof penetrations. Work to maintain roof warranty. Coordinate location, size, structural connections/requirements and flashing prior to installation.

.7 Vibration isolators not to cause change of position of equipment or piping which would stress piping connections or misalignment shafts or bearings. Isolated equipment is to be level and in proper alignment with connecting ducts and pipes.

.5 Metal Fabrications: Conform to requirements of Division 5 and Section 15010.

.6 Equipment: Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce installations free of vibration or other defects. Align and pin to common bedplate equipment and drivers connected by flexible couplings.

.7 Base and Bedplate Grouting: Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45 degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth, dense finish and damp cure with burlap for three (3) days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as required to conform to the allowable tolerances.

.1 Make an allowance of at least 38 mm for grout under the equipment bases, whether or not shown on the Final Design. Use steel shims to level and adjust the bases. Shims may be left embedded in the grout; in which case they are to be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise approved, all grout to be a favorably reviewed non-shrink, non-metallic grout.

.2 Grout: Section 03600.

.3 Place the grout through the grout holes in the equipment base and work outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

.8 Adjusting:

.1 Adjust isolators after piping systems have been filled and equipment is at operating weight.

.2 Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

.3 Attach thrust limits at centreline of thrust and adjust to a maximum of 6.4 mm movement during start and stop.

.4 Adjust active height of spring isolators.

END OF SECTION

INSULATION FOR EXPOSED PIPING AND EQUIPMENT

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing for thermal insulation for exposed piping, valves, related equipment, and appurtenant surfaces.

1.2 Standards

.1 National Energy Code of Canada for Buildings.

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

.1 ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.2 ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate:

.3 ASTM C533 – Calcium Silicate Block and Pipe Thermal Insulation.

.4 ASTM C534 – Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

.5 ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C552 – Cellular Glass Thermal Insulation.

.7 ASTM C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.8 ASTM C592 – Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation.

.9 ASTM C692 - Standard Test Method for Evaluating the Influence of Thermal Insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel.

.10 ATSM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.11 ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

.12 ASTM E96 – Water Vapour Transmission of Materials.

.13 ASTM C1729 – Standard Specification for Aluminum Jacketing and Insulation.

.14 ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.

.2 Federal Specification (FEDSPEC) - L-P-535E -- Plastic Sheet (Sheeting) “Plastic Strip” Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate), Rigid.

.3 British Columbia Insulation Contractors Association (BCICA):

.1 BCICA 1501, 1C11(b).

1.3 Definitions

.1 Terminology used in this Section conforms to the following definitions:

.1 Jacket: protective outer layer placed over insulation on straight runs of pipe.

.2 Cover (when referring to piping and appurtenances): protective outer layer placed over insulation on pipe fittings, couplings, and equipment.

.3 Exposed: All area exposures specified in Section 01450 other than buried, submerged, or encased/embedded.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Certification of jacket ratings for water vapour transmission, puncture and stiffness as specified.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Hitco AIM.

.2 Advanced Thermal Products.

.3 SEI Temp-Set.

.4 Industrial Insulation Group Minwool.

.5 Knauf Earthwool.

.6 Owens Corning Fiberglas Pipe Insulation.

.7 Industrial Insulation Group Thermo Gold.

.8 Industrial Insulation Group Super Caltemp Gold.

.9 Roxul.

.10 Armacell.

.11 Or approved equivalent.

2.2 Performance Criteria

.1 Insulation thickness: Minimum insulation thicknesses are to meet the requirements of the National Energy Code of Canada for Buildings. Where the Detailed Piping Specification Sheets dictate a higher insulation thickness, use the higher insulation thickness.

.2 Operating Temperature Range: Furnish insulation materials for piping and equipment according to the operating temperature range in the table below.

	Operating Temperature Range, Name	**Operating Temperature Range, ºC**	**Insulation Material**
(1)	Low	-75 to +40	Unicellular Elastomeric Thermal
(2)			Cellular Glass
(3)			Mineral Wool
(4)			Fibreglass
(5)			Fibreglass with synthetic wicking material
(6)	Medium	40 to 400	Cellular Glass
(7)			Mineral Wool
(8)			Fibreglass
(9)	High	400 to 650	Preformed mandrel wound Mineral Wool suitable for 650°C

.3 Insulation Service Types:

.1 Insulation of exposed piping is provided for the following insulation service types: condensate control (CC), personnel protection (PP), freeze protection (FP), and energy conservation (EC). Insulation Service Types and insulation thicknesses are specified in the Final Design.

.2 Insulation service type CC is specified for piping that is to be insulated for condensate control. Where insulation service type CC is specified for a piping service, furnish insulation for all exposed piping and pipeline appurtenances in accordance with the Final Design. Insulate piping appurtenances connected to the piping. Insulate in accordance with the following:

.1 Non-Process Area: Fibreglass with synthetic wicking material and factory polymer jacket complete with evapouration holes.

.2 Process Area – Non-Corrosive: Elastomeric with lap seal and aluminum jacketing.

.3 Process Area – Corrosive: Elastomeric with lap seal and Stainless Steel jacketing.

.3 Insulation Service Type PP is specified for piping that is to be insulated for personnel protection. Furnish insulation in accordance with the Final Design where all the following conditions are present:

.1 Insulation Service Type PP is specified for the piping service.

.2 Piping is connected to the discharge or exhaust of equipment (includes equipment and pipeline appurtenances).

.3 Equipment, pipe, or pipeline appurtenances are located within 0 to 2.4 m above a floor, stair, landing, other type of walkway accessible by plant staff, or within 1.2 m of a guardrail or ladder cage. Pipe, pipeline appurtenances, joints, flanges, valves, and equipment in vaults, utilidors, and other spaces that are not designed for pedestrian access by plant staff are not insulated for insulation service type PP.

.4 Insulation service type FP is specified for piping that is to be insulated for freeze protection. Furnish insulation in accordance with the insulation thickness scheduled in the Final Design for all piping to be protected by electric heat trace tape as specified in Section 15265. Coordinate electric heat trace tape installation with specified insulation requirements for freeze protection to provide freeze protection for piping as specified in Section 15265 and the Final Design.

.5 Insulation Service Type EC is specified for piping that is to be insulated for energy conservation. Where insulation service type EC is specified for a piping service, furnish insulation for all exposed piping, connected equipment, and pipeline appurtenances in accordance with the Final Design.

2.3 Materials

.1 Comply with following table:

Component	**Material**
Unicellular elastomeric thermal insulation with reinforced lap seal and antimicrobial mold protection	ASTM C534, Type I – Grade 1
Cellular glass insulation	ASTM C552, Type II
Fibreglass and mineral wool insulation	ASTM C553 Type II; ASTM C547 Type I
Pre-formed mandrel wound mineral wool (stone wool)	ASTM C547 Grade A Type I, II IV, ASTM C795, ASTM C692
Blanket Fibreglass and mineral wool	ASTM C592 Type I or II
Fibreglass with synthetic wicking material complete with factory polymer facing and evapouration skirt	ASTM C547 Type 1, ASTM C795

.2 Provide materials that are new and undamaged. Protect materials from weather and other sources of damage during storage and installation.

.3 Provide insulating and sealing materials, including but not limited to cements and coverings that do not contain asbestos, mercury, or lead.

.4 When covering stainless steel, use insulation that complies with ATSM C795 and has less than 600 mg/L of leachable chlorides, and greater than 20 mg/L of sodium silicate for each mg/L of chloride.

.5 Flame spread classification for insulation materials is not to exceed twenty-five (25) when tested in accordance with ASTM E84.

2.4 Configuration, Components and Features

.1 Piping insulation is to be tubular type or the flexible blanket type.

.2 Insulation for valves, strainers, fittings, expansion joints, flanges and other connections are to be segmented sections, molded, or blanket type coverings of the specified type and thickness of pipe insulation.

.3 Use fibrous loose fill insulation for joint filler around insulated expansion joints.

.4 Equipment insulation is to be flexible blanket type or rigid board type cut to fit the surface. Do not use loose pack insulation.

.5 Flexible Blanket Insulation:

.1 The blanket is to be a custom sewn, flexible, reusable jacket, custom designed to closely fit the piping or the equipment housing.

.2 Blanket is to be custom fitted to not restrict access to any instrumentation or equipment.

.3 Insulation is to not compact or shake down in vibrating service.

.4 Where the operating temperature range meets a designated “High” as specified by the Design Builder, provide non-combustible silica cloth jacket and non-asbestos white ceramic fiber insulation for Flexible Insulation Blankets.

.5 Where the operating temperature range meets a designated “Very High” as specified by the Design Builder, provide non-combustible silica cloth jacket and high purity alumina and silica non-asbestos white ceramic fiber insulation for Flexible Insulation Blankets.

.6 Provide soft covers for flexible blanket insulation that are sewn, reusable type, fabricated from 900-gram TFE-coated or silicone coated fibreglass cloth. Provide fabricated soft covers with concealed/interior stitching (not exposed to weather). Secure soft covers in place with stainless steel anchor hooks, lock washers, and tie wire.

.6 Pipe Insulation Jackets:

.1 Furnish laminated jackets consisting of aluminum and white kraft paper over insulation for pipe. Jackets are to have a perm rating for water vapour transmission of not more than 0.02 in accordance with procedure A of ASTM E96.

.2 Aluminum jackets constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 3003, or 3105 temper H14, with integral vapour barrier. Jacket thicknesses are to be per ASTM C1729, as follows.

	Outer Insulation Diameter (mm)	Aluminum jacket thickness, rigid insulation (mm)	Aluminum jacket thickness, non-rigid insulation (mm)
(1)	≤ 200	0.4	0.4
(2)	201-275	0.4	0.5
(3)	276-600	0.4	0.6
(4)	≥ 601	0.5	0.8

.1 Sheet metal screws are to be aluminum or stainless steel.

.2 Jackets secured with 0.5 by 19 mm Type 304 stainless steel expansion bands.

.3 Stainless steel jackets constructed of smooth finish stainless steel sheet conforming to ASTM- A240, T-316 grade with integral vapour barrier. Jacket thickness is to be per ASTM C1767.

.1 Sheet metal screws are to be stainless steel.

.2 Jackets secured with 0.5 by 19 mm Type 304 stainless steel expansion bands.

.7 Insulation Covers:

.1 Furnish covers over insulation for pipe fittings, couplings, valves, and pipeline appurtenances.

.2 Aluminum covers are to be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 3003, or 3105 temper H12, with integral vapour barrier. Cover thicknesses: 0.8 mm, minimum.

.3 Stainless steel jackets constructed of smooth finish stainless steel sheet conforming to ASTM- A240, T-316 grade with integral vapour barrier.

.4 One piece PVC covers: fire and smoke hazard ratings (composite) not exceeding a flame spread of 25 and smoke developed of 50; conform to BCICA 1501, 1C11(b); do not use PVC covers in combination with medium or higher temperature class insulation.

.5 Polypropylene covers at elbows, tees, or other changes in direction and where indicated: heat-shrink type cover with a minimal thickness of 0.1 mm; do not use polypropylene cover in combination with insulation for medium high or very high operating temperature ranges.

.8 Shields:

.1 Provide thermal pipe hanger shields at pipe supports and as specified in Section 15096.

.9 Flashing:

.1 Provide flashing at joints between insulation jackets, between insulation jackets and insulation covers, and at endcaps.

.2 Flashing includes aluminum caps, sealant and reinforcing.

.3 Provide aluminum caps, 20 gauge, cut to completely cover the insulation.

.4 Provide sealants as recommended by the insulation manufacturer.

.5 Provide wire mesh reinforcement or nylon fabric reinforcement as recommended by the insulation manufacturer.

.6 Provide flashing around flange sets, connections, and joint fittings. Allow adequate clearance between insulation rings, jackets and the joint connection for the removal and reinstallation of hardware during inspection and maintenance activities.

.10 Protective Coatings:

.1 Apply protective coatings to pipes prior to insulating per Section 09905.

.2 Do not apply protective pipe coatings to outside surface of insulation jackets or covers.

.3 Do not paint PVC, polypropylene, aluminum or fabric covers.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Where double layer insulation is provided to achieve the specified insulation thickness, stagger section joints.

.4 Supply thermal pipe hanger shields and install them during pipe support installation. Where thermal pipe hanger shields are used, apply the following to all butt joints:

.1 For pipe with a medium, high, or very high operating temperature range, apply 75 mm wide vapour barrier tape or band over the butt joints.

.2 For pipe with a low operating temperature range, apply a wet coat of vapour barrier lap cement on all butt joints and seal the joints with a minimum 75 mm wide vapour barrier tape or band.

.5 Piping Insulation:

.1 Insulate piping continuously along its entire length including all in-line devices such as valves, fittings, flanges, couplings, strainers and other piping appurtenances. Butt insulation firmly together and provide jacket laps and joint strips with lap adhesive. Install jackets with their seams located on the underside of pipe.

.2 Do not use PVC covers specified in this Section with medium-, high-, or very high-temperature class insulation. Removable unicellular elastomeric thermal -type insulation need not be jacketed in Non-Process areas. Provide fitting, connection, flange, and valve insulation with covers as specified within this Section. Secure insulation in place with 20-gauge wire and a coat of insulating cement. Covers are to overlap the adjoining pipe insulation and jackets. Install covers with their seams located on the underside of fittings and valves.

.3 Low Operating Temperature Range:

.1 Seal off ends of pipe insulation with a vapour barrier coating.

.2 Interior Non-Process Area: Except where soft covers are provided, provide insulation with rigid PVC covers as specified within this Section. Seal covers at edges with vapour barrier adhesive. Secure the ends of covers with vinyl tape. The tape is to overlap the jacket and the cover at least 25 mm. Do not penetrate vapour barrier.

.3 Interior Process Area – Non-Corrosive: Except where soft covers are provided, provide insulation with rigid aluminum covers as specified within this Section. Mechanically secure covers using corrosion-resistant self-tapping screws or stainless steel gear clamps.

.4 Interior Process Area – Corrosive: Except where soft covers are provided, provide insulation with rigid stainless steel covers as specified within this Section. Mechanically secure covers using corrosion-resistant self-tapping screws and stainless steel gear clamps.

.4 Medium, High, and Very High Operating Temperature Range:

.1 Except for flexible blanket type insulation, seal ends of insulation with end joint strips and use waterproof adhesive to hold them in place.

.2 Except where flexible blanket type insulation is provided, provide rigid insulation with rigid aluminum jackets for non-corrosive areas and stainless steel jackets for corrosive areas as specified within this Section. Mechanically secure covers using corrosion-resistant self-tapping screws and stainless steel gear clamps.

.5 Insulation for Outdoor Piping:

.1 Provide aluminum jackets as specified in this Section for rigid insulation on outdoor piping. Flexible blanket type insulation on outdoor piping is to be fitted with a 12 mm thick outer layer of unicellular elastomeric thermal insulation enclosed in a soft cover as specified in this Section. Where piping emerges from soil without concrete or asphalt overtop, extend the insulation a minimum of 300 mm below the finished ground level. Where piping emerges from concrete or asphalt, extend the insulation to within 25 mm of the finished surface. Do not push insulation into contact with the finished concrete or asphalt surface.

.2 Provide heat tracing as specified in Section 15265. Install insulation over heat tracing according to the Specifications of the heat trace tape and insulation manufacturers.

.3 For fittings, connections, flanges, and valves, provide rigid insulation with rigid aluminum covers as specified within this Section. Flexible blanket type insulation on outdoor piping is to be fitted with a 12 mm thick outer layer of unicellular elastomeric thermal insulation enclosed in a soft cover as specified in this Section.

.6 Insulation Jacketing:

.1 Where rigid jacketing is specified in corrosive process areas, as determined by the Corrosion Study in Schedule 18 Technical Requirements, provide stainless steel jacketing.

.2 Where rigid jacketing is specified in non-corrosive areas provide aluminum jacketing.

.7 Mechanical Equipment Insulation:

.1 Unless otherwise specified in this Section, fit insulation to the contours of equipment and secure it with 112 mm by 0.4 mm stainless steel bands. Weld pins or stick clips with washers may be used for flat surfaces and spaced a maximum 450 mm apart. Stagger joints and fill voids with insulating cement.

.2 Unless specifically specified to be uninsulated, insulate all equipment connected to insulated piping.

.3 Overlap ends of blanket segments to prevent gaps and voids when the piping and equipment are heated.

.4 Secure blankets snugly under nuts and bolt heads to assure complete coverage during operation and to prevent vibration-induced gaps or voids.

.5 Secure blankets in strict accordance with the manufacturer's instructions.

.6 Low Operating Temperature Range:

.1 Unicellular elastomeric thermal type insulation, 38 mm thick.

.2 Enclose in a soft cover as specified in this Section.

.7 Medium, High, and Very High Operating Temperature Range:

.1 Flexible blanket type insulation, 100 mm thick.

.2 Fitted with an additional 12 mm thick outer layer of unicellular elastomeric thermal insulation enclosed in a soft cover as specified in this Section.

.8 Flashing:

.1 Provide flashing at jacket penetrations and terminations. Provide clearance for flashing between insulation system and piping supports.

.2 Trowel a heavy tack coat of sealant over the insulation, extending it over the jacket edge 25 mm and over the pipe or protrusion 50 mm. Stretch reinforcement over the tack coat after clipping to fit over pipe and jacket. Strap clipped reinforcing with a continuous band of reinforcing to prevent curling. Then trowel sealant over the reinforcement to a minimum thickness of 3 mm.

.3 Form aluminum caps to fit over the adjacent jacketing and to completely cover coated insulation. Hold cap in place with a jacket strap.

END OF SECTION

ELECTRIC HEAT TRACE

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of electric heat trace and its control for protection of exposed piping against freezing and for domestic hot water service temperature maintenance.

1.2 Standards

.1 National Electrical Manufacturer Association (NEMA):

  .1 NEMA ICS 1, Industrial Control and Systems.

.2 American National Standards Institute (ANSI).

.3 Canadian Electrical Code.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

  .2 Certifications that heat trace can withstand temperatures specified in this Section.

2. PRODUCTS

2.1 Performance Criteria

.1 Provide a freeze protection, water temperature and maintenance system as follows:

  .1 Design the systems based on requirements specified in this Section and Section 15261.

  .2 Design freeze protection systems to perform under the following conditions:

    .1 Insulation type and thickness is specified in Section 15055. Insulation materials are specified in Section 15261.

    .2 Select the electric heat trace cable thermal rating (W/mm) required to maintain the temperature specified with the thermostat type in this Section.

2.2 Configuration, Components and Features

.1 Provide heat trace cable that meets the following general requirements:

  .1 Self-limiting, parallel circuit construction with a continuous inner core of conductive material between two (2) cooper bus wires.

.2 Resistance and heating capacity of the heating material varies in response to piping and ambient temperature changes.

.3 Withstands continuous exposure to 65°C temperature.

.2 Heat trace cable for use with Type A, Type B, Type C, and Type D thermostat controllers as follows:

.1 Operates using single phase, 60 Hz power, 120 VAC unless specified otherwise in this Section.

.2 Protected by ground-fault equipment protection (GFEP; 20 or 0 mA) circuit breaker.

.3 Heat trace cable for use with Type E controllers as follows:

.1 Operates using single phase, 60 Hz power, 208 VAC.

.2 Rated for long pipeline service. Provide heat tracer cable with copper shield and fluoropolymer jacket.

.3 Protected by ground-fault equipment protection (GFEP; 20 or 30mA) circuit breaker.

.4 Provide electric heat trace cable, heat trace cable controllers and heat trace power supplies installed in classified areas that meet the heat trace cable Manufacturer’s recommendations for materials and installation in classified areas.

.5 Finish heat trace cable with thermal rating not exceeding 8W per 300 mm at 10°C. Maximum loading for each heat trace controller is 16A unless otherwise specified in this section. Conform to Manufacturer’s recommendations for maximum thermal rating and maximum amperage per heat trace controller where Manufacturer’s recommendations are less than those specified in this section.

2.3 Equipment and System Controls

.1 General:

.1 Control each length of heat trace cable by a thermostat, unless otherwise noted. Provide thermostat in an aluminum, NEMA 4, watertight enclosure or if more stringent as required for the area exposure designation as set out in Section 01450 and Division 16.

.2 Provide each length of heat trace with a signal light wired to the terminating end. Light shall indicate that tape is energized.

.2 Type A: Type A thermostat controls by sensing ambient temperature and has the following characteristics:

.1 Electrical rating: 16A at 120 VAC.

.2 Setpoint temperature range: minus 25 to 60°C.

.3 Calibration tolerance: 1°C.

.4 Sensor material: stainless steel.

.5 Housing exposure temperature range: minus 40 to 70°C.

.6 Maintain temperatures: 4°C.

.7 Dry contact for remote monitoring of fault alarm condition by PCS.

.3 Type B: Type B thermostat controls by sensing pipe temperature and has the following characteristics.

.1 Electrical rating: 16A at 120 VAC.

.2 Setpoint temperature range: minus 30 to 110°C.

.3 Calibration tolerance: 1 percent of full scale.

.4 Bulb and capillary material: Stainless steel.

.5 Housing exposure temperature range: minus 55 to 60°C.

.6 Pipe sensor exposure limit: 220°C.

.7 Maintain Temperatures: 4°C.

.8 Dry contact for remote monitoring of fault alarm condition by PCS.

.4 Type C: Type C thermostat controls by sensing ambient temperature and has the following characteristics:

.1 Electrical rating: 16A at 120 VAC.

.2 Setpoint temperature range: minus 25 to 60°C.

.3 Calibration tolerance: 1°C.

.4 Sensor material: stainless steel.

.5 Housing exposure temperature range: minus 40 to 70°C.

.6 Maintain temperatures: 4°C.

.7 Approved for area classification Class 1, Zone 1.

.8 Dry contact for remote monitoring of fault alarm condition by PCS.

.5 Type D: Type D PCS thermostat controller energizes the heat trace during occupied periods, disables during unoccupied periods, and has the following characteristics:

.1 Electrical rating: 16A at 120 VAC.

.2 Type: dry contact.

.3 Housing material: stainless steel.

.4 Housing exposure temperature range: minus 40 to 70°C.

.5 Dry contact for remote monitoring of fault alarm condition by PCS.

.6 Type E: Type E microprocessor-based heat trace thermostat controls by sensing ambient temperature, and has the following characteristics and features:

.1 Electrical rating: 60A at 208 VAC, UL listed.

.2 NEMA 4X stainless steel enclosure.

.3 RTD ambient-sensing sensor.

.4 Setpoint temperature range: minus 25 to 60°C.

.5 Housing exposure temperature range: minus 40 to 70°C.

.6 Maintain temperatures: 4°C.

.7 Controls up to two (2) heat trace circuits, each with a 2-pole relay.

.8 Include ground fault sensing, alarm, and trip functionality that complies with CEC requirements for ground fault protection.

.9 Dry contact for remote monitoring of fault alarm condition by PCS.

.10 Include connection kit for splices or tee connections with each controller.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the provision of materials, installation and testing of insulation for HVAC ducts.

1.2 Standards

.1 Thermal Insulation Association of Canada (TIAC) – Mechanical Insulation Best Practices Guide.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.2 ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.3 ASTM C1071 – Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.4 ASTM E84/UL 723 – Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 51.10 – Standard for: Thermal Insulation, Mineral Fiber, Block or Board, for Ducting, Machinery and Boilers.

.2 CAN/CGSB 51.11 – Thermal Insulation, Mineral Fiber, Blanket, for Piping, Ducting, Machinery and Boilers.

.4 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S110 - Standard Methods of Test for Air Ducts.

.2 ULC 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

.5 National Association of Pipe Fabricators (NAPF):

.1 NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.

.2 NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.

.3 NFPA 90B – Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Manufacturer’s data including weight density of insulation, thickness, certifications, thermal resistance (R-value), flame spread, smoke generation, and jackets (both factory and field applied if any) for each type of product indicated.

2. PRODUCTS

2.1 Performance Criteria

.1 Service Conditions:

Description	**Requirements**
Type A-Flexible Fibreglass Blanket	ASTM C1071; Flexible Blanket “K’ Value: ASTM C518, 0.036 W/(m°C) at 24°C maximum service temperature: 120°C. Density: 12 kg/m^3 Vapour Barrier Jacket: FSK aluminum foil reinforced with fibreglass yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapour barrier mastic as needed.
Type B-Duct Liner	ASTM C1071; flexible blanket. “K’ Value: ASTM C518, 0.036 W/(m°C) at 24°C, maximum service temperature: 120°C. Maximum Velocity on Mat or Coated Air Side: 25 m/s. Adhesive: UL listed waterproof type. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened. Erosion-Resistant Surfaces: ULC S110. ASTM G21 and ULC S110 Microbial Growth Resistance.

Description	Requirements
Type C-Rigid Fibreglass Board	ASTM C612; rigid board. 'K" Value: 0.033 W/(m°C) at 24°C, maximum service temperature: 120°C. Density: 43 kg/m^3. Vapour Retardant Jacket: AP, bleached Kraft paper bonded to aluminum foil, reinforced with fibreglass yarn; or FSK aluminum foil reinforced with fibreglass yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapour barrier mastic as needed.
Jacketing	Canvas Jacket: UL listed fabric, 203 g/m^2, plain weave cotton treated with dilute fire-retardant lagging adhesive. PVC preformed molded insulation covers. Zeston. Stainless Steel Jacket: Type 304 stainless steel, minimum 0.25 mm thick, smooth finish. Aluminum Jacket: 0.41 mm thick smooth finish.

.2 Fire Hazard Classification:

.1 A minimum fire hazard classification of the composite insulation construction as installed to be not more than a flame spread of 25, fuel contributed of 50 and smoke developed of 50 as tested by current edition of ASTM E84 (NFPA 255) method.

.2 Test duct insulation in accordance with current editions of ASTM E84, UL 723, NFPA 255, NFPA 90A and NFPA 90B.

2.2 Manufacturers and Products

.1 Acceptable Products:

.1 Johns-Manville, 800 Series Spin-Glas.

.2 Johns-Manville, Linacoustic RC.

.3 Johns-Manville, SuperDuct RC.

.4 Owens Corning, SoftR Duct Wrap.

.5 Owens Corning, QuietR Duct Liner Board.

.6 Owens Corning, QuietR Duct Board.

.7 Or approved equivalent.

2.3 Configuration, Components and Features

.1 Equipment Insulation Jacketing: Presized glass cloth, not less than 264 g/m^2, except as otherwise indicated. Coat with gypsum based cement.

.2 Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finished as recommended by insulation Manufacturer for application instead.

.3 Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation Manufacturer for applications indicated. Accessories (adhesives, mastics, cements and tape) to have the same flame and smoke component ratings as the insulation material with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide non-water soluble treatments. Provide UV protection recommended by Manufacturer for outdoor installation.

.4 Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation Manufactures for applications as indicated.

.5 Outdoor ducting cover requirements:

.1 Stainless Steel Jacket: with longitudinal slip joints and 50 mm laps.

.2 Non-water vapour retarder, non-burning, weatherproof coating for use over insulation where “breathing” is required.

.3 UV resistant polyvinyl chloride covering with joints secured and sealed.

.6 Indoor corrosive process areas:

.1 Stainless steel jacket.

.7 Indoor non-corrosive process areas:

.1 Aluminum jacket.

.8 Indoor non-process:

.1 Canvas jacket.

.1 Outside air intake ducts and plenum, supply ducts heating and cooling (exposed) and return air ductwork.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Do not apply insulation until pressure testing of the ducts and piping has been completed. Do not apply to pipe with heat tracing until system has been tested. Do not apply insulation until the duct has been inspected.

.4 Apply insulation material, accessories, and finishes according to the Manufacturer's printed instructions. Seal joints and seams to maintain vapour barrier. Seal penetrations for hangers, supports, and anchors. Keep insulation material dry during application. Apply vapour barrier on seams, joints, over staples, and at end butt to fittings.

.5 Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapour barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 50 mm below top of roof flashing. Seal metal jacket to roof flashing with vapour barrier coating.

.6 Interior Walls and Partitions Penetration: Apply insulation continuously through walls and partitions, except fire-rated walls. Apply aluminum jacket with factory-applied moisture barrier over insulation. Extend 50 mm from both surfaces of wall on partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapour barrier coating. Seal around penetration with joint sealer.

.7 Whenever possible, slip insulation on pipe before making connections. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.

.8 Ductwork:

.1 Butt installation joints firmly together and install jackets and tapes smoothly and securely.

.2 Apply duct installation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapour barrier materials to form complete unbroken vapour seal over insulation.

.3 Cover breaks in jacket materials with patches of same material as vapour barrier. Extended patches not less than 50 mm beyond break or penetration on all directions and secure with adhesive and staples. Seal staples and joints with vapour barrier coating.

.4 Fill jacket penetrations including hangers, thermometers and damper operating rods, and other voids in insulation with vapour barrier coating. Seal penetration with vapour barrier coating. Insulate hangers and supports for cold duct in un-conditioned spaces to extent to prevent condensation on surfaces.

.5 Seal and flash insulation terminations and pin punctures with reinforced vapour barrier coating.

.6 Continue insulation at fire dampers and fire/smoke dampers up to and including those portions of damper frame visible at outside of the rated fire barrier. Insulating terminations at fire dampers in accordance with this Section.

.7 Do not conceal duct access doors with insulation. Install insulation terminations at access door in accordance with this Section.

.8 Duct Liners: Matte finish surface on air stream side. Secure insulation to cleaned sheet metal duct with continuous (minimum 90 percent) coat of adhesive. For widths over 500 mm, additionally secure liner with mechanical fasteners 380 mm on centre or per Manufacturer requirements. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation overlap sides. Factory/field coat exposed edges. Metal nosing for exposed lending edges and when velocity exceeds 18 m/s or Manufacturer rating on exposed edges. Keep duct liner clean and free from dust. As a condition of acceptance, by Professional of Record vacuum duct liner if it is dirty or dusty. Cut studs off near washers. Do not use small pieces. If insulation is installed without horizontal, longitudinal, and end joints butted together, installation is to be rejected and work removed and replaced with that which conforms to this Section.

.9 Duct Wrap:

.1 Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 50 mm. Adhere insulation with 100 mm strips of insulation bonding adhesive at 200 mm on centre. On ducts over 610 mm wide, additionally secure insulation with suitable mechanical fasteners at 450 mm on centre. Circumferential and longitudinal joints stapled with flare staples 150 mm on centre and covered with 75 mm wide, foil reinforced tape.

.10 Outdoor Duct Exposed to Weather:

.1 Install jacket with brakes/slope to prevent standing water on duct.

.2 Weatherproof seal at joints and seams. Minimum 50 mm overlap.

.3 Label jacket every 1850 mm and within 610 mm of building penetrations and equipment connections: “Do not stand or place equipment on duct".

.9 Interface with Other Work:

.1 Insulate ductwork surfaces as required for the Final Design and to meet the requirements as set out in the Design and Construction Specifications. Insulation thickness shown in the following table is a minimum requirement:

	Item to be Insulated	System Insulation Type	Duct Size	Insulation Thickness
(1)	Supply ductwork where duct is not specified to be lined.	A	All	40 mm
(2)	Return ductwork where duct is not specified to be lined or where duct board is not utilized.	- -	All	None
(3)	Supply ductwork (exposed to weather, in crawl space and in unheated attics).	C	All	80 mm

	Item to be Insulated	System Insulation Type	Duct Size	Insulation Thickness
(4)	Return ductwork (exposed to weather, in crawl space and in unheated attics).	C	All	80 mm
(5)	Duct silencers.	C	All	40 mm
(6)	Outside air ducts.	A	All	80 mm
(7)	HVAC plenums and unit housings not pre-insulated.	B	All	80 mm
(8)	Exposed insulation in mechanical rooms or areas subject to damage.	C	All	40 mm

.10 Repair/Restoration:

.1 Protect installed insulation during Construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapour barrier damage and moisture saturated units.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for commissioning of the water supply, sanitary and waste drainage systems.

.2 Prior to commissioning complete cleaning in accordance with the requirements set out in Section 15546.

.3 Provide commissioning of all water supply and waste drainage piping, equipment and systems including the following:

- .1 PW – potable water (domestic).
- .2 DHW – domestic hot water.
- .3 DHR – domestic hot water return.
- .4 TDW – tempered domestic water.
- .5 NPW – non-potable water.
- .6 FSW – flushing water.
- .7 RWL – rain water, leader.
- .8 SAN – sanitary drainage.
- .9 SWD – storm water drainage.
- .10 PD – process drain.
- .11 VTA – vent to atmosphere.
- .12 W – Municipal Water Supply.

.4 Commissioning related to water supply, sanitary and waste drainage systems shall include the start-up, set up, adjustment and recording of the operational data of following systems and components at a minimum:

- .1 Incoming municipal water pressure.
- .2 Pressure reducing valve set points and downstream pressures.
- .3 Domestic water heater temperature set points and capacity flow test.
- .4 Central and individual tempered water mixing valve set points.
- .5 Operation of all water supply and waste drainage fixtures.

.6 Testing and certification of all backflow preventers.

.7 Emergency showers, eyewash stations, drench hoses and related tempering valves complete with water flow, temperature and duration.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

WATER SUPPLY AND WASTE DRAINAGE SPECIALTIES AND ACCESSORIES

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of the following water supply and waste drainage specialties and accessories:

.1 Clean-outs.

.2 Water hammer arresters.

.3 Vacuum breakers.

.4 Roof drains.

.5 Floor drains.

.6 Trench drains.

.7 Acid neutralization tanks.

.8 Oil interceptors.

.9 Trap primers.

.10 Backflow preventers.

.11 Thermometers.

.12 Pressure gauges.

.13 Recirculation pumps.

.2 Expansion Tanks: Refer to Section 15130.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B40.200 - Thermometers, Direct Reading and Remote Reading.

.2 ASSE Std. 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes.

.4 American Water Works Association (AWWA):

.1 AWWA Std. C511, AWWA Standard for Reduced-Pressure Principle Backflow Prevention Assembly.

.5 Canadian Standards Association (CSA):

.1 CSA B64.0, Definitions, General Requirements, and Test Methods for Vacuum Breakers and Backflow Preventers.

.2 CSA B64.2, Vacuum Breakers - Hose Connection Type.

.3 CSA B64.5, Double Check Valve (DCVA) Backflow Preventers.

.6 Underwriters Laboratories of Canada (ULC):

.1 UL Classified File No. EX3185 Listed by IAPMO (UPC).

.7 USC Foundation for Cross-Connection Control and Hydraulic Research.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers and Products:

.1 Clean-outs:

.1 Jay R. Smith.

.2 Zurn.

.3 Watts.

.4 Or approved equivalent.

.2 Water Hammer Arresters:

.1 Jay R. Smith.

.2 Zurn.

.3 Watts.

.4 Or approved equivalent.

.3 Vacuum Breakers:

.1 Jay R. Smith.

.2 Zurn.

.3 Watts.

.4 Or approved equivalent.

.4 Roof Drains:

.1 Jay R. Smith.

.2 Zurn.

.3 Watts.

.4 Or approved equivalent.

.5 Floor Drains:

.1 Jay R. Smith.

.2 Zurn.

.3 Watts.

.4 Or approved equivalent.

.6 Trench Drains:

.1 Jay R. Smith.

.2 Zurn.

.3 Watts.

.4 Or approved equivalent.

.7 Acid Neutralization Tanks:

.1 Cylindrical Polypropylene Vertical Tank:

.1 Watts.

.2 PH Pro.

.3 Fabco.

.4 Or approved equivalent.

.8 Oil Interceptors:

.1 Recessed Mount with Integral Storage:

.1 Watts.

.2 Zurn.

.3 Jay R. Smith.

.4 Or approved equivalent.

.9 Trap Primers:

.1 Watts.

.2 Zurn.

.3 Precision Plumbing Products.

.4 Or approved equivalent.

.10 Backflow Preventers:

.1 Type - 1 (Reduced Pressure Zone):

.1 Watts LF909 series.

.2 Apollo RPLF-4A series.

.3 Or approved equivalent.

.2 Y-strainer:

.1 Watts 77F-DI-FDA series with 20 mesh, stainless steel screen and optional magnets.

.2 Or approved equivalent.

.3 Type - 3 (Hose Connection Vacuum Breaker):

.1 Watts 8A and/or NF8.

.2 Or approved equivalent.

.11 Thermometers:

.1 Type - 1:

.1 Marsh.

.2 Ashcroft.

.3 Winters.

.4 Weksler.

.5 Or approved equivalent.

.2 Type - 2:

.1 Marsh.

.2 Or approved equivalent.

.12 Pressure Gauges:

.1 Ashcroft Duragauge Model 45-1279-S-SL-02-L.

.2 Root Valves: Anderson, Greenwood & Company M9 VIS-4 or H1 VDS-4, Hoke HM68111F8YL or HM2511F8YL.

.3 Or approved equivalent.

.13 Recirculation Pumps:

.1 Bell & Gosset.

.2 Armstrong.

.3 Taco.

.4 Grundfos.

.5 Or approved equivalent.

2.2 Materials

Component	**Material**
Floor cleanout access covers	
Frame and plate	Scoriated nickel bronze
Securing screws	Stainless steel
Floor cleanout access covers (Corrosive Environments)*	
Frame and plate	Stainless steel
Securing screws	Stainless steel
Water hammer arresters bellows	Stainless steel
Vacuum Breakers	Stainless steel
Roof drains – all major components	
Sump receiver	Dura-coated cast iron
Body	Dura-coated cast iron

Component	**Material**
Clamp	Dura-coated cast iron
Collar	Dura-coated cast iron
Drainage grid	Stainless steel
Dome	Aluminum
Bolts/Nuts	Stainless steel
Floor drains	
Body	Dura-coated cast iron
Strainer	Dura-coated cast iron
Strainer	Polished nickel bronze
Securing screws	Stainless Steel
Floor drains (Corrosive Environments)*	
Body	Stainless steel
Strainer	Stainless steel
Securing screws	Stainless Steel
Trench drains	
Channel sections	HDPE
Frame	Acid resistant coated or stainless steel
Grates	Varies*
Trap Primers	Brass
Acid Neutralization Tanks	Polypropylene
Backflow Preventers	
Reduced Pressure*	Lead-free cast copper silicon / Stainless steel*
Double Check	Stainless Steel
Oil Interceptors	Epoxy coated steel
Thermometers	
Type – 1	Molded plastic case Mercury-free liquid Glass cover Brass stem
Type – 2	304 stainless steel
Pressure gauges	Phenolic case Glass window 316 stainless steel stem
Recirculation Pumps	Bronze body and impeller

* Corrosive environments: adjust materials accordingly to provide appropriate corrosion resistance as set out in Section 01450 and Section 15096.

2.3 Equipment Components

.1 Clean-outs and Clean-Out Access Covers:

.1 Provide threaded type extended to finished floor or wall surface.

.2 Provide bolted coverplate clean-outs on vertical rainwater leaders only.

.3 Ensure ample clearance at clean-out for rodding of drainage system.

.4 Floor clean-out access covers in unfinished areas to be round.

.5 Provide round access covers in finished areas with depressed centre section to accommodate floor finish.

.6 Provide membrane flange and clamp collar for clean-outs in the structural slab of finished and unfinished areas.

.2 Water Hammer Arresters:

.1 Provide water hammer arresters on potable water lines connected to solenoid valves, flush valves, and to fixture or group of fixtures complete with accessible isolation valve.

.2 Factory air-charged, permanently capped and sealed.

.3 Vacuum Breakers:

.1 Provide vacuum breakers at hose connections on potable water lines.

.4 Roof Drains:

.1 Flow characteristics: full open flow.

.2 Roof drain for conventional inverted roof, with underdeck clamp, sump receiver and drainage grid.

.3 Body:

.1 Discharge: non-threaded mechanical joint.

.2 Bosses: solid, integrally cast, for under deck clamping ring and flashing flange bolts.

.3 Deck flange: nominal 300 mm outside diameter, minimum 50 mm width.

.4 Flashing clamping flange: outside diameter same as outside diameter of deck flange; V-notched positive draining gravel stop lip, 15 mm high.

.5 Dome strainer: minimum 150 mm high, 8 mm to 15 mm slotted openings, sides and top.

.6 Acceptable Products:

.1 Zurn Z121-SS.

.2 Or approved equivalent.

.5 Floor Drains:

.1 All floor drains, except those located in slab on grade, shall be provided with weeping flange with clamp collar.

.2 Provide lead or Duraloy flashings where no waterproofing floor membrane is provided.

.3 Heavy duty adjustable 229 mm round floor drain and grate with primer connection in structural and slab on grade. Connection size 150 mm diameter.

.1 Acceptable Products:

.1 Zurn Z-538.

.2 Or approved equivalent.

.4 Square funnel floor drain with minimum 200 mm x 200 mm strainer, funnel and primer connection in structural slab. Connection size 150 mm diameter.

.1 Acceptable Products:

.1 Zurn ZX-415-Y8-414.

.2 Or approved equivalent.

.5 Round floor drain without grate with primer connection in structural slab. Connection size 100 mm diameter.

.1 Acceptable Products:

.1 Zurn Z-536.

.2 Or approved equivalent.

.6 Heavy duty round floor drain, grate and primer connection in structural and slab on grade. Connection size 100 mm diameter.

.1 Acceptable Products:

.1 Zurn Z-555.

.2 Or approved equivalent.

.7 Square washroom floor drain with 150 x150 strainer and primer connection. Connection size 100 mm diameter.

.1 Acceptable Products:

.1 Zurn ZXN-415-H-Y-P.

.8 Heavy duty adjustable 200 mm round floor drain with grate, in structural slab. Connection size 100 mm diameter.

.1 Acceptable Products:

.1 Zurn Z-536.

.2 Or approved equivalent.

.9 Round stainless steel industrial floor drain in structural or slab on grade with sediment bucket.

.6 Trench Drains:

.1 Modular type system designed for placement in cast concrete floors, width and length as indicated in the Final Design.

.2 Channel sections shall be made of HDPE plastic with interlocking ends and curved bottom. Channels shall be provided with 1 percent built-in slope.

.3 Minimum invert shall be 150 mm.

.4 Channel system shall have provisions for positioning and anchoring in concrete slab. System shall include acid resistant coated or stainless steel frame to distribute weight between grate and channel.

.5 Outlets shall be no-hub end, bottom, or side outlet type and 100, 150, or 200 mm size.

.6 Grates shall be heavy duty, with material suitable for areas as indicated in Section 01450 (ductile iron, acid resistant coated ductile iron, galvanized steel, galvanized ductile iron, stainless steel, fiberglass reinforced polyester (FRP), etc.) with slotted or bar type pattern. Grates shall be Class C rated, unless noted otherwise.

.1 Acceptable Products:

.1 Zurn Z1800-8B.

.2 Or approved equivalent.

.7 Equipment Drains:

.1 Provide a sloped connection from equipment with drain pans to nearest sanitary sewer trapped connection.

.2 Slope at minimum of 0.5 percent grade.

.3 Drains size to be 25 mm complete with 100 mm deep trap at unit.

.8 Trap Seal Primers:

.1 For non-process areas provide automatic trap primer complete with vacuum breaker, union and access door for concealed installations with 12 mm copper tubing connections between primer valve and floor drain.

.2 Acceptable Products:

.1 Watts Series LFTP300.

.2 Or approved equivalent.

.9 Acid Dilution Tanks:

.1 Provide free standing vertical cylindrical tank containing marble chips at the termination of acid waste piping.

.1 Integral inlet and outlet fittings.

.2 Plugged drain down connection.

.3 Perforated diffuser across tank bottom.

.4 Removable top cover.

.10 Oil Interceptors:

.1 Provide recessed mount oil interceptor with:

.1 Integral oil storage tank.

.2 Secured gasketed skid-proof cover.

.3 Deep seal trap with clean-out.

.4 Inlet, outlet, dual vent and oil draw-off connections.

.5 Sediment bucket.

.6 Flow control plate.

.11 Backflow Preventers:

.1 Provide backflow preventers on all non-potable water systems which are connected to potable water.

.2 The type of cross-connection control device shall be determined by the degree of hazard. Type 1 reduced pressure zone backflow preventers shall be used at all cross-connections between potable and non-potable water supplies. Type 2 shall only be used at connections to fire protection systems which do not contain hazardous or toxic fluids. Provide a universal test kit with digital read-out and print-out containing hoses, adapters, instruction booklet in a rugged carrying case.

.3 Type - 1:

.1 Reduced pressure zone backflow preventers shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Back-siphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the check valves and test cocks. The assembly shall be lead free and comply with provincial codes and standards, where applicable, requiring reduced lead content. The assembly shall meet the requirements of ASSE Std.

1013; AWWA Std. C511; CSA B64.5; and UL Classified File No. EX3185. Listed by IAPMO (UPC). The assembly shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

.4 Type - 2:

.1 Double-check detector backflow preventers shall consist of two positive seating check valves located between two resilient seated shutoffs with a hydraulically balanced bypass line and four test cocks. The main valve body shall be manufactured from 300 series stainless steel. The check valves shall utilize a spring to provide positive closure. There shall be no brass or bronze parts used within the check valve assembly. The check valve seats shall be of molded thermoplastic construction. The use of seat screws as a retention method is prohibited. All internal parts shall be accessible through a single cover on the valve assembly. The bypass line shall be hydraulically sized to accurately measure low flow. The bypass line shall consist of a meter, a small diameter double check assembly with test cocks and isolation valves. The bypass line double check valve shall have two independently operating check valves. Assembly shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

.5 Type - 3, small hose connection vacuum breaker - 20 mm. Single check with atmospheric vacuum breaker for mounting on hose thread faucets.

.12 Thermometers:

.1 Type - 1:

.1 Thermometers shall be suitable for the system into which they are installed. All Type – 1 thermometers shall be captive liquid type provided with 178 mm, dual scales °C and °F. Minimum accuracy shall be 1 percent of full scale. Mercury shall not be used in any portion of the thermometer. Fluid shall be magnified for better visibility. Scale shall be readable from ground level and allow vertical or horizontal orientation. Type – 1 thermometers shall be used in dry, non-corrosive areas as indicated in Section 01450. Systems and temperature ranges shall be as indicated in this Section.

System	**Gauge Range (°C)**
C1	0 to 50
DHF/DHR (domestic hot water)	0 to 100
HRS/HRR	0 to 150

.2 Thermowells shall comply with ASME B40.200. Temperature taps shall be 12 mm NPT, and lagging extensions shall be provided on insulated vessels or pipes. Thermowells and bushings shall be machined from Type 316 stainless steel bar stock unless otherwise specified.

.3 Acceptable Products:

.1 Weksler Model A935AC3-AL.

.2 Or approved equivalent.

.2 Type - 2:

.1 Thermometers shall be suitable for the system into which they are installed. All Type – 2 thermometers shall be bi-metal dial type provided with 127 mm diameter dial, hermetically sealed case, external reset for field calibration, and adjustable dial. Type – 2 thermometers shall be used in wet and corrosive areas as indicated in Section 01450. Systems and temperature ranges shall be as indicated in this Section.

System	**Gauge Range (°C)**
DHF/DHR (domestic hot water)	0 to 100
HRS/HRR	0 to 100

.3 Acceptable Products:

.1 Winters Model TBM52.

.2 Or approved equivalent.

.13 Pressure Gauges:

.1 Pressure gauges shall be 114 mm premium grade, glycerin filled units with bourdon tube element, 270 degree milled stainless steel movement, phenolic case, and shatterproof glass window. Accuracy shall be 1 percent of span or better. All exposed metal parts shall be stainless steel.

.2 Root valves shall be ASTM A276, Type 316 stainless steel bar stock with 13 mm NPT male process connection and three 13 mm NPT female instrument connections. One instrument connection shall be provided with an ASTM A276, Type 316 stainless steel bleed valve. ASTM A276, Type 316 stainless steel plugs shall be provided for unused ports.

.14 Recirculation Pumps:

.1 Lead-free bronze construction with mechanical seal, stainless steel shaft, permanently lubricated bearing and ODP motor.

.2 Maximum operating temperature 107°C.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Review and follow the requirements of the Plumbing Systems section of the City of Winnipeg, Winnipeg Sewage Treatment Program – Building Mechanical design Guideline.

.3 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.4 Lubricate clean-out plugs with mixture of graphite and linseed oil.

.5 Where floor drains are located over occupied area, provide waterproof installation.

.6 Provide trap primers where required by applicable Law and for mechanical rooms, service rooms, washrooms and shower rooms.

.7 Locate plumbing vents a minimum 5 m away from air intakes.

.8 Install free standing neutralization tanks in accordance with Manufacturer's instructions and provide an initial fill to the 75 percent level with marble chips.

.9 Install oil interceptors on all floor drainage systems that may be subject to oil leak contamination other than generator rooms where dry sumps are to be provided with no connection to building drainage.

.10 Backflow Preventers:

   .1 Type - 1: Install assembly with optional air gap fitting. Install assembly with Y-strainer upstream. Assembly shall be installed in an upright orientation with water flow horizontal. Outlet of air gap shall be minimum 305 mm from floor and isolation valve handles 1,400 mm from floor maximum. Perform function test per Manufacturer's recommendations prior to commissioning of the system.

   .2 Type - 2: Assembly shall be installed in an upright orientation with water flow horizontal. Bottom of assembly shall be 305 mm from floor minimum and isolation valve handles shall be 1,400 mm from floor maximum. Perform function test per Manufacturer's recommendations prior to commissioning of the water supply and waste drainage systems.

   .3 Type - 3: Hose connection vacuum breaker is to be installed on all hose connections installed in the potable water piping system. Hose bibbs are provided with vacuum breakers, so hose connection vacuum breakers are not required on hose bibbs.

.11 Thermometers:

   .1 Provide thermometers on the following systems in locations identified in the Final Design:

      .1 Potable water.

      .2 Domestic hot water.

      .3 Non-potable water.

      .4 Compressed air.

.5 Tanks, pumps, compressors.

.6 Water heaters.

.2 Install in thermowells specified in this section in accordance with the Manufacturer's instructions and the specified functional requirements.

.3 For pipelines less than 100 mm diameter, thermowell shall be installed in a pipeline elbow. Where elbow is not available, a wye fitting shall be installed in the pipeline for installation of the thermowell at a 45-degree angle with the flow.

.12 Pressure Gauges:

.1 Provide pressure gauges at:

.1 Both sides of pressure reducing valves.

.2 Backflow prevention stations.

.3 Pumps.

.4 Compressors.

.2 Root valves shall be provided at all pressure taps except taps made for safety instruments. Manifold root valves shall be provided where two or more instruments are connected to a single tap. Plug un-used ports in manifold root valves with Type 316 stainless steel pipe plug.

.13 Recirculation Pumps:

.1 Provide check valve at discharge and isolation valves at pump inlet and downstream of the check valve.

.2 Integrate controls with the PCS.

END OF SECTION

WATER SUPPLY AND WASTE DRAINAGE FIXTURES AND TRIM

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for product selection, supply, installation and testing of water supply and waste drainage fixtures, fixture trim, and emergency eyewash and showers including the following:

- .1 Water closets and flush valves.
- .2 Urinals and flush valves.
- .3 Lavatories and faucets.
- .4 Kitchen sinks and faucets.
- .5 Utility sinks and faucets.
- .6 Service sinks and faucets.
- .7 Hose Bibb (Interior).
- .8 Hose Bibb (Exterior).
- .9 Showers and mixing valve.
- .10 Combination emergency eyewash and showers.
- .11 Tempered water mixing valves.
- .12 Thermostatic mixing valves.

1.2 Standards

.1 American Disabilities Association.

.2 American National Standards Institute (ANSI):

- .1 ANSI/ISEA Z358.1 - Standard for Emergency Eyewash and Shower Equipment.

.3 ASSE 1071 – Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment.

.4 Canadian Standards Association (CSA):

- .1 CSA/CAN3-B45.0 - General Requirements for Plumbing Fixtures.
- .2 CSA/CAN3-B45.1 - Vitreous China Plumbing Fixtures.
- .3 CSA/CAN3-B45.2 - Enamelled Cast Iron Plumbing Fixtures.

.4 CSA/CAN3-B45.3 - Porcelain Enamelled Steel Plumbing Fixtures.

.5 CSA/CAN3-B45.4 - Stainless Steel Plumbing.

.6 CSA B125.1 / ASME A112.18.1 - Standard for Plumbing Supply Fittings.

.5 National Sanitation Foundation (NSF).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Provide fixtures and fittings of the same type from one Manufacturer.

.2 Acceptable Manufacturers and Products:

.1 Water Closets:

.1 Zurn.

.2 American Standard.

.3 Kohler.

.4 Or approved equivalent.

.2 Water Closet Flush Valves:

.1 Zurn.

.2 Delta Commercial.

.3 Sloan.

.4 Or approved equivalent.

.3 Urinals:

.1 Zurn.

.2 American Standard.

.3 Kohler.

.4 Or approved equivalent.

.4 Urinal Flush Valves:

- .1 Zurn.
- .2 Delta Commercial.
- .3 Sloan.
- .4 Or approved equivalent.

.5 Lavatories:

- .1 Zurn.
- .2 American Standard.
- .3 Kohler.

.6 Lavatory Faucets.

- .1 Zurn.
- .2 Delta Commercial.
- .3 American Standard.
- .4 Chicago Faucets.
- .5 Or approved equivalent.

.7 Kitchen Sinks:

- .1 Elkay.
- .2 Griffin.
- .3 Franke.
- .4 Or approved equivalent.

.8 Faucet for Kitchen Sinks:

- .1 American Standard.
- .2 Kohler.
- .3 Zurn.
- .4 Delta Commercial.
- .5 Chicago Faucets.

.6 Or approved equivalent.

.9 Utility Sinks:

.1 Elkay.

.2 Griffin.

.3 Franke.

.4 Or approved equivalent.

.10 Faucet for Utility Sinks:

.1 American Standard.

.2 Kohler.

.3 Zurn.

.4 Delta Commercial.

.5 Chicago Faucets.

.6 Or approved equivalent.

.11 Service Sinks:

.1 American Standard.

.2 Kohler.

.3 Zurn.

.4 Or approved equivalent.

.12 Faucet for Service Sinks:

.1 American Standard.

.2 Kohler.

.3 Zurn.

.4 Delta Commercial.

.5 Chicago Faucets.

.6 Or approved equivalent.

.13 Hose Bibb (Interior)

.1 Zurn.

.2 Watts.

.3 Mifab.

.4 Or approved equivalent.

.14 Hose Bibb (Exterior)

.1 Zurn.

.2 Watts.

.3 Mifab.

.4 Or approved equivalent.

.15 Showers and Mixing Valves:

.1 American Standard.

.2 Delta Commercial.

.3 Chicago Faucets.

.4 Or approved equivalent.

.16 Combination Emergency Eyewash and Showers:

.1 Haws.

.2 Speakman.

.3 Bradley.

.4 Acorn.

.5 Or approved equivalent.

.17 Tempered Water Mixing Valves:

.1 Haws.

.2 Acorn.

.3 Bradley.

.4 Powers.

.5 Or approved equivalent.

.18 Thermostatic Mixing Valves:

.1 Watts.

.2 Powers.

.3 Symmons.

.4 Acorn.

.5 Haws.

.6 Bradley.

.7 Or approved equivalent.

2.2 Configuration, Components and Features

.1 Water Closet:

.1 Bowl: White wall hung or floor mounted - vitreous china with antimicrobial surface which inhibits the growth of stain and odor causing bacteria mold and mildew - siphon jet flush action - condensate channel - elongated bowl - 54 mm fully glazed internal trapway – 38 mm dia. Top spud.

.1 Acceptable Products:

.1 American Standard 3351101.020.

.2 Or approved equivalent.

.2 Minimum working pressure range: 175 kPa to 550 kPa maximum.

.3 Water Surface: 305 mm x 254 mm water surface.

.4 Water Consumption: 4.8 L per flush.

.2 Flush Valve: Reclaimed water flushometer exposed manual for top spud toilet.

.1 Acceptable Products:

.1 Sloan Royal 111-1.28 RW.

.2 Or approved equivalent.

.2 4.8 L factory set flow.

.3 Quiet action 'PERMEX' diaphragm type with linear filtered bypass.

.4 Non-hold open feature.

.5 American Disabilities Association compliant triple seal oscillating handle.

.6 Smooth design stop cap on back-check angle stop (screwdriver operated).

.7 High pressure vacuum breaker.

.3 Carrier (for wall hung): Single horizontal, toilet carrier adjustable for barrier-free applications.

.1 Acceptable Products:

.1 Watts ISCA-101-M11.

.2 Or approved equivalent.

.2 All epoxy coated cast iron fitting.

.3 Cast iron footings adjustable for standard or barrier-free applications.

.4 Adjustable ABS slide nipple with integral test cap and neoprene bowl gasket.

.5 Plated hardware, chrome cap nuts.

.6 Tiling frame.

.7 ABS nipples with integral test caps.

.8 Neoprene bowl gaskets.

.9 102 mm no hub waste.

.10 51 mm no hub vent.

.11 Minimum space required: 305 mm finished metal stud wall to back of pipe space.

.4 Seat: toilet seat, heavy duty, for elongated bowl, open front, white solid plastic.

.1 Acceptable Products:

.1 Centoco 500STSCC.001.

.2 Or approved equivalent.

.2 Less cover.

.3 Stainless steel check hinges, metal flat washers stainless steel posts and nuts.

.2 Urinal:

.1 Bowl: Vitreous china, wall hung, extended sides for privacy, washdown action, flushing rim, 19 mm dia. Top spud, elongated rim, integral P-trap, outlet connection 51 mm, two (2) wall hangers, chrome plated, non-metallic strainer.

.1 Minimum working pressure range: 137 kPa to 550 kPa maximum.

.2 Nominal dimensions: 470 mm wide x 356 mm projection x 692 mm high.

.3 Water consumption: operates in the range of 0.5 L to 3.8 L per flush.

.4 Acceptable Products:

.1 American Standard 6590.001 / 7301242-100.

.2 Or approved equivalent.

.2 Flush Valve: Exposed Touchless Sensor Flushometer for Top Spud urinal, chrome plated.

.1 0.5 L factory set flow.

.2 Mechanical Override Flush Button.

.3 Alkaline batteries included.

.4 “Low Battery” Flashing LED.

.5 “User in View” Flashing LED.

.6 Quiet action 'PERMEX' diaphragm type with dual filter by-pass.

.7 Valve body is Semi-red brass.

.8 Smooth design stop cap on back-check angle stop (screwdriver operated).

.9 High pressure vacuum breaker.

.10 Suitable for use with reclaimed water.

.11 Acceptable Products:

.1 Sloan Royal 186 SFSM-0.125.

.2 Or approved equivalent.

.3 Carrier: Heavy gauge epoxy coated steel.

.1 Top and bottom universal steel hanger plates.

.2 Offset uprights with welded feet supports.

.3 Plated hardware.

.4 Minimum space required: for one unit: 102 mm for two to six units in a row: 152 mm finished metal stud wall to back of pipe space.

.4 Wall cleanout: two piece expandable plug with 102 mm diameter stainless steel access cover, secured with vandal proof stainless steel screw.

.1 Acceptable Products:

.1 Watts CA-321.

.2 Or approved equivalent.

.3 Lavatories – Counter Mount:

.1 Bowl: self-rimming, drop-in basin, vitreous china, side rear overflow, faucet ledge.

.1 Nominal Dimensions: 533 mm wide x 445 mm front to back x 175 mm high.

.2 Bowl Dimensions: 441 mm x 279 mm x 133 mm.

.3 102 mm centres.

.4 32 mm waste.

.5 Acceptable Products:

.1 American Standard 9494.001.

.2 Or approved equivalent.

.2 Faucet: Touchless Sensor lavatory Faucet, chrome plated, 100 mm centreset.

.1 Commercial grade.

.2 Lead free cast brass construction.

.3 119 mm projection rigid cast brass spout.

.4 1 liter per minute flow rate.

.5 Multi-laminar flow spray outlet.

.6 Adjustable range infared sensor.

.7 Control module with solenoid and serviceable filter.

.8 Adjustable run-time time-out.

.9 Alkaline batteries included.

.10 13 mm National Pipe Straight Mechanical supply inlets.

.11 Faucet supplies, chrome plated polished brass, heavy duty angle stops, 10 mm inlet x 76 mm long rigid horizontal nipples, loose keys, escutcheon and flexible copper risers.

.12 Acceptable Products:

.1 Sloan SF-2350-BAT-BDM-CP.

.2 Or approved equivalent.

.3 Grid drain: Offset open grid drain, cast brass one piece top, 1.5 mm tubular 32 mm tailpiece.

.1 Acceptable Products:

.1 McGuire 155WC.

.2 Or approved equivalent.

.4 Barrier-free pipe safety covers: vandal-resistant, flexible, seamless molded closed-cell PVC with anti-microbial additive to cover all exposed pipe below basin.

.1 Acceptable Products:

.1 Prowrap PW2000WC.

.2 Or approved equivalent.

.4 Lavatories – Wall Hung (Shops):

.1 Bowl: Wall hung Basin - 16 GA. (1.5 mm) Type 304 stainless steel seamless weld construction, satin finish, 76 mm high backsplash.

.1 Acceptable Products:

.1 Dura-ware 1950-1-9-H24-GT-AB.

.2 Or approved equivalent.

.2 Nominal dimensions: 457 mm wide x 381 mm deep x 178 mm high.

.3 Bowl dimensions: 368 mm x 251 mm x 152 mm.

.4 102 mm centres.

.5 Mounting bracket provided w/ angle braces.

.6 32 mm waste w/ grid strainer.

.2 Faucet: Touchless Sensor lavatory Faucet, chrome plated, deck-mounted.

.1 Commercial grade.

.2 Lead free cast brass construction.

.3 147 mm projection gooseneck spout.

.4 Laminar flow spray outlet.

.5 4 liter per minute flow rate.

.6 Integrated mixer.

.7 Adjustable range infared sensor.

.8 Control module with solenoid and serviceable filter.

.9 Adjustable run-time time-out.

.10 Alkaline batteries included.

.11 13 mm National Pipe Straight Mechanical supply inlets.

.12 Faucet supplies, chrome plated polished brass, heavy duty angle stops, 10 mm inlet x 76 mm long rigid horizontal nipples, loose keys, escutcheon and flexible copper risers.

.13 Acceptable Products:

.1 Sloan EAF-750-BAT-ISM-CP.

.2 Or approved equivalent.

.14 Grid Drain: Offset open grid drain, cast brass one piece top, 1.5 mm tubular 32 mm tailpiece. Acceptable Products:

.1 McGuire 155WC.

.2 Or approved equivalent.

.5 Kitchen Sinks:

.1 Bowl: kitchen sinks are to be double bowl countertop mount with self-rimming – backledge.

.1 Grade 18-10 20 GA. (0.9 mm) Type 302 stainless steel satin finish rim and bowls.

.2 Fully undercoated to reduce condensation and resonance.

.3 Factory applied rim seal.

.4 89 mm crumb cup waste assembly with 38 mm tailpiece.

.5 Nominal dimensions: 794 mm wide x 521 mm x 203 mm high.

.6 Acceptable Products:

.1 Franke – LBD6408-1/1.

.2 Or approved equivalent.

.2 Faucet: single handle.

.1 Chrome plated.

.2 Centre hole only.

.3 Lead free cast brass body.

.4 8.3 L/min aerator outlet.

.5 239 mm long spout.

.6 Lever handle volume control.

.7 9.5 mm compression inlets.

.8 Copper tubes.

.9 Supplies, chrome plated polished brass, heavy duty angle stops, 10 mm Inlet x 76 mm long rigid horizontal nipples, loose keys, escutcheon and flexible copper risers.

.10 Acceptable Products:

.1 American Standard 4175.100 Colony Soft.

.2 Or approved equivalent.

.6 Utility Sinks:

.1 Sink: stainless steel Type 304, single compartment.

.1 600 mm x 600 mm.

.2 Two faucet holes 200 mm apart.

.3 200 mm high backsplash with 45 degree sloped top.

.4 Sinks are to bear the NSF International Certification mark.

.5 Sinks shall be provided with chrome-plated strainer, support legs, tailpiece, and p-trap.

.6 Acceptable Products:

.1 Elkay Model SS8124.

.2 Or approved equivalent.

.2 Faucet: Wall mount polished chrome service sink faucet.

.1 75 mm cast brass spout.

.2 Vacuum breaker.

.3 Integral supply stops.

.4 Vandal-resistant lever handles.

.5 12 mm connections on 200 mm centres.

.6 Bucket hook.

.7 19 mm threaded hose connection.

.8 Wall escutcheons.

.9 Acceptable Products:

.1 American Standard 8350.243.

.2 Or approved equivalent.

.7 Service Sinks:

.1 Sink: Enameled cast iron, single compartment.

.1 Nominal dimensions 610 mm x 521 mm x 286 mm high.

.2 Two faucet holes 200 mm apart.

.3 229 mm high backsplash.

.4 Stainless steel rim guard.

.5 P-trap complete with floor pedestal.

.6 Sinks shall be provided with chrome-plated strainer.

.7 Acceptable Products:

.1 American Standard 7695.008.

.2 Or approved equivalent.

.2 Faucet: Wall mount polished chrome service sink faucet.

.1 75 mm cast brass spout.

.2 Vacuum breaker.

.3 Integral supply stops.

.4 Vandal-resistant lever handles.

.5 12 mm connections on 200 mm centres.

.6 Bucket hook.

.7 19 mm threaded hose connection.

.8 Wall escutcheons.

.9 Acceptable Products:

.1 American Standard 8350.243.

.2 Or approved equivalent.

.8 Hose Bibb (Interior):

.1 Cast bronze wall hydrant with vacuum breaker. Meets NSF/ANSI 372.

.2 Standard of Acceptance: Zurn 195XL-VB.

.3 Provide with heavy duty rubber “Y” hose connection when used with hose reel.

.9 Hose Bibb (Exterior):

.1 Non-freeze wall hydrant with vacuum breaker. Brass interior parts and operating key, stainless steel cover plate and box.

.2 Standard of Acceptance: Zurn ZN-1320-15.

.10 Shower Trim: Mixing valve and shower head.

.1 Acceptable Products:

.1 Chicago Faucets SH-PB1-03-000 / 620-ALCP.

.2 Or approved equivalent.

.2 Shower valve:

.1 Pressure balancing.

.2 Washerless ceramic drip-free disk valve cartridge.

.3 Solid brass body.

.4 Built-in hot temperature limit and cold supply inlet check stops.

.5 Integral service stops.

.6 Metal wall escutcheon,

.3 Shower head: 5.7 L/min showerhead with arm and flange.

.11 Combination Emergency Eyewash and Showers:

.1 Eye/face wash shall be stainless steel 27.9 cm round bowl, an eye/face wash head with inverted directional laminar flow, and an integral flow control. Yellow plastic pop-off dust cover for eyewash head.

.2 Showerhead shall be hydrodynamic designed stainless steel showerhead with flow control, chrome-plated brass stay-open ball valve equipped with stainless steel ball and stem, and chrome-plated brass in-line 50 x 50 mesh water strainer.

.3 Supply riser / stand shall be Schedule 40 hot-dipped galvanized steel pipe and fittings with a cast-iron 22.9 cm diameter floor flange, all with green corrosion resistant epoxy coating, self-adhesive high visibility safety green and bright yellow stripes, universal sign, and 32 mm supply.

.4 Combination emergency eyewash/shower units shall be certified by CSA to meet ANSI Z358.1 requirements.

.5 Acceptable Products:

.1 Haws Model 8300CRP-8309CRP Series.

.2 Or approved equivalent.

.6 Per the WSTP Building Mechanical Design Guideline, provide a flow switch with an alarm signal to the PCS upon operation of the shower or eyewash.

.1 Pipe mounted, emergency alarm and light system operated by a double pole, double throw flow switch at a flow rate of 0.15 l/sec.

.2 Contains multiple sets of contacts for remote activation.

.3 Complete with amber flashing beacon and sounder producing a minimum of 90 db at 3.05 m (10 ft). Buzzer shall be capable of being silenced during testing.

.4 Voltage: 120 VAC, 60 cycles and CSA electrically certified as TYPE 4.

.5 Standard of Acceptance: Haws Model 9001.

.12 Combination Emergency Eyewash and Showers serving Corrosive Areas:

.1 Eye/Face Wash: Stainless steel 27.9 cm round bowl, an eye/face wash head with inverted directional laminar flow, and an integral flow control. Stainless steel valve actuator flag. Stainless steel dust cover for bowl.

.2 Showerhead: Hydrodynamic designed stainless steel showerhead with flow control, Type 316 stainless steel stay-open ball valve equipped with stainless steel ball and stem, and Type 304 stainless steel in-line 50 x 50 mesh water strainer.

.3 Supply Riser / Stand: Type 304 stainless steel pipe and fittings with a stainless steel 22.9 cm diameter floor flange, with self-adhesive high visibility safety green and bright yellow stripes, universal sign, and 32 mm supply.

.4 Combination emergency eyewash/shower units shall be certified by CSA to meet ANSI Z358.1 requirements.

.5 Acceptable Products:

.1 Haws Model 8330.

.2 Or approved equivalent.

.6 Per the WSTP Building Mechanical Design Guideline, provide a flow switch with an alarm signal to the PCS upon operation of the shower or eyewash.

.1 Pipe mounted, emergency alarm and light system operated by a double pole, double throw flow switch at a flow rate of 0.15 l/sec.

.2 Contains multiple sets of contacts for remote activation.

.3 Complete with amber flashing beacon and sounder producing a minimum of 90 db at 3.05 m (10 ft). Buzzer shall be capable of being silenced during testing.

.4 Voltage: 120 VAC, 60 cycles and CSA electrically certified as TYPE 4.

.5 Standard of Acceptance: Haws Model 9001.

.13 Tempered Water Mixing Valves:

.1 Valve body shall be “lead-free' brass with corrosion resistant internal components. Checks and screen shall be integral.

.2 The sensor is to be an advance paraffin actuator with a temperature range of 16°C to 35°C, factory set to 26.7°C and adjustable by the safety officer. A locknut shall prevent unauthorized or accidental set point changes.

.3 CSA certified to ASSE 1071 and CSA standards.

.4 Valve shall have an on demand internal cold water bypass of at least 60% of the normal flow rate.

.5 Positive hot water shutoff on loss of cold water pressure.

.6 Provide mixing valve with discharge temperature gauge.

.7 Surface wall mounting cabinet with plexi-glass window in door.

.8 Shut-offs shall be lockable to help prevent unauthorized or accidental closing in accordance with ANSI Z358.1 and ASSE 1071 shall be a reliable ball valve design.

.9 Acceptable Products:

.1 Haws Model 9201 EFE.

.2 Or approved equivalent.

.14 Thermostatic Mixing Valves:

.1 Thermostatic Mixing Valve shall be independent lab certified to ASSE 1071 and CSA standards. Valve shall have an on demand internal cold water bypass of at least 60 percent of the normal flow rate. Valve body shall be “lead-free” brass with corrosion resistant internal components. Checks and screen shall integral.

.2 The sensor shall be an advance paraffin actuator with a temperature range of 32°C to 71°C, factory set to 43°C and adjustable by the safety officer. A locknut shall prevent unauthorized or accidental set point changes.

.3 Provide mixing valve with discharge temperature gauge.

.4 Acceptable Products:

.1 Watts LF1170.

.2 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.1 Isolation valves for tempered water mixing valves shall be positively locked in the open position.

.2 Thermostatic mixing valve shall be installed at each lavatory and sink, unless noted otherwise. Valve shall be accessible for maintenance from ground level working surface without ladders or working platforms. Thermostatic mixing valves shall have discharge temperature set to 43°C.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies natural gas, electric, and indirect (boiler water heat source) water heaters for domestic water, complete with insulated tank, valving and corrosion controls as applicable.

.2 Comply with the requirements of The City of Winnipeg, Winnipeg Sewage Treatment Program – Building Mechanical Design Guideline as specified in Appendix 18D.

.3 Preference given to hot water systems using natural gas as an energy source.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

- .1 ASME Boiler and Pressure Vessel Code.

.2 American National Standards Institute (ANSI):

- .1 ANSI Z21.22.CSA 44.4 - Relief Valves for Hot Water Supply Systems.

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

- .1 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

.4 Canadian Standards Association (CSA):

- .1 CAN/CSA-C22.2 No. 64 - Household Cooling and Liquid-Heating Appliances.
- .2 CAN/CSA-C22.2 No. 88 – Construction and Test of Industrial Heating Equipment.

.5 Canadian Gas Association (CGA).

.6 National Electrical Manufacturers Association (NEMA).

.7 National Sanitation Foundation (NSF):

- .1 NSF/ANSI 61 - Drinking Water System Components – Health Effects.
- .2 NSF 5 - Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment.

.8 Underwriters Laboratories of Canada (ULC):

- .1 UL 499 - Electric Heating Appliances.
- .2 ULC S636 - Standard for Type BH Gas Venting Systems.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Supply products modified as necessary by the Manufacturer to provide the specified features and to meet the specified operating conditions. Product to be CSA labelled.

.2 Acceptable Manufacturers:

  .1 Tank-Type Natural Gas Water Heaters:

    .1 Bradford White.

    .2 A.O. Smith.

    .3 Rheem.

    .4 Or approved equivalent.

  .2 Tank-Type Electric Water Heaters:

    .1 Bradford White.

    .2 A.O. Smith.

    .3 Rheem.

    .4 Or approved equivalent.

  .3 Tank-Type Indirect Water to Water Heaters:

    .1 Lochinvar.

    .2 Hubble.

    .3 Or approved equivalent.

  .4 Tankless Electric Water Heaters:

    .1 Keltech.

    .2 A. O. Smith.

    .3 Hubble.

    .4 Or approved equivalent.

.5 Tankless Natural Gas Water Heaters:

.1 A. O. Smith.

.2 Rheem.

.3 John Wood.

.4 Or approved equivalent.

2.2 Materials

Component	Material
Tank	Glass-lined steel
Shell	Steel Baked Enamel Finish
Insulation	Polyurethane Foam
Anode	Magnesium or Aluminum
Relief Valve	Brass
Drain Valve	Brass
Heat Exchanger (Boiler)	Copper
Element (Electric)	Incoloy with Stainless Steel Sheath

2.3 Configuration, Components and Features

.1 Provide complete indirect tank-type water heater unit including:

.1 Double wall removable heat exchanger compatible with boiler heat source complete with leak detection port.

.2 Provide double wall removable heat exchanger to transfer heat from hot water buffer tank source complete with leak detection port.

.3 50 mm tank insulation meets ASHRAE 90.1.

.4 Corrosion protection with two sacrificial anodes.

.5 Operating and safety controls.

.6 Adjustable thermostat.

.7 ASME rated Pressure-temperature relief valve.

.8 Drain valve.

.9 Complete with drip pan.

.2 Provide complete tank-type gas fired hot water heater unit including:

.1 CGA approved, natural gas fired, forced draft, package type, 83 percent fuel to water efficiency, potable hot water heater.

.2 ASME constructed, rated and stamped steel tank with "NICKELSHIELD" lining.

.3 ASME rated temperature and pressure relief valve.

.4 High density fibreglass insulation.

.5 Drain valve.

.6 A baffle to divert incoming cold water to permit approximately 80 percent of the tank storage capacity to be usable at plus or minus 3°C (5.4°F) of the thermostat setpoint.

.7 Segmented steel jacket with a baked enamel finish.

.8 A 2-pass, completely submerged U-bend fire tube heat exchanger with all wetted parts constructed of non-ferrous materials, flange bolted to the tank.

.9 A forced draft modulating power burner with leak-free cast aluminum housing, CGA approved gas piping train, electronic spark ignition, and solid-state electronic flame monitoring with 100 percent safety shut-off.

.10 All required operating and safety controls including thermostat(s), temperature limit switch (manual reset), dial thermometer and pressure gauges, low water cut-off, and thermal expansion control valve in the cold-water section of the tank to relieve pressure in excess of 690 kPa (100 psi).

.11 Complete with drip pan.

.3 Provide complete tank-type electric hot water heater unit including:

.1 Equipped with extruded high-density anode.

.2 All internal surfaces of the heater(s) exposed to water shall be glass lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 1400°F to 1600°F.

.3 Electric heating elements shall be low watt density. Each element shall be controlled by an individually mounted thermostat and high temperature cut-off switch.

.4 All internal circuits shall be fused.

.5 The outer jacket shall be of baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through front panel and shall enclose the tank with foam insulation.

.6 Electrical junction box with heavy duty terminal block shall be provided.

.7 The drain valve shall be located near the front for ease of servicing.

.8 Manufacturer shall supply ASME rated temperature and pressure relief valve.

.9 Complete with drip pan.

.4 Provide complete point-of-use (0.1 L/s or less) tankless electric water heater unit including:

.1 Electric tankless commercial water heater, UL 499, sized for low flow constant temperature requirements, with PID Controller, liquid-cooled triac switches, low flow activation, and overheat protection.

.2 Enclosure: 1.59 mm thick stainless steel NEMA 4X.

.3 Heat Exchanger: Copper tubing with brazed brass fittings and large internal passageways for minimal pressure drop. NSF 61 barrier materials for potable water, without storage capacity.

.4 Pressure rating: 1035 kPa.

.5 Heating Element: heavy duty, low-watt density Incoloy 800 sheathed resistive element.

.6 Temperature Control: microprocessor with PID logic and dual display of set-point and actual outlet water temperature.

.7 Safety controls:

.1 Surface mounted bi-metal thermostat with manual reset.

.8 The heater is to include automatic and manual resets for disabling the heater if the water temperature increases to 79.5°C.

.5 Provide complete high efficiency condensing tankless natural gas water heater unit for flows of 0.3 L/s or less including:

.1 Natural gas tankless commercial water heater, fully modulating constant temperature requirements.

.2 Integral controller, thermistor to monitor water and exhaust temperature, low flow activation, flame monitor, and overheat protection.

.3 Controls will allow linking of multiple heaters for added capacity with rotating priority.

.4 Certified to NSF 5 standards.

.5 CSA approved.

.6 Primary Heat Exchanger: Commercial-grade copper fin tube with quick release brass or bronze waterways.

.7 Secondary Heat Exchanger: Type 316 stainless steel.

.8 Thermal efficiency of 96%.

.9 Pressure rating: 1035 kPa.

.10 Burner: Aluminized stainless steel with electronic spark igniter and modulating gas valve.

.11 Venting: Power vented with ULC S636 approved schedule 40 PVC, CPVC, polypropylene or Category III / IV vent pipe.

.12 Safety controls:

.1 High-limit temperature switches on exhaust and water.

.2 Dual freeze protection to auto fire burner and heater blocks to protect heat exchanger.

.3 Overheat cutoff fuse.

.4 In-line fusing and surge absorbers for surge protection.

.6 Thermal Expansion Tank:

.1 Refer to Section 15130.

2.4 Extended Warranty

.1 In addition to the Warranties requirements as set out in the DBA, provide the following from Substantial Completion:

.1 A five (5) year unconditional warranty on hot water tanks and exchangers.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 If shipped loose, install pressure and temperature safety relief valves on water heater. Run relief valve discharge lines as shown in Manufacturer's instructions.

.4 Extend relief-valve outlet line, and discharge by positive air gap above closest floor drain.

.5 Factory Testing:

.1 Test the units at 1034 kPa working pressure.

.2 Factory test high-capacity tankless heater: Test and inspect domestic-water heaters according to ASME "Boiler and Pressure Vessel Code". Submit test reports.

.6 Replace defective or malfunctioning controls and equipment.

END OF SECTION

NATURAL GAS DISTRIBUTION SYSTEMS

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for the supply, installation, testing and commissioning of a complete natural gas distribution system.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

- .1 ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.
- .2 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .4 ASME B18.2.1 - Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials (ASTM):

- .1 ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 ASTM B75M - Standard Specification for Seamless Copper Tube.
- .4 ASTM B837 - Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA):

- .1 CSA W47.1 - Certification of Companies for Fusion Welding of Steel.
- .2 CAN/CSA B149.1HB - Natural Gas and Propane Installation Code Handbook.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

- .1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Pipe, Jointing Material, Fittings and Valves

.1 Refer to Section 15055.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install drip points:

- .1 At low points in piping system.
- .2 At connections to equipment.

.4 Perform the following additional pre-installation testing activities:

- .1 Have Manufacturer of products supplied under this section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with the Final Design.
- .2 Provide Manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with Manufacturer's instructions.
- .3 Schedule site visits to review work at stages listed:
  - .1 After delivery and storage of products, and when preparatory work on which work of this section depends is complete, but before installation begins.
  - .2 Twice during progress of work at 25 and 60 percent complete.
  - .3 Upon completion of work, after cleaning is carried out.

.5 Complete the following additional pre-start-up inspections:

- .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
- .2 Check gas trains, entire installation is approved by authority having jurisdiction.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements of the design, supply, installation and testing of the fire sprinkler equipment.

1.2 Standards

.1 ASME Boiler and Pressure Vessel Code.

.2 Electrical Equipment Manufacturers Association of Canada (EEMAC).

.3 National Fire Protection Association (NFPA):

  .1 NFPA 13 - Standard for the Installation of Sprinkler Systems.

  .2 NFPA 11 - Standard for Low-, Medium-, and High-Expansion Foam.

  .3 NFPA 16 - Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.

  .4 NFPA 20 - Standard for the Installation of Stationary Pumps for Fire Protection.

  .5 NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances.

  .6 NFPA 1963 - Fire Hose Connections.

.4 Underwriters Laboratories of Canada (ULC):

  .1 CAN/ULC S543 - Standard for Internal Lug Quick-Connect Couplings for Fire Hose.

.5 UL 162 - Safety Foam Equipment and Liquid Concentrates.

.6 UL 393 - Safety Indicating Pressure Gauges for Fire-Protection Service.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Materials

.1 Materials to NFPA 13.

2.2 Performance Criteria

.1 Design automatic wet and dry pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by pipe schedules for applicable occupancy classifications or hydraulic calculations for uniform distribution of water over design area.

.2 Determine volume and pressure of incoming water supply from water flow test data.

.3 Provide wet pipe, dry pipe and/or pre-action type sprinkler system to suit the hazards and location.

.4 Interface system with the Fire Alarm system and the PCS.

.5 Provide fire department connections.

.6 Design, calculate, and lay out sprinkler system, to local codes and NFPA 13.

.7 Design of sprinkler system must be completed by a certified sprinkler system engineer.

2.3 Sprinkler Heads

.1 General: design to NFPA 13 for fire services.

.2 Sprinkler Head Type:

  .1 Type A: upright bronze.

  .2 Type B: pendant chrome glass bulb type.

  .3 Type C: recessed polished chrome, glass bulb type with ring and cup.

  .4 Type D: flush polished chrome link and lever type.

  .5 Type E: side wall polished chrome link and lever type.

.3 Provide nominal 1.2 cm orifice sprinkler heads.

.4 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.

.5 Provide polished stainless steel ceiling plates and chromium-plated pendent sprinklers below suspended ceilings.

.6 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.

.7 Deflector: not more than 75 mm below suspended ceilings.

.8 Ceiling plates: not more than 25 mm deep.

2.4 Sprinkler Piping

.1 Pipe:

.1 Ferrous: to NFPA 13.

.2 Copper tube: to NFPA 13.

.2 Fittings and joints to NFPA 13:

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

.1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.

.2 Copper tube: screwed, soldered, brazed, grooved.

.3 Provide welded, threaded, or grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.

.4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied are not permitted.

.5 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.

.6 Fittings: for use in wet pipe sprinkler systems.

.7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same Manufacturer.

.8 Side outlet tees using rubber gasketed fittings are not permitted.

.9 Sprinkler pipe and fittings: metal.

.3 Valves:

.1 ULC listed for fire protection service.

.2 Gate valves: open by counterclockwise rotation.

.3 Provide OS & Y valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.

.4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 100 mm and larger.

.4 Provide gate valve in piping protecting elevator hoist ways machine rooms, and machinery spaces.

.5 Pipe hangers:

.1 ULC listed for fire protection services in accordance with NFPA.

.6 Water flow switch: suitable for horizontal or vertical mounting, with contacts compatible for use with alarm control system.

.7 Fire Department Connections:

.1 Outlet: flush mounted wall type, thread size to suit fire department requirements, internal lug quick-connect, with threaded dust cap and chain of matching material and finish.

.2 Provide a label: "Sprinkler - Fire Department Connection".

2.5 Alarm Check Valve

.1 Alarm check valve to NFPA 13 and ULC listed for fire service.

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

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

2.6 Water Monitor Alarms

.1 Provide approved weatherproof and guarded type alarms to sound locally on flow of water in each corresponding sprinkler system.

.2 Mount alarms on outside of outer walls of each building at location as required by the Final Design.

.3 Provide separate drain piping directly to exterior of building.

2.7 Supervisory Switches

.1 General: to NFPA 13 for fire service.

.2 Valves:

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

.3 Pressure or Flow Switch Type:

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

.2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.

.3 Connect into building fire alarm system in PCS and automation system.

.4 Connection of switch: Section 16721.

.5 Alarm actuating device: mechanical diaphragm-controlled retard device adjustable from ten (10) to sixty (60) seconds and instantly recycle.

.4 Pressure Alarm Switch:

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

2.8 Water Gong

.1 To NFPA 13 and ULC listed for fire service.

2.9 Fire Department Connection

.1 Provide connections approximately 1.5 m above finish grade. Location to be coordinated with the local fire department.

.2 To NFPA 13 and ULC S543 listed, Siamese type.

.3 Polished chrome plated exposed of approved two-way type with 65 mm National Standard female hose threads with plug, chain, and identifying fire department connection escutcheon plate.

.4 Thread specifications: compatible with local fire department.

.5 Install a 90-degree elbow with drain connection at the low-point near each fire department connection to allow for system drainage to prevent freezing.

2.10 Excess Pressure Pump

.1 Provide pumps on each sprinkler piping riser.

.2 Pumps:

.1 Pumps: positive displacement, gear type rated at 1 L/min, integrally mounted with motor.

.2 Double acting displacement type, open cylinder design, direct drive, ULC listed, complete with relief valve.

.3 Pump and Motor Unit:

.1 Approved for automatic wet pipe fire extinguishing sprinkler systems, complete with pilot light panel, differential motor control switch, high pressure switch, and low pressure switch.

.2 EEMAC Class B squirrel cage induction 1,725 rpm, continuous duty, drip proof, ball bearing, maximum temperature rise 50°C, 0.25 kW, 120/1/60.

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

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

.6 Provide pressure pump sensing piping in supply piping upstream of fire pump.

.7 Pump operation switch: to operate excess pressure pump with pressure differential of 103 kPa.

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

2.11 Dry Pipe Valve

.1 Cast or ductile iron, flanged or grooved end type, sized to suit water main.

.2 Components:

.1 Accelerator.

.2 Air maintenance device with low pressure alarm.

.3 Alarm pressure switch with supervisory capability.

.4 Pressure gauges.

.5 Drain valve.

.6 Test valve with associated piping.

.7 Shut off valve - OS & Y with tamper-proof device wired back to fire alarm panel.

.8 Required air pressure 90 kPa.

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

2.12 Pre-Action/Deluge Alarm Valve

.1 Cast or ductile iron, flanged or grooved end type, sized to suit water main.

.2 Components:

.1 Accelerator.

.2 Air maintenance device with low pressure alarm.

.3 Alarm pressure switch with supervisory capability.

.4 Test valve and associated piping.

.5 Drain valve.

.6 Electrical tripping device.

.7 Shut off valve - OS & Y with tamper-proof device wired back to fire alarm panel.

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

2.13 Foam Systems

.1 Foam-Concentrate Storage Tanks: Buna-N, bladder-type proportioning tank complying with UL 162 and ASME Boiler and Pressure Vessel Code: Section VIII; designed for use with foam-concentrate pumps and for specific type of foam concentrate used. Include bladder, internal piping, fill and drain, glass sight gauge, piping, and valves. Contain concentrate in the bladder.

.1 Orientation: Vertical design with skirt support.

.2 Foam-Concentrate Pumps: Listed for use in foam-water systems according to NFPA 20. Include supply side pressure relief valve and drain cock or valve.

.3 Proportioning Controllers: Venturi type complying with UL 162 and of capacity to match design at minimum and maximum flow.

.4 Concentrate Control Valves: Water-operated ball or deluge valve designed to open with flow through the proportioning controller.

.5 Concentrate Strainers: Bronze body and stainless-steel mesh strainer with minimum 3.2 mm perforations to remove solids that would block system components.

.6 Pressure Gauges: Comply with UL 393; with 90 mm minimum-diameter dial, 0 to 2070 kPa dial range, and caption "WATER" or "CONCENTRATE" on dial face.

.7 Foam Concentrate:

.1 Description: AFFF liquid concentrate, complying with NFPA 11 and UL 162, for making foam-water fire-extinguishing foam solution.

.8 Discharge Devices:

.1 In first paragraph below, retain closed, non-air-aspirating type sprinklers for wet-pipe, dry-pipe, and preaction systems; retain open, non-air-aspirating or air-aspirating type sprinklers for deluge systems.

.2 Sprinklers: Closed air-aspirating type for use with type of foam concentrate used.

.3 Spray Nozzles: For foam water; include foam generator and distributing deflector to distribute foam or water.

2.14 Compressed Air Supply

.1 Automatic Air Compressor.

.2 Capacity:

  .1 To restore normal air pressure in system within 30 minutes for low differential systems.

  .2 To provide air pressure in accordance with instruction sheet furnished with dry pipe valve.

.3 Piping: ferrous, NPS 3/4 screwed joints and fittings, to NFPA 13.

2.15 Pressure Gauges

.1 ULC listed and to Section 15022.

.2 Maximum limit of not less than twice normal working pressure at point where installed.

2.16 Escutcheon Plates

.1 Provide one piece type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.

.2 Provide polished stainless steel plates in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

2.17 Inspector's Test Connection

.1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.

.2 Provide test connection piping to location where discharge is to be readily visible and where water may be discharged without property damage.

.3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.18 Signs

.1 Attach properly lettered and approved metal signs to each valve and alarm device to NFPA 13.

.2 Permanently fix hydraulic design data nameplates to riser of each system.

2.19 Antifreeze

.1 Antifreeze loops to NFPA 13.

2.20 Spare Parts Cabinet

.1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

2.21 Pressure Maintenance Pump

.1 Type: close coupled motor and positive displacement pump unit.

.2 Performance: flow and pressure required to perform design requirements, plus 15 percent additional capacity.

.3 Motor: capable of additional 15 percent of design load, open drip proof, permanently lubricated.

.4 Accessories: flexible hose connections, inlet strainer, relief valve, steel mounting plate.

.5 Operation: automatic, with manual override.

2.22 Air compressor

.1 Sufficient size and capacity to maintain design requirements plus 30 percent, with motor, motor starter, safety valves, check valves, air maintenance device incorporating electric pressure switch and unloader valve.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Provide fire alarm annunciator panel complete with indication of various fire zones and trouble signal.

.4 Provide piping to drain points so that entire system can be drained.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of the standpipe and fire hose equipment.

1.2 Standards

.1 National Fire Protection Association (NFPA):

  .1 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

.2 Underwriters Laboratories of Canada (ULC).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 General

.1 Design system to NFPA 14 and following parameters:

  .1 Combined with sprinkler systems: hydraulic.

2.2 Pipe, Fittings and Valves

.1 Pipe:

  .1 Ferrous: to NFPA 14.

  .2 Copper tube: to NFPA 14.

.2 Fittings and joints to NFPA 14:

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

    .1 Grooved joints designed with two (2) ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.

  .2 Copper tube: screwed, soldered, brazed.

.3 Valves:

  .1 ULC listed for fire protection service.

.2 Up to 50 mm: bronze, screwed ends, grooved, OS&Y gate.

.3 65 mm and over: cast or ductile iron, flanged or roll grooved ends, indicating butterfly valve.

.4 Check valves: spring actuated swing type, composition disk or seal.

.4 Pipe Hangers:

.1 ULC listed for fire protection services.

.2 Hangers in corrosive environments are to be manufactured from stainless steel.

.5 Drain valve: 25 mm, complete with hose end, cap and chain.

.6 Inspector's test connections: 25 mm gate valve.

2.3 Cabinets

.1 To NFPA 14 and ULC listed: flush, surface or semi-recessed type to suit wall construction, constructed of 1.6 mm thick steel, 180 degrees opening door of 2.5 mm thick steel with hinge same side as water supply and latching device.

.2 Cabinets to maintain fire resistive rating of construction in which they occur.

.3 Cabinet door: with 5 mm glass viewing panel, 1/3 of door area.

.4 Large enough to accommodate angle valve, hose rack, fire hose nozzle and spanner, and 65 mm fire department valve.

.5 Cabinets in corrosive area exposure designations including Process Corrosive, Head Space, and Chemical Corrosive are to be manufactured from stainless steel.

2.4 Hose Rack

.1 ULC listed, swivel type with pins to permit hose to be hung in folds stationary-type rack with pins designed for 180 degrees movement. Locking device is to prevent flow of water into hose until last fold is removed from rack. Complete with hose, nozzle and angle valve.

2.5 Fire Hose and Nozzle

.1 Hose: ULC listed, 38 mm nominal diameter, 23 m long, synthetic jacket, synthetic rubber lined.

.2 Nozzle: ULC listed, 38 mm nominal diameter, forged brass adjustable combination fog-straight stream with shut-off.

2.6 Angle Valves

.1 ULC listed for fire service. 40 mm cast or forged brass complete with hand wheel, open or drip connections, or hydrolator valve. Where water pressure exceeds 690 kPa, provide ULC listed pressure reducing device.

2.7 Swinging Hose Reel

.1 ULC listed, designed so hose can be removed from reel when water is flowing, and with 20 mm nominal diameter hose 23 m long, and nozzle.

2.8 Fire Department Valve

.1 ULC listed, 65 mm forged or cast brass angle valve: with thread compatible with local fire department, complete with handwheel, cap and chain. Cap to be part of ULC listing for valve.

2.9 Pumper Connection

.1 To NFPA 14, ULC listed, Siamese type, Threads to be compatible with local fire department complete with threaded metal caps and chains.

.2 Polished bronze surface mounted with identifying sign cast on plate.

2.10 Pressure Gauges

.1 90 mm diameter, conform to Section 15022.

2.11 Finishes

.1 In finished areas, chrome plate valves, nozzles, fittings and hose rack and spanner.

.2 Cabinets:

  .1 Tub: prime coated.

  .2 Door and frame: No. 4 satin finish stainless steel.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install and test to acceptance in accordance with NFPA 14.

.4 Install drain pipes and valves to drain parts of systems and so arranged that any one standpipe riser can be drained without shutting down any other parts of systems.

.5 Install 90 mm diameter pressure gauge in accordance with Section 15022 at top of risers and in accordance with NFPA 14.

.6 Water Supply for Standpipe System:

.1 Class I Systems:

.1 Receive water supply sufficient to provide 1890 L/min and 950 L/min for each additional standpipe.

.2 Total supply not to exceed 9460 L/min.

.3 Supply system: capable of maintaining residual pressure of 690 kPa at each topmost outlet with 1890 L/min flowing from most remote standpipe and 950 L/min flowing from each additional standpipe up to maximum of 9460 L/min.

.2 Class II Systems:

.1 Receive water supply sufficient to provide minimum of 380 L/min.

.2 System: capable of maintaining residual pressure of 414 kPa at topmost outlet with 380 L/min flowing.

.3 Class III Systems:

.1 Receive water supply from source sufficient to provide 1892.50 L/min for single standpipe and 950 L/min for each additional standpipe.

.2 Total supply not to exceed 9460 L/min.

.3 System: capable of maintaining residual pressure of 690 kPa at each top most outlet with 1890 L/min flowing from most remote standpipe and 950 L/min flowing from each additional standpipe up to maximum of 9460 L/min flowing.

.4 Water Supply for Combined Standpipe and Sprinkler Risers:

.1 Standpipe piping may be used to supply water for automatic fire sprinkler systems.

.2 Standpipe systems: hydraulically designed.

3.2 Testing System

.1 Verify that ULC labels are visible.

.2 Fill system with water for pressure. Record water supply pressure.

.3 Pressure test piping system.

.4 Startup fire pumps and jockey pumps.

.5 Verify flow switches are operational.

.6 Verify valves in system are visible and monitored.

.7 Flushing: fill with water, let stand at operating pressure for one (1) week. Drain risers separately, then drain main.

.8 Flush buried mains and lead-in connections before making connection to indoor sprinkler system.

.9 Perform flow tests, including tests of pre-action systems.

.10 Record incoming pressure to building for ten (10) days prior to activating system.

.11 Adjust PRV on pump discharge to maximum pressure of 620 kPa at top fire hose station.

.12 Adjust PRV's at lower fire hose stations to 550 kPa maximum.

.13 Fill glycol legs, confirming proper operation of backflow preventers.

.14 Adjust pressure switches.

.15 Verify that properly sized pressure restricting disks are installed where required.

.16 Prepare schematic, mount behind glare-free glass.

.17 Prepare valve schedule, mount behind glare-free glass.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for the pre-start-up cleaning, degreasing, and chemical treatment of all systems that use glycol or water as a heat transfer medium.

.2 Provide for cleaning and disinfection of domestic hot and cold systems.

.3 Provide all temporary strainers, connections and by-pass lines as required.

.4 Provide equipment to add chemicals to the systems as specified herein.

.5 Provide equipment to operate and control the system as specified herein. Provide appropriate protection so that capped off unused piping does not corrode.

.6 Provide corrosion coupons for all closed and open loop circulation systems.

.7 Piping systems shall be chemically treated include the following systems:

- .1 Hot water and glycol heating system(s).

1.2 Standards

.1 American Water Works Association (AWWA):

- .1 AWWA C651 - Disinfecting Water Mains.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

- .1 Manufacturer's descriptive literature for materials.
- .2 Proposed chemicals, quantities, calculations, procedures and equipment to be used. Provide written operating instructions and system schematics complete with all chemical treatment components.
- .3 Provide written report containing log and procedure of system cleaning, giving times, dates, problems encountered and condition of water.

1.4 Quality Assurance

.1 This work is to be supervised by a qualified professional who, upon completion shall certify that the process is satisfactory and submit a report outlining the cleaning operation and the water treatment process.

1.5 Water Treatment Service

.1 The qualified professional shall provide supervision of installations, set-up and adjustments and submit a written report on system operations.

.2 All chemicals, feed systems and test equipment shall be provided by the qualified professional.

.3 Treatment chemicals shall not contain hydrazene.

.4 Treatment chemicals shall be non-foaming.

.5 The qualified professional shall instruct the maintenance personnel before Substantial Completion. Written instructions of the treatment, dosages control charts and test procedures shall be included in the maintenance manuals.

.6 The qualified professional shall provide monthly visits to check chemical treatment, take water samples and recommend any necessary changes to treatment, and provide a written report during the Operations Advisory Period.

.7 At Substantial Completion, provide a stock of chemicals, filters and corrosion coupons suitable for twelve (12) months normal operation.

.8 Provide one (1) mild steel and one copper corrosion coupon package to monitor corrosion rate for each open and closed systems.

2. PRODUCTS

2.1 Materials

.1 System Cleaner: Use a sodium metasilicate, sodium nitrite and a wetting agent compound which in solution removes grease and petroleum products. Concentration level shall be determined by the qualified professional.

  .1 Acceptable Products:

    .1 PACE Chemicals Ltd.

    .2 PURGEX L-24.

    .3 Or approved equivalent.

.2 Closed System Treatment (Hot Water, Glycol System): Use an all-organic based corrosion inhibitor. Maintain levels at 60 to 100 ppm. The use of nitrite only, molybdate only or sulphite only is not permitted.

  .1 Acceptable Products:

    .1 PACE Chemicals Ltd.

    .2 BAR COR CWS-105.

    .3 Or approved equivalent.

.3 Glycol System: Charge hot water and/or heat recovery system(s) and chilled water system(s) with a 50 percent solution of inhibited propylene glycol for freeze protection to 12°C.

.1 Acceptable Product:

.1 DOWFROST.

.2 Or approved equivalent.

.4 Allow for the provision of sufficient chemicals to treat the system once prior to Commissioning. Allow for testing water/glycol quality prior to Substantial Completion. In addition, provide a stock of chemicals, filters and corrosion coupons suitable for twelve (12) months of normal operation.

.5 Materials which may contact finished areas shall be colourless.

2.2 Equipment

.1 Closed System (Heating Systems):

.1 Bypass Pot Feeder: All closed hot water and chilled water systems shall have a by-pass chemical pot feeder with a 7.6 L capacity. Shall be constructed of heavy duty cast iron or welded steel (suitable for 1380 kPa working pressure), with quick opening cap and complete with 20 mm NPT connections. Isolating valves shall be installed on the inlet, outlet and drain.

.2 Sidestream Filter: All closed hot water and chilled water systems shall have a sidestream filter housing of steel construction using a 250 mm x 30 micron filter cartridge, with a minimum flow rate of 35 L/m. A flow indicator shall be installed in conjunction with the sidestream filter. Connections shall be 20 mm MxFNPT and all isolating valves shall be installed as per Manufacturer's instructions. Provide six (6) filter cartridges.

.3 Totalizing Make-up Water Meter: Cast Bronze body, 20 mm NPT connections, thermoplastic rotor and gear train, rated at 1,034 kPa maximum operating pressure. Pulse transmitter to building controls.

.4 Chemical Feed Piping:

.1 Schedule 40 black steel.

.5 Corrosion Coupon and Holder Assembly:

.1 Mild steel corrosion coupon.

.2 Holder, 20 mm or 25 mm NPT male connection.

.3 Provide malleable or cast iron cross, 20 mm or 25 mm NPT female connection.

.2 Test Kits:

.1 Provide test kits to determine proper systems treatment, including but not limited to the following:

.1 Closed System Test Kit: To determine proper level of inhibitor in closed system treatment.

.1 Acceptable Product:

.1 PACE Chemicals Test Kit #105.

.2 Or approved equivalent.

.2 Glycol System Specific Gravity Test Kit: To determine freezing point of glycol systems. To contain a suitable hydrometer cylinder, a 300 mm specific gravity hydrometer equivalent to Kessler Model 8350 with scale range of 1.000 -1.110 at .001 specific gravity increments and a 305 mm brass armoured, mercury-filled thermometer with scale range of minus 35°C to plus 50°C.

.1 Acceptable Product:

.1 Kessler Model 2048/3252

.2 Or approved equivalent.

.3 Provide a chart showing the specific gravity of the specified solution by volume, at a specified temperature.

.1 Acceptable Product:

.1 PACE Chemicals Test Kit #127

.2 Or approved equivalent.

.4 Provide a test kit suitable for all chemical treatments used. The test kit shall be made available for on-site tests to check conductivity. Hand over the kit to the City at the end of the Operations Advisory Period.

.1 Acceptable Product:

.1 Myron L Three Range TDS meter.

.2 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Heating System Equipment:

.1 All systems shall be leak tested per Section 15050 and 15055 prior to chemical cleaning.

.2 All systems shall be chemically cleaned and flushed before water treatment is added. This includes partial or complete filling for pressure testing.

.3 Provide drain connections to drain system in one (1) hour.

.4 All drains for chemical treatment are to be piped to the sanitary sewer.

.5 Install totalizing water meter(s) and record capacity in each system.

.6 After all components of the piping system have been pressure tested and proven to be in full operational condition and leak free, flush entire system with fresh, clean make-up water to remove loose mill scale, sediment and construction debris.

.7 After initial flushing has been completed, clean all strainer screens.

.8 System pumps may be used for cleaning, provided that pumps are dismantled and inspected, worn parts repaired with new gaskets and seals installed. Submit used seals.

.9 Add cleaner to closed systems at concentration levels recommended by the qualified professional.

.10 For hot water heating and glycol systems, apply heat while circulating, raise temperature slowly to 70°C and maintain at 70°C for a minimum of twelve (12) hours. Remove heat and circulate at 40°C or less. After cleaning, drain system as rapidly as possible. Flush system by opening drain valves and opening bypass valve on water make-up to system. Continue flushing until tests show pH, iron, TDS and chloride levels of water leaving system are the same as entering system. Install corrosion coupons, refill system and immediately add water treatment to proper level.

.11 Use neutralizing agents upon recommendation of the qualified professional and as approved by the Professional of Record.

.12 Inspect, remove sludge and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

.13 Glycol System Equipment:

.1 Pre-mix solution in mixing tank, demonstrate specific gravity of solution to the Professional of Record at sample points and charge system(s) using feed pump. After system has been filled, check specific gravity of solution in each system. Leave mixing tank filled with specified glycol solution.

.14 Potable Water Equipment:

.1 All domestic water piping shall be thoroughly flushed so that it is free from scale, sediment and construction debris.

.2 On completion of installation and testing of the potable water systems, pre-flush, chlorinate with sodium hypochlorite to AWWA C651 specifications and let stand for twenty-four (24) hours. Thoroughly flush again until flush water meets AWWA standards.

.3 Retain an independent inspection firm to supervise and inspect the chlorination and flushing procedures and perform coliform and chemical tests as required.

.1 Submit certificate from the testing firm, stating that the chlorination and flushing have been successfully completed.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of fire extinguishers.

1.2 Standards

.1 National Fire Protection Association (NFPA):

  .1 NFPA 10 - Standard for Portable Fire Extinguishers.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Recessed Cabinet with Extinguisher (Finished Areas)

.1 229 mm wide x 610 mm high x 152 mm deep cabinet.

.2 Semi-recessed steel cabinet with turnback frame for 100 mm wall thickness.

.3 Full length semi-concealed piano hinges for 180-degree swing.

.4 Flush stainless steel door latch with no exposed fasteners.

.5 22 gauge steel tub.

.6 16 gauge steel door and trim with optional 5 mm clear tempered glass (-G-T).

.7 Grey prime coated finish ready for field painting.

2.2 Surface Mounted Cabinet with Extinguisher (Corrosive Environments)

.1 292 mm wide x 660 mm high x 203 mm deep cabinet.

.2 Surface mount cabinet, injection molded body and frame, red virgin high-impact crystal polystyrene of 2.8 mm wall thickness with ultra-violet inhibitors, virgin acrylic Plaskolite® (or approved equivalent) panel of 2.03 mm thickness.

.3 Coordinate make and model of cylinder lock with key with the City.

.4 Provide same keying throughout the Facility and re-key and turn keys over to the City at Substantial Completion.

.5 Provide break glass hammer and instruction decal.

2.3 Portable Hand Fire Extinguishers

.1 Multi-Purpose Dry Chemical: Pressurized with hose and shut-off nozzle or integral shut-off nozzle and mounting brackets 4.5 kg capacity rating 4A:60BC; 9.0 kg capacity rating 10A:80BC.

.2 Carbon Dioxide: Hose and horn discharge, self-closing lever or squeeze grip operated, insulated handle fully charge, 2.25 kg capacity. Rating 5BC.

3. EXECUTION

3.1 General

.1 Include the location of fire extinguishers and types in the NEWPCC Fire Safety Plan.

.2 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.3 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.4 Install fire extinguishers in cabinets in accordance with the requirements of NFPA 10.

.5 Mount fire extinguishers and cabinets such that the top of the extinguisher is at 1,220 mm above the floor.

.6 Install fire extinguisher cabinet doors, glazing panels and fire extinguishers in the cabinets prior to Substantial completion or sooner if required by authority having jurisdiction.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for the design, supply, installation, testing and commissioning of fire tube boilers.

1.2 Standards

.1 American National Standards Institute (ANSI):

  .1 ANSI Z21.13 - Gas-Fired Low Pressure Steam and Hot Water Boilers.

.2 American Society of Mechanical Engineers (ASME):

  .1 Code Section IV.

  .2 CSD-1: Controls and Safety Devices for Automatically Fired Boilers.

.3 Canadian Gas Association (CGA).

.4 Canadian Standards Association (CSA):

  .1 CSA B149.1: Natural gas and propane installation code.

  .2 CSA B149.6: Code for digester gas, landfill gas, and biogas generation and utilization.

.5 International Organization for Standardization (ISO):

  .1 Manufacturer is to be ISO 9001:2000 Quality Management Systems Certified.

.6 National Electrical Manufacturer Association (NEMA):

  .1 Enclosure to follow standard NEMA Standard 250. (NEMA-1).

.7 Underwriters Laboratories of Canada (ULC):

  .1 UL standard 916: Energy Management Equipment.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

  .2 Factory Acceptance Test: Submit boiler factory inspection and test reports.

  .3 Complete an authorized boiler inspection prior to shipment and submit a copy of inspection report.

.4 Operating and maintenance documentation to include any special cleaning requirements and service intervals associated with the use of digester gas.

1.4 Quality Assurance

.1 Manufacturer's Quality System:

.1 Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.

.2 The control to be UL tested and certified per standard 916.

.2 Construct to applicable Section of ASME section IV Heating Boiler Code and complete authorized boiler inspection prior to shipment.

.3 Each Packaged boiler shall meet the local codes and ordinances, including the Canadian Registration Number (CRN) for Manitoba.

2. PRODUCTS

2.1 Manufactures and Products

.1 Acceptable Manufacturers:

.1 Cleaver Brooks.

.2 Unilux.

.3 Indek (Volcano).

.4 Simoneau

.5 Boilersmith

.6 Or approved equivalent.

2.2 Design Criteria

.1 Each unit shall be furnished as a packaged steam boiler, consisting of boiler, burner, forced draft fan, controls, and accessories.

.2 Each unit shall be furnished with required wiring and piping, and factory-assembled on a structural steel base as a self-contained unit.

.3 The burner and boiler package must meet CSA requirements for field approval.

.4 Provide factory assembled, factory fire-tested, self-contained, readily transported unit, ready for automatic operation except for connection of water, fuel, electrical, drain and vent Services.

.5 The boiler shall be designed to burn either digester gas or natural gas.

.6 Boiler to be constructed for digester gas with the water, H_2S and siloxane concentrations determined for the Final Design.

.7 Provide fuel connections for both digester gas and natural gas.

.8 Provide flanged chimney connection.

.9 Provide drain connections.

.10 Provide boiler complete with control panels and all required instrumentation for a complete system.

.11 Boiler is to operate using digester gas if there is sufficient biogas pressure available. If there is not sufficient biogas pressure available, the boiler is to automatically shut down and switch to natural gas.

2.3 General Design and Construction

.1 Unit is to be a steel, fire tube style boiler on integral structural steel frame base with integral forced draft burner, burner controls, boiler trim, refractory, insulation, jacket and control panel.

.2 Construct to ASME Boiler Code for allowable working pressure of 1100 kPa (160 psig) steam and a design maximum pressure of 1400 kPa (200 psig).

.3 Each Packaged boiler shall meet the local codes and ordinances, including the Canadian Registration Number (CRN) for Manitoba.

.4 The boiler is to be a minimum three-pass, dry-back fire tube design.

.5 The boiler shall be equipped with an integral, factory installed steam separation system. The boiler shall produce a steam quality of 99,5%.

.6 Tubes must be free of any baffles or restrictions.

.7 Provide adequate tappings, observation ports, removable panels and access doors for entry, cleaning and inspection. Front and rear access doors are to be hinged. Doors are to be sealed with fibreglass gaskets. Front and rear tube sheets and all flues to be fully accessible for inspection and cleaning when the doors are swung open. Observation ports for the inspection of the flame conditions are to be provided at both ends of the boiler.

.8 Provide an appropriate number and location of lifting eyes (not less than two) on top of the boiler to allow safe and balanced lifting of the boiler assembly.

.9 Unit shall be provided with minimum 50 mm thick mineral wool insulation. The boiler shall be lagged with a minimum 0.76 mm (22 gauge) thick steel jacket coated with enamel based paint.

.10 Factory paint boiler, base and other components with hard finish silicone enamel.

2.4 Components, Configuration and Features

.1 Steam Boiler Trim:

.1 Provide pressure gauge and ASME rated pressure relief valve.

.2 Provide water column with cocks, gauge glass set, blowdown valves for gauge glass and column.

.3 Provide float type low water cut-off with manual reset integral with water column to automatically prevent burner operation whenever boiler water falls below safe level. Provide electronic auxiliary low water cut-off as backup.

.4 Boiler condensate return pump control, integral with water column shall automatically maintain water level by controlling pump operation.

.5 Operating pressure controller shall control burner to maintain steam pressure setting.

.6 Limit pressure controller shall control burner to prevent steam pressure from exceeding safe system pressure.

.7 Feed water pump control shall be piped and wired on boiler at the factory to automatically activate feed water pump for makeup water. For model under 200 HP, pump control shall be of ON/Off type. Higher capacity, pump control shall be of modulating type with a pneumatic feed water assembly piped on boiler at factory complete with flow control valve, with bypass and isolating valves. A feed water stop valve, a check valve and a strainer will complete the assembly.

.8 Primary low water cut off shall be piped and wired on boiler at the factory to stop burner operation when water falls below its set level.

.9 Auxiliary low water cut off of the probe type shall be mounted and wired on the boiler at the factory.

.10 Operating steam pressure limit control with auto reset and excess steam pressure limit control with manual reset shall be piped and wired on boiler at the factory.

.2 Fuel Burning System:

.1 The burner is to be approved for operation on both digester gas and natural gas. The boiler is to include all controls necessary for the safe monitoring, switching and sequencing of the boiler between burning digester or natural gas.

.2 All burners to bear either CSA, CGA or ULC label.

.3 Forced draft high radiant multi-port power burner integral with front head of boiler designed to burn natural gas and digester gas.

.4 The turndown ratio shall be a minimum of 7:1 for gas firing. The O2 level shall be a maximum of 3% at high fire and 4.5% at low fire. CO shall not exceed 20 ppm for gas firing at all rates.

.5 Burner operation is to have fully modulating fuel input with low fire ignition.

.6 Combination natural gas/digester gas burner is to be built as a single unit without need for interchanging natural gas burner and digester gas burner. Fuel changeover from Digester gas to Natural gas shall be by automatic switching with no requirement for re-adjustment of any kind and controlled by a gas low pressure switch.

.7 Burners are to have valves for precise setting of fuel/air input at all load settings. Natural gas and digester gas to be capable of being controlled, totally independent of each other, including input.

.8 Individual servo-drives for air, natural gas, digester gas.

.9 The maximum sound level of the boiler/burner package is not to exceed 80 dBA.

.10 Burner housing:

  .1 Cast aluminum.

  .2 Capable of hinging open. Flange safety interlock switch to prevent burner from starting when in the open position.

  .3 Self-checking differential air pressure switch.

  .4 Sight glass for viewing the flame and a removable cover to allow free access to serviceable components.

.11 Blower:

  .1 Blower is to be statically and dynamically balanced and operate without undue noise, vibration or pulsation.

  .2 Blower motor is to be totally enclosed fan cooled type, inverter rated.

.12 Air intake:

  .1 Aluminum air intake vanes on the suction side for combustion air regulation.

  .2 Motorized air louvers adjustable from 0 to 90 angular degrees.

  .3 Air intake shall include sound attenuating material and a screen to reduce the likelihood of foreign material entering the blower.

.13 Combustion Head:

  .1 Stainless steel alloy flame tube and diffuser assembly.

  .2 All serviceable components shall be accessible without need for burner removal.

  .3 Combustion head shall be adjustable such that the pressure drop across the diffuser can be optimized to match the maximum firing rate of the burner.

.3 Gas Valve Trains:

.1 Include two (2) complete gas valve trains for the two fuel types: Natural gas and digester gas.

.2 Gas trains are to include the following: gas pressure regulators, test valves, primary gas shutoff valve, manual shutoff valve, high/low pressure gas switches. All gas valves and switches are to comply to CSA B149.1 and CSA B149.6 as applicable.

.3 The LSG valve train is to be designed in accordance with CSA B149.6 and the valves used are to be appropriate for digester gas, as defined by the Canadian Gas Association.

.1 Acceptable Manufacturers:

.1 Motorized main gas valves for LSG:

.1 Maxon.

.2 Or approved equivalent.

.2 Flame arrestors for each fuel:

.1 Varec.

.2 Or approved equivalent.

.4 The primary gas shutoff valve is to be motor operated with spring return to start or stop the gas burner and to close automatically in the event of power failure, flame failure, or a low water condition. A manual, lubricated plug cock shutoff valve is to be located ahead of the motorized valve for manual shutoff. A proof of closure switch on the primary shutoff valve plus high and low gas pressure switches is to be provided. digester gas train piping is to be of Type 316L stainless steel construction.

.5 Pressure regulators are to be CSA approved. Pressure switches with a Type 316 stainless steel sensing element, Buna-N actuator seal, snap action, narrow dead band type.

.6 All gas train components are to conform to CSA B149.1 and CSA B149.6.

.4 Flame Arrester and Check Valve:

.1 Provide cast aluminum flame arrestors flanged, ANSI Class 125 and digester gas check valve.

.5 Boiler Emergency Shut-Off:

.1 Provide an emergency shutdown switch outside boiler room door that meets the requirements of ASME CSD-1.

2.5 Control Panels

.1 The following clauses form the basis of design for the boiler controls. All control power, IO, communications protocol, panel construction, and components are to be coordinated with Division 16.

.2 The boiler controls are to communicate with the PCS and be capable of communicating boiler status and alarms.

.3 Provide a control panel to include but not be limited to the 600/120VAC transformer, relays, motor starter for the blower. It is to contain flame safeguard controls, main disconnect, switches, indicating lights.

.4 Provide a control panel to include but not be limited: local controller, HMI, ethernet switch, indicating lights and UPS. The UPS is to be used to provide backup power for the local controller, HMI, and ethernet switch. The panel is to house a dedicated 120VAC circuit for the three-way valve power supply.

.5 The local controller is to control stand-by, pre and post combustion purge, pilot, main fuel ignition starting, run and stop. Burner is to shut down in the event of ignition pilot or main flame failure or if combustion air pressure in the fan chamber falls below present level, high or low pressure in gas train, high limit or low water condition in boiler.

.6 Burner controller is to have PID logic control and be fully adjustable and to operate in response to a temperature sensor mounted in the hot water outlet.

.7 The boiler control panel is to contain manually adjustable lead/lag operation. Lead boiler is to start on a "call for heat" and be ramped to full fire before second boiler and subsequent boilers are to start. Adjustable time delay between starting of each boiler is to be provided. The boilers are to shut down in reverse order of firing.

.8 The control panel is to contain manual-automatic selector switch. In manual mode firing is to be controlled by a potentiometer set at the desired point between high and low fire. In the auto mode the firing rate is to control in response to the load demand.

.9 The control panels are to be mounted to the front door of the boiler in a location convenient to the operator. The hinged metal cabinet is to include a dust seal and cabinet lock.

.10 Control panel is to annunciate the following alarm points to the HMI screen:

  .1 No Start.

  .2 No call for heat or safety circuit open.

  .3 Controlled shut down.

  .4 Lockout due to air pressure drop.

  .5 Lockout due to flame fault.

  .6 Lockout flame failure after first safety check.

.7 Lockout due to main flame failure.

.8 Lockout due to pilot failure.

.9 Lockout after incompletion of program, (i.e. extraneous light due to flame not extinguished, UV tube fault or fault in supervision circuit).

.10 An alarm horn is to activate when an abnormal condition exists.

.11 Provide an hour counter for each burner.

.12 Provide volt free contacts for burner fault, burner on-off status for connection to the PCS.

.13 The boiler local controller is to have the following IOs available:

.1 Digital Inputs:

.1 Natural Gas Pressure (Low).

.2 Boiler Hot Water Flow Switch.

.3 Circulation Pump Running from the PCS.

.4 Boiler enable signal from the PCS.

.2 Digital Outputs:

.1 Circulation pump Start/Stop command.

.3 Analog Inputs:

.1 Boiler inlet digester gas and natural gas pressure.

.2 Boiler gas suction pressure.

.3 Boiler return water temperature transmitter.

.4 Analog Outputs:

.1 Three way valve command – 4 to 20 mA output.

.14 Provide a natural gas-digester gas selector switch.

2.6 Integrated Boiler Control System

.1 The boiler is to incorporate an Integrated Control System. This is to be a local controller based control system and is to incorporate programming to control boiler lead/lag sequencing, linkage-less firing rate controls, digester/natural gas Auto-Changeover and communications.

.2 The system integrates a local controller, touch screen graphical HMI, and burner management control with the features of parallel positioning fuel-air-ratio control (FARC) and Ethernet master controller communications.

.3 The system is to provide automatic burner sequencing, firing rate control, system fault indication, self-checking diagnostics, fault messaging in a plain text type format. Control settings, firing rate, sequencing and other control parameters to be provided to the PCS.

.4 The integrated control system for the boiler is to include: Local Controller, HMI interface, firing rate control, thermal shock protection, dual set points (local or remote selectable), assured low fire cut-off, remote lead-lag capability, high stack temperature alarm and shutdown, system process monitoring and alarm points, alarm and diagnostics screens in plain text, remote set point, parallel positioning control.

2.7 Integrated Boiler Controls

.1 Integrated control system to include:

.1 Local controller.

.2 Touch screen HMI – 250 mm minimum.

.3 Various controller IO (analog and digital) modules.

.4 One (1) burner management controller and wiring sub-base.

.5 One (1) flame scanner: infrared, ultra-violet, or UV self-checking scanner.

.6 One (1) flame amplifier to correspond with the selected flame scanner.

.7 Various temperature and pressure sensors.

.2 Major functions that the boiler control system is to provide:

.1 Automatic sequencing of the boiler through standby, pre-purge, pilot flame establishing period, main flame establishing period, run and post purge.

.2 Flame proving and lockout on flame failure during pilot flame proving, main flame proving, or run.

.3 Low fire damper/valve position for flame ignition trials.

.4 Full modulating control of fuel and combustion air.

.5 Utilize solid state controls and sensors to provide various control functions, such as:

.1 On/Off, and modulating control.

.2 Modulating control algorithm is to be proportional-integral-derivative (PID) type.

.3 Thermal shock protection based on water temperature and setpoint.

.4 Various high and low limit alarms and shutdowns.

.6 HMI operator interface and monitoring:

.1 Manual control of the boiler-firing rate utilizing control screens on the HMI to increment and decrement the firing rate.

.2 On screen indication of burner management controller status and diagnostics.

.3 On screen real-time display of all connected process parameters.

.4 On screen display of system alarms and faults.

.5 On screen history of alarms and faults.

.6 On screen recommendation for troubleshooting fault conditions.

.7 On screen water level indication and alarm(s).

.7 Communications.

.8 Tamper resistant control logic and password protection.

.9 Night/day setback control.

.10 Stack flue gas, combustion air, and shell (water) temperatures.

.11 Boiler efficiency calculation.

.12 Outdoor reset for hot water boilers.

.13 Remote modulation or firing rate setpoint control.

.14 Assured low fire cut-off.

.15 Assured start permissive safety interlocking.

.3 The boiler control system is to provide the following safety provisions for:

.1 Integrated Burner Management:

.1 Examine all load terminals to assure it is capable of recognizing the true status of the external controls, limits and interlocks. If any input fails this test, the burner management system should lockout on safety shutdown.

.2 Closed-loop logic test verifies integrity of safety critical loads (ignition, pilot, and main fuel valves) and to be able to lockout on safety.

.3 Pre-ignition interlocks and flame signal checked during standby and pre-purge.

.4 Dynamic checking of the flame signal amplifier. The control flame signal amplifier to be able to recognize a no flame signal during this dynamic amplifier check.

.5 Safe start check and expand check to include monitoring flame signal during standby.

.6 High and low fire switches checked for proper sequencing.

.7 Tamper-proof purge timing and safety logic.

.2 Integrated Boiler Controls:

.1 Operating and modulating control.

.2 Primary low water cut-off.

.3 Password protection of programmable controller logic.

.4 Password protection of parallel positioning control.

.4 The control system is to provide annunciation and diagnostics:

.1 Active alarm annunciation.

.2 Provide historical alarm information for on screen display.

.3 Detects and isolates an alarm and reports internal circuit faults.

.4 Printer output capable for logging alarms.

.5 Capability of printing alarm history of date, time, cycle of occurrence and date and time of acknowledgement up to the most recent 100 faults.

.6 English text description of the system fault and troubleshooting procedures.

.7 Water level indication and low water shutdown alarm.

.8 Dynamic Self-Checking.

.5 The Boiler Control System is to be able to operate in these environmental conditions:

.1 Supply Voltage: 600 VAC (plus 10 percent/minus 15 percent) 60 Hz.

.2 Maximum total connected load: 4,000 VA.

.3 Operating temperature limits: 0 to 55°C.

.4 85 percent RH continuous, non-condensing, humidity.

.5 0.5G continuous vibration.

.6 Boiler Control System component functions are to be as follows:

.1 Burner Management Controller: Provides boiler sequencing logic to meet FM/UL/cUL approval body requirements.

.2 HMI: Provides user interface to the control system, boiler overview screen with connected boiler parameter readouts, Burner Management Control status screen, alarm banners, diagnostic screens for fault troubleshooting, alarm history screen, system firing rate screen and system configuration screens.

.3 Local Controller Input/Output modules: Provides interface for discrete powered and/or isolated relay signals, as well as for analog signals, from and/or to other input/output devices.

.4 Stack Temperature Sensor: Measures and transmits a signal to the Programmable Controller in relation to boiler exit flue gas temperature. It is used for indication and in the calculation of boiler efficiency; it can also be used for high stack temperature alarm and shutdown. Boiler efficiency calculation shall be in accordance with ASME – PTC-4.1.

.5 Water Temperature Transmitter: Provides an analog signal to the Programmable Controller for indication of boiler water temperature; utilized for on/off and modulating control of the burner.

.6 Water (shell) Temperature Sensor: Measures and transmits a signal to the Programmable Controller in relation to boiler water temperature; used for indication and thermal shock protection.

2.8 Parallel Positioning System

.1 The purpose of the parallel positioning system is to control fuel, combustion air and flue gas recirculation if applicable. Use individual actuators to control each of above functions. The logic is to be integrated into the control system.

.2 Actuator Requirements

.1 General: Reversing Motor with Position Feedback.

.2 Application: Control of dampers and fuel valves. Position to be controlled by a PLC; no servo-positioning module is required.

.3 Rotary: 90 degree rotation. 10-15 second timing (for 90 Degrees), 11 Nm torque, 0.1 percent Resolution (over 90 Degrees).

.4 Linear: 25 mm linear travel, 10-15 second timing (for 25 mm travel), 30 kg thrust, 0.1 percent Resolution (over 25 mm travel).

.5 Electrical: 120 or 24 VAC preferred (24 VDC acceptable), control signal: 4-20 mA.

.6 Duty: Continuous, position feedback.

.7 Signal: 4-20 MA, position feedback Resolution: 0.1 percent (over specified travel).

.8 Control Description: Control is to be parallel positioning with cross limiting. System is to be capable to accommodate dual fuel. System is not to be capable for simultaneous fuel firing. System is to be capable to accommodate dual gas flow control valves.

2.9 Controller Communication

.1 The communication protocol to be used for communication with the PCS is Ethernet IP.

.2 PCS interface to provide monitoring of all key operational functions and statuses as well as alarms, faults and historical data including but not limited to:

.1 Status.

.2 Boiler temperatures.

.3 Boiler pressures.

.4 Water levels.

.5 Burner management:

.1 Firing rate.

.2 On / off points.

.6 Data as required by the PCS to generate hourly, daily, monthly and annual reports on:

.1 Fuel consumption.

.2 Runtime per fuel per boiler.

.3 Alarm and fault history.

2.10 Three Way Valve

.1 Provide three-way valve complete with electric actuator.

.2 The electric actuator is to have output for position indication. The actuator is to be mated with the valve for operation.

.3 Temperature transmitters are to modulate three-way valves associated with the boiler to maintain minimum return hot water temperature.

2.11 Temperature Transmitters for Three Way Valves Control

.1 Provide temperature sensors/transmitters with analog output and wired to the associated boiler local controller. The measuring range as per boiler Manufacturer.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Start-up Service:

  .1 A factory approved and authorized start-up report is to be submitted at the time of start-up and is to include the following tests:

    .1 Demonstrate that the boiler, burner, controls, and accessories comply with the requirements in this Section. Pre-test all items prior to scheduling the final testing and witness testing.

    .2 Take readings at different firing rates (20, 50, 75 and 100 percent) of load for the modulating burner and provide a written report of the tests submitted. The reports are to include readings for each firing rate tested and include stack temperatures, O_2, CO, NO_x, and overall boiler efficiency. Adjust the boiler as required to meet the published efficiency data for the boiler.

    .3 Auxiliary Equipment and Accessories: Observe and check all valves, draft fans, electric motors and other accessories and appurtenant equipment during the operational and capacity test for leakage, malfunctioning, defects and non-compliance with referenced standards or overloading as applicable.

    .4 The Manufacturer's Representative is to perform the following:

      .1 Fireside inspection.

      .2 Set up fuel train and combustion air system.

      .3 Set up operating set points.

      .4 Check all safeties, including flame safeguard, LWCO, airflow, fuel pressure, high limits.

      .5 Set up and verify efficiencies at 20, 50, 75 and 100 percent.

      .6 Set up and verify burner turndown.

      .7 Set up and verify digester gas – natural gas automatic switch over in both directions.

END OF SECTION

WATER TUBE GAS FIRED BOILERS

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for the design, supply, installation, testing and commissioning of water tube boilers.

1.2 Standards

.1 American National Standards Institute (ANSI):

.1 Z21.13: Gas-Fired Low Pressure Steam and Hot Water Boilers.

.1 American Society of Mechanical Engineers (ASME):

.1 Code Section IV.

.2 CSD-1: Controls and Safety Devices for Automatically Fired Boilers.

.2 International Organization for Standardization (ISO):

.1 Manufacturer to be ISO 9001:2000 Quality Management Systems Certified.

.3 National Electrical Manufacturer Association (NEMA):

.1 Enclosure follows standard NEMA Standard 250. (NEMA-1).

.4 Underwriters Laboratories, Inc. (UL):

.1 Tested per standard 916, Temperature Indicating and Regulating Equipment.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Test Data: Submit boiler pre-shipment inspection and test reports.

.3 Operating and maintenance documentation to include any special cleaning requirements and service intervals associated with the use of digester gas.

1.4 Quality Assurance

.1 Manufacturer’s Quality System:

.1 Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.

.2 The control to be UL tested and certified per standard 916, Temperature Indicating and regulating Equipment.

.2 Boiler to be constructed for digester gas with the H_2S and siloxane concentrations determined during the Final Design.

.3 Provide factory tests to check construction, controls and operation of unit.

.4 Each Packaged boiler shall meet the local codes and ordinances, including the Canadian Registration Number (CRN) for Manitoba.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers (Boilers):

.1 Cleaver Brooks.

.2 Indek (Volcano).

.3 Unilux.

.4 Or approved equivalent.

2.2 Design Criteria

.1 Each unit shall be furnished as a packaged steam boiler, consisting of boiler, burner, forced draft fan, controls, and accessories.

.2 Each unit shall be furnished with the required wiring and piping, and factory-assembled on a structural steel base as a self-contained unit.

.3 The burner and boiler package must meet CSA requirements for field approval.

.4 Provide factory assembled, factory fire-tested, self-contained, readily transported unit, ready for automatic operation except for connection of water, fuel, electrical, drain and vent Services.

.5 The boiler will be designed to burn either digester gas or natural gas.

.6 Boiler to be constructed for digester gas with the water, H_2S and siloxane concentrations determined for the Final Design.

.7 Boiler is to operate using digester gas as long as there is sufficient biogas pressure available. If there is not sufficient biogas pressure available, the boiler is to automatically shut down and switch to natural gas.

.8 Boiler supplier to coordinate digester gas booster selection with the digester gas booster supplier. Digester gas booster to satisfy boiler supplier’s requirements for digester gas flow, pressure and temperature off the gas booster.

.9 The boiler to be a two-drum, flexible watertube design with a tangent-tube waterwall furnace mounted on a heavy steel frame. Top, bottom and sides of the furnace to be water cooled. Unit to be complete with a control panel.

.10 Construct to ASME Boiler Code for allowable working pressure of 1100 kPa (160 psig) steam and a design maximum pressure of 1400 kPa (200 psig).

.11 Each Packaged boiler shall meet the local codes and ordinances, including the Canadian Registration Number (CRN) for Manitoba.

.12 The heat release of the boiler is to not exceed 2,235 MJ per m^3 of furnace volume. Operating radiation losses are to be less than 1/4 of 1 percent input.

.13 The tangent wall tubes to be covered with 40 mm (1-1/2 inch) of insulation under a gas-tight, 16-gauge inner casing. Provide 50 mm (2 inch) of insulation between the inner and outer casing. The outer casing to be 20 gauge. The boiler base frame and other components to be factory-painted before shipment, using a hard enamel finish.

.14 Boiler tubes to be 40 mm diameter, with 2.4 mm (0.095 inch) wall thickness and to be easily removed and replaced without requiring expanding or welding at the attachments to the drum.

.15 Provide adequate tappings, observation ports, removable panels and access doors for entry, cleaning and inspection.

.16 Provide an appropriate number and location of lifting eyes (not less than two) on top of the boiler to allow safe and balanced lifting of the boiler assembly.

.17 Boiler Manufacturers to meet the specifications listed herein. Any deviations/variations from the specification to be submitted to the Professional of Record for approval.

2.3 Components, Configuration and Features

.1 Steam Boiler Trim:

- .1 Provide pressure gauge and ASME rated pressure relief valve.
- .2 Provide water column with cocks, gauge glass set, blowdown valves for gauge glass and column.
- .3 Provide float type low water cut-off with manual reset integral with water column to automatically prevent burner operation whenever boiler water falls below safe level. Provide electronic auxiliary low water cut-off as backup.
- .4 Boiler condensate return pump control, integral with water column shall automatically maintain water level by controlling pump operation.
- .5 Operating pressure controller shall control burner to maintain steam pressure setting.
- .6 Limit pressure controller shall control burner to prevent steam pressure from exceeding safe system pressure.

.2 Fuel Burning System:

.1 Provide a stainless steel digester gas train for the gas valving, regulator and hydromotor valve as per CSA B149.6.

.2 The burner to be approved for operation on both digester and natural gas. The boiler to include all controls necessary for the safe monitoring, switching and sequencing of the boiler between burning digester gas and natural gas.

.1 Burner operation is to allow a minimum 4-1 turndown and be able to fire on a full modulation principle. Burner is to have low fire ignition. Maintain air/fuel ratio with flue gas temperature a minimum of 37.8°C above dew point. Provide flue gas thermometer.

.3 Burner operation is to have fully modulating fuel input with low fire ignition.

.4 Combination natural gas/digester gas burner is to be built as a single unit without need for interchanging natural gas burner and digester gas burner.

.5 Blower is to be statically and dynamically balanced and operate without undue noise, vibration or pulsation.

.6 The burner to be forced draft type with full firing rate modulation. All combustion air to be furnished by the burner fan and an integral part of the burner.

.7 All burners to bear either CSA, CGA or ULC label.

.8 Gas trains to include gas pressure regulators, test valves, shut off valves and other appurtenances.

.9 Burners to incorporate stainless steel flame retention type combustion heads.

.10 A permanent observation port to be provided in the burner to allow observation of both the pilot and main flame. Both the pilot and the flame scanner to be easily accessible without opening or disassembling the burner.

.11 The burner to be equipped with an aluminium reverse curve fan for lower fan motor HP requirements and self-cleaning characteristics.

.12 Primary-secondary air control to be a design function of the combustion head. Combustion heads requiring an internal adjustment are not permitted.

.13 The burner is to operate with no more than 15 percent excess air and less than 50 ppm (3 percent O_2) CO in the products of combustion.

.14 The maximum sound level of the boiler/burner package is not to exceed 80 dBA.

.15 Burner to be manufactured by the boiler Manufacturer and shipped as a packaged unit from the factory.

.3 Gas Valve Trains:

.1 Include two (2) complete gas valve trains for the two fuel types: natural gas and digester gas.

.2 Gas trains to include the following: primary gas shutoff valve, manual shutoff valve, high/low pressure gas switches. All gas valves and switches to comply to CSA B149.1 and CSA B149.6 as applicable.

.3 The digester gas valve train to be designed in accordance with CSA B149.6. Valves to be appropriate for digester gas, as defined by the Canadian Gas Association.

.4 Acceptable Manufacturers:

.5 Motorized main digester gas valve: Maxon.

.6 Flame arrestor: Varnec flame.

.7 The primary gas shutoff valve to be motor operated with spring return to start or stop the gas burner and to close automatically in the event of power failure, flame failure, or a low water condition.

.8 A manual, lubricated plug cock shutoff valve to be located ahead of the motorized valve for manual shutoff.

.9 A proof of closure switch on the primary shutoff valve plus high and low gas pressure switches to be provided. Digester gas train piping to be of Type 316L stainless steel construction.

.10 Pressure switches with a Type 316 stainless steel sensing element, Buna-N actuator seal, snap action, narrow dead band type.

.11 All gas train components to conform to CSA B149.1 and CSA B149.6.

.4 Flame Arrester and Check Valve:

.1 Provide cast aluminum flame arrestors flanged, ANSI Class 125. Provide digester gas check valves.

.5 Boiler Emergency Shut-Off:

.1 Provide an emergency shutdown switch outside boiler room door that meets the requirements of ASME CSD-1.

2.4 Equipment Controls

.1 Control Panels:

.1 The following describe the general requirements for the boiler controls. All control power, IO, communications protocol, panel construction, and components to be coordinated with Division 16 and Division 17.

.2 Boiler controls to communicate with the PCS and be capable of communicating all boiler alarms.

.3 Provide a control panel to include but not be limited to the 600/120 VAC transformer, relays, motor starter for the blower. Control panel to contain flame safe guard controls, main disconnect, switches, indicating lights.

.4 Provide a control panel to include but not be limited: PLC, operator interface terminal, Ethernet switch, indicating lights and UPS. The UPS to provide backup power for the PLC, operator interface terminal and Ethernet switch. Control panel to house a dedicated 120 VAC circuit for the three way valve power supply.

.5 PLC to control stand-by, pre and post combustion purge, pilot, main fuel ignition starting, run and stop. Burner to shut down in the event of ignition pilot or main flame failure or if combustion air pressure in the fan chamber falls below present level, high or low pressure in gas train, high limit or low water condition in boiler.

.6 Burner controller to have PID logic control, and be fully adjustable and to operate in response to a temperature sensor mounted in the hot water outlet.

.7 The boiler control panel to contain manually adjustable lead/lag operation. Lead boiler to start on a "call for heat" and be ramped to full fire before second boiler and subsequent boilers to start. Adjustable time delay between starting of each boiler to be provided. The boilers to shut down in reverse order of firing.

.8 The control panel to contain manual-automatic selector switch. In manual mode, firing is to be controlled by a potentiometer set at the desired point between high and low fire. In the auto mode, the firing rate is to control in response to the load demand.

.9 The control panels to be mounted to the front door of the boiler in a location convenient to the operator. The hinged metal cabinet to have NEMA-4X rating that includes a dust seal and cabinet lock.

.10 Control panel to annunciate the following alarm points on the Panel View Touch-Screen:

    .1 No Start.

    .2 No call for heat or safety circuit open.

    .3 Controlled shut down.

    .4 Lockout due to air pressure drop.

    .5 Lockout due to flame fault.

    .6 Lockout flame failure after first safety check.

    .7 Lockout due to main flame failure.

    .8 Lockout due to pilot failure.

.9 Lockout after incompletion of program, including extraneous light due to flame not extinguished, UV tube fault or fault in supervision circuit).

.10 An alarm bell to pulse when an abnormal condition exists.

.11 Provide an hour counter for each burner.

.12 Provide volt free contacts for burner fault, burner on-off status. These contacts are for connection to the PCS.

.13 The boiler controls to have the following IOs available:

.1 Digital Inputs:

.1 Boiler inlet digester gas and natural gas pressure.

.2 Boiler hot water flow switch.

.3 Circulation pump running from the PCS.

.4 Boiler enable signal from the PCS.

.2 Digital Outputs:

.1 Circulation pump start/stop command.

.3 Analog Inputs:

.1 Boiler gas suction pressure.

.2 Boiler return water temperature transmitter.

.4 Analog Outputs:

.1 Three way valve command – 4-20 mA output.

.14 Provide natural gas-digester gas selector switch.

.2 Integrated Boiler Control System:

.1 The boiler to incorporate an integrated control system (ICS).

.2 ICS to be a PLC based control system and incorporate programming to control boiler lead/lag sequencing, linkageless firing rate controls, digester/natural gas auto-changeover and communications.

.3 The boiler to be factory equipped with an integrated ICS. The system integrates a PLC, Touch Screen Graphical HMI, and Burner Management Control with the features of parallel positioning Fuel-Air-Ratio Control (FARC) and serial or Ethernet master PLC communications.

.4 ICS to be integrated with the PCS and provide automatic burner sequencing, firing rate control, system fault indication, self-checking diagnostics, fault messaging in a plain text type format. Control settings, firing rate, and sequencing to be controlled by the PCS.

.5 ICS for the boiler to include: PLC, color touch screen user interface, firing rate control, thermal shock protection, dual set points (local or remote selectable), assured low fire cut-off, remote lead-lag capability, high stack temperature alarm and shutdown, system process monitoring and alarm points, alarm and diagnostics screens in plain text, remote set point, parallel positioning control.

.6 Major system components to include:

- .1 PLC.
- .2 Touch screen HMI –10 inch minimum.
- .3 Various controller IO (analog and digital) modules.
- .4 One (1) burner management controller and wiring sub-base.
- .5 One (1) flame scanner: infrared, ultra-violet, or UV self-checking scanner.
- .6 One (1) flame amplifier, to correspond with the selected flame scanner.
- .7 Various temperature and pressure sensors.

.7 ICS to provide the following major functions:

- .1 Automatic sequencing of the boiler through standby, pre-purge, pilot flame establishing period, main flame establishing period, run and post purge.
- .2 Flame proving and lockout on flame failure during pilot flame proving, main flame proving, or run.
- .3 Low fire damper/valve position for flame ignition trials.
- .4 Full modulating control of fuel and combustion air.
- .5 Utilize solid state controls and sensors to provide various control functions, such as:
    - .1 On/Off and modulating control.
    - .2 Modulating control algorithm to be PID type.
    - .3 Thermal shock protection based on water temperature and setpoint.
    - .4 Various high and low limit alarms and shutdowns.
- .6 Touch Screen graphical operator interface and monitoring:

.1 Manual control of the boiler-firing rate utilizing control screens on the HMI to increment and decrement the firing rate.

.2 On screen indication of burner management controller status and diagnostics.

.3 On screen real-time display of all connected process parameters.

.4 On screen display of system alarms and faults.

.5 On screen history of alarms and faults.

.6 On screen recommendation for troubleshooting fault conditions.

.7 On screen water level indication (optional) and alarm(s).

.8 Printing alarm/fault history.

.7 E-mail or paging of boiler alarms (with either Ethernet/IP or modem option).

.8 Process Area PCS interface (with Ethernet/IP option).

.9 Ethernet and internet communications (with Ethernet/IP option).

.10 Tamper resistant control logic and password protection.

.11 Night/day setback control.

.12 Stack flue gas, combustion air, and shell (water) temperatures.

.13 Boiler efficiency calculation.

.14 Outdoor reset for hot water boilers.

.15 Remote modulation or firing rate setpoint control.

.16 Assured low fire cut-off.

.17 Assured start permissive safety interlocking.

.8 ICS to provide the following safety provisions for:

.1 Integrated Burner Management:

.1 Examine all load terminals to assure it is capable of recognizing the true status of the external controls, limits and interlocks. If any input fails this test, the burner management system should lockout on safety shutdown.

.2 Closed-loop logic test verifies integrity of safety critical loads (ignition, pilot, and main fuel valves) and to be able to lockout on safety.

.3 Pre-ignition interlocks (fuel valve proof of closure) and flame signal checked during Standby and Pre-Purge.

.4 Dynamic checking of the flame signal amplifier. The control flame signal amplifier to be able to recognize a no flame signal during this dynamic amplifier check.

.5 Safe start check and expand check to include monitoring flame signal during standby.

.6 High and low fire switches checked for proper sequencing.

.7 Tamper-proof purge timing and safety logic.

.2 Integrated Boiler Controls:

.1 Operating and modulating control.

.2 Primary low water cut-off.

.3 Password protection of PLC.

.4 Password protection of parallel positioning control.

.9 ICS to provide annunciation and diagnostics:

.1 Active alarm annunciation.

.2 Provide historical alarm information for on screen display.

.3 Detects and isolates an alarm and reports internal circuit faults.

.4 Printer output capable for logging alarms.

.5 Capability of printing alarm history of date, time, cycle of occurrence and date and time of acknowledgement up to the most recent 100 faults.

.6 English text description of the system fault and troubleshooting procedures.

.7 Water level indication and low water shutdown alarm.

.8 Dynamic self-checking.

.10 ICS to be able to operate in these environmental conditions:

.1 Supply Voltage: 600 VAC (plus 10 percent/minus 15 percent) 60 Hz.

.2 Maximum total connected load: 4,000 VA.

.3 Operating temperature limits: 32 to 130°F.

.4 85 percent RH continuous, non-condensing, humidity.

.5 0.5 G continuous vibration.

.11 ICS component functions to be as follows:

.1 Burner Management Controller: Provides boiler sequencing logic to meet FM/UL/cUL approval body requirements.

.2 Touch Screen Graphical Interface: Provides user interface to the control system, boiler overview screen with connected boiler parameter readouts, Burner Management Control status screen, alarm banners, diagnostic screens for fault troubleshooting, alarm history screen, system firing rate screen and system configuration screens.

.3 Various Programmable Controller Input/Output modules: Provides interface for discrete powered and/or isolated relay signals, as well as for analog signals, from and/or to other input/output devices.

.4 Stack Temperature Sensor: Measures and transmits a signal to the Programmable Controller in relation to boiler exit flue gas temperature. It is used for indication and in the calculation of boiler efficiency; it can also be used for high stack temperature alarm and shutdown.

.5 Water Temperature Transmitter: Provides an analog signal to the Programmable Controller for indication of boiler water temperature; utilized for on/off and modulating control of the burner.

.6 Water (shell) Temperature Sensor: Measures and transmits a signal to the Programmable Controller in relation to boiler water temperature; used for indication and thermal shock protection.

.3 Parallel Positioning System:

.1 The purpose of the parallel positioning system is to control fuel, combustion air and flue gas recirculation (FGR) if applicable. Individual actuators to be used to control each of above functions. The logic to be integrated into the ICS noted previously.

.2 Actuator Specifications

.1 General: Reversing motor with position feedback.

.2 Application: Control of dampers and fuel valves. Position to be controlled by a PLC; Servo-Positioning Module is not required.

.3 Rotary: 90 Degree Rotation. 10-15 Second Timing (for 90 Degrees), 100 in-lb Torque, 0.1 percent Resolution (over 90 Degrees).

.4 Linear: 25 mm (1 inch) linear travel, 10-15 second timing (for 25 mm travel), 70 lb thrust, 0.1 percent resolution (over 25 mm travel).

.5 Electrical: 120 or 24 VAC; Control signal: 4-20 mA.

.6 Duty: Continuous, Position Feedback Signal: 4-20 mA, Position Feedback Resolution: 0.1 percent (over specified travel).

.7 Control Description: Control to be parallel positioning with cross limiting. System to be capable to accommodate dual fuel with FGR. System is not to be capable of simultaneous fuel firing. System to accommodate dual gas flow control valves.

.4 PLC Communication:

.1 Confirm the communication protocol to be used for communication with the PCS. The gateways/protocol convertors are not permitted.

.5 Three Way Valve:

.1 Supply the three way valve complete with electric actuator.

.2 The electric actuator to have output for position indication. The actuator to be mated with the valve to ensure reliable operation.

.3 Temperature transmitters to modulate three-way valves associated with the boiler to maintain minimum return hot water temperature.

.6 Temperature Transmitters for Three Way Valves Control:

.1 Provide temperature sensors/transmitters with analog output and wired to the associated boiler PLCs. The measuring range as per boiler Manufacturer's recommendations.

2.5 Extended Warranty

.1 The boiler pressure vessel to be warranted against thermal stress cracking for a period of ten years from date of shipment. The warranty to cover the boiler pressure vessel under all operating conditions and include temperature differentials up to 83°C (150°F) between upper and lower drum.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Start-up

.1 After the boiler installation is completed, Manufacturer to provide the services of a field representative for starting the unit and training.

.2 A factory approved and authorized start-up report is to be submitted at the time of start-up and is to include the following tests:

.1 Demonstrate that the boiler, burner, controls, and accessories comply with the requirements in this section. Pre-test all items prior to scheduling the final testing and witness testing.

.2 Take readings at different firing rates (20, 50, 75 and 100 percent) of load for the modulating burner and provide a written report of the tests submitted. The reports are to include readings for each firing rate tested and include stack temperatures, O_2, CO, NOx, and overall boiler efficiency. Adjust the boiler as required to meet the published efficiency data for the boiler.

.3 Auxiliary Equipment and Accessories: Observe and check all valves, draft fans, electric motors and other accessories and appurtenant equipment during the operational and capacity test for leakage, malfunctioning, defects and non-compliance with referenced standards or overloading as applicable.

.4 Manufacturer's representative to perform the following:

.1 Fireside inspection.

.2 Set up fuel train and combustion air system.

.3 Set up operating set points.

.4 Check all safeties, including flame safeguard, LWCO, airflow, fuel pressure, high limits.

.5 Set up and verify efficiencies at 20, 50, 75 and 100 percent.

.6 Set up and verify burner turndown.

.7 Set up and verify digester gas – natural gas automatic switch over in both directions.

END OF SECTION

HEAT EXCHANGERS FOR HVAC

1. GENERAL

1.1 Summary

.1 This Section specifies the design, supply, installation, testing and commissioning requirements for heat exchangers for HVAC systems.

1.2 Standards

.1 American National Standards Institute (ANSI).

.2 American Society of Mechanical Engineers (ASME) Section VIII.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A516/A516M - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.

.2 ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

.4 Canadian Standards Association (CSA):

.1 CSA B51: Boiler, pressure vessel, and pressure piping code.

.5 Canadian Centre for Occupational Health and Safety (CCOHS).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Performance Criteria

.1 Provide heat exchangers suitable for a working pressure of 860 kPa and a working temperature of 150°C.

.2 Allow a safety factor of 1.2 when determining heat exchanger flow rates. Adjust flow rates to account for viscosity with systems operating with glycol.

.3 Design heat exchanger for a maximum pressure drop of 24 kPa.

.4 Frame to be able to accommodate 30 percent additional plates.

.5 The exchanger is to be constructed for field disassembly without special tools to facilitate periodic cleaning.

.6 Provide ports for chemical cleaning and backflush.

2.2 Heat Exchangers - Plate Type

.1 Frame:

.1 The frame plate and pressure plate shall be fabricated from carbon steel to SA 516 grade 70 and be of sufficient thickness to meet the ASME design pressure. Stiffeners or support brackets are not permitted. Frame components shall have an epoxy paint finish. The frame design shall allow the thermal plates to be supported by the carry bar, top bar. The guide bar, bottom bar, shall only help properly align the plates. A roller assembly from the carry bar shall support the pressure plate for units taller than 50". Tightening bolts shall be zinc plated carbon steel SA193 B7. Provide aluminum or stainless steel CCOHS splash shield.

.2 Connections:

.1 65 mm or greater: Alloy lined studded ports to mate with raised face or flat faced ANSI flanges.

.2 50 mm or less: Carbon steel female tapped NPT or male NPT connections if an alloy material is required.

.3 Plates:

.1 Plates shall be constructed of Type 316 L Stainless Steel and pressed in a one-step stamping process. Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate and carry bar and guide bar. Welded on hanging brackets or stiffeners are not acceptable. Plates shall be permanently marked to indicate plate material and thickness.

.4 Gaskets:

.1 The gaskets shall be manufactured from nitrile butadiene rubber and be of a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination.

.2 Gaskets are to be “mechanically fixed”. Glued gaskets are not acceptable.

2.3 Shell and Tube Heat Exchanger

.1 General:

.1 Units shall be designed for heating fluid in shell and heated fluid in tubes.

.2 Provide for temperature regulator sensor at heated fluid outlet.

.3 Provide ASME rated pressure and temperature relief valve on the heated fluid side.

.4 Provide thermometers and pressure gauge tappings in fluid inlets and outlets.

.5 Provide ASME rated pressure relief valve on steam side.

.6 Provide valved shell drain and vent.

.2 Shell:

.1 Steel, with threaded or flanged piping connections and necessary tappings.

.3 Tubes:

.1 0.9 mm thickness copper with brass tube support. Maximum velocity 2 m/s.

.4 Saddle Supports:

.1 Steel with attaching U-bolts.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install with safety relief valve piped to drain, hose bibb and drain valve.

.4 Install thermometer wells with thermometers on inlet and outlet of both source and load water connections.

.5 Install pressure gauges on inlet and outlet of both source and load water connections.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of wall finned radiation, unit heaters and related accessories and specialties.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

  .1 ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.2 Canadian Standards Association (CSA):

  .1 CSA C22.1 - Canadian Electrical Code.

.3 Manitoba WSHA.

.4 National Electrical Manufacturers Association (NEMA).

.5 National Fire Protection Association (NFPA):

  .1 NFPA 70 - National Electrical Code.

.6 Underwriters Laboratories (UL):

  .1 UL 1995/CSA C22.2 No. 236-95: Heating and Cooling Equipment.

  .2 UL 1996 - Electric Duct Heaters.

  .3 ULC S636 - Standard for Type BH Gas Venting Systems.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

.2 Submit, in addition to Shop Drawings, schedules of radiation heating elements and enclosure indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and a comparison of specified heat required to actual heat output provided.

.3 Submit a schedule of radiant panels indicating location, size, and heating and cooling outputs at specified temperatures. Include all installation details and accessories for specific installations.

2. PRODUCTS

2.1 General

.1 Factory apply baked primer coat on metal surfaces of enclosure or cabinet of all baseboard, wall fin, convectors, unit heaters, cabinet unit heaters and unit ventilators in non-process areas).

.2 Provide all necessary trim to properly install radiant panels in all types of ceilings.

2.2 Electric Unit Heaters (Non-Classified Areas)

.1 Casing:

  .1 1.31 mm thick galvanized steel, epoxy coated finish with lugs for unit suspension and hinged door accessed control panel.

.2 Heating elements:

  .1 Metal-sheathed finned tube with epoxy sealed terminals.

.3 Fan:

  .1 Direct drive propeller type, factory balanced, with aluminum alloy blades, steel hub and approved fan guard.

.4 Motor:

  .1 Totally enclosed, permanently lubricated ball bearings with thermal overload protection.

.5 Air outlet:

  .1 Individually adjustable extruded aluminum directional vanes.

.6 Temperature hi-limit:

  .1 Automatic reset.

.7 Disconnect Switch:

  .1 Factory installed.

.8 Fan-only switch:

  .1 Factory Installed.

.9 Contactor:

  .1 Factory installed.

.10 Core:

.1 Steel with aluminum fins.

.11 Thermostat:

.1 PCS direct control.

.2 Back up wall mounted local control.

2.3 Electric Unit Heaters (Classified Areas)

.1 General:

.1 Rated and labeled for Zone 1 and Zone 2 applications.

.2 Provide stainless steel construction and Heresite-coated heating elements.

.2 Casing:

.1 2.6 mm thick galvanized steel, epoxy coated finish with lugs for unit suspension. Alternate 316 stainless steel per 2.3.1.2.

.3 Heating Elements:

.1 Low-watt density, metal-sheathed elements, glycol filled. Heresite coating as required per 2.3.1.2.

.4 Motor:

.1 Explosion-proof, thermally protected and permanently lubricated.

.5 Fan:

.1 Direct drive propeller type, factory balanced, with aluminum alloy blades, steel hub and fan guard approved by WSHA.

.6 Air outlet:

.1 Will have directional vanes.

.7 Temperature hi-limit:

.1 Automatic reset snap action bimetal.

.8 Control circuit:

.1 120 V.

.9 Disconnect switch:

.1 Factory installed.

.10 Fan-only switch:

.1 Factory Installed.

.11 Control transformer:

.1 Factory installed.

.12 Contactor:

.1 Factory installed.

.13 Core:

.1 Steel with aluminum fins.

.14 Thermostat:

.1 PCS direct control.

.2 Back up wall mounted local control to be suitable for Class 1 Zone 2 Hazardous Locations per NFPA 70.

2.4 Electric Unit Heaters (Washdown for Non-Classified Areas)

.1 Casing:

.1 16 gauge, stainless steel, moisture and corrosion resistant.

.2 NEMA 4X non-metallic electrical enclosure.

.2 Heating elements:

.1 Sealed tubular heating element with stainless steel fins.

.3 Fan:

.1 Direct drive propeller type, factory balanced, delayed-action, with epoxy painted anodized aluminum blades.

.4 Motor:

.1 Totally enclosed, permanently lubricated ball bearings with thermal overload protection.

.2 Epoxy coated motor.

.5 Air outlet:

.1 Individually adjustable stainless steel outlet louvers.

.6 Temperature hi-limit:

.1 Automatic reset.

.7 Disconnect Switch:

.1 Factory installed.

.8 Fan-only switch:

.1 Factory Installed.

.9 Contactor:

.1 Factory installed.

.10 Thermostat:

.1 PCS direct control.

.2 Back up wall mounted local control.

.11 Mounting:

.1 Stainless steel swivel mounting bracket for wall or ceiling mounting.

2.5 Electric Baseboard Heaters (Non-Classified Areas)

.1 Casing:

.1 22 gauge steel body.

.2 20 gauge steel front panel and steel connection box.

.3 Epoxy/polyester powder paint finish in manufacturer standard colour.

.2 Heating elements:

.1 Stainless steel tubular heating element with aluminum fins on high-temperature nylon bushings.

.2 Average standard watt density of 902 W/m (275 W/ft).

.3 Temperature hi-limit:

.1 Automatic reset.

.4 Disconnect Switch:

.1 Factory installed.

.5 Contactor:

.1 Factory installed.

.6 Thermostat:

.1 PCS direct control.

.2 Back up wall mounted local control.

2.6 Electric Force Flow Heaters (Non-Classified Areas)

.1 Casing:

.1 18 gauge steel front cover.

.2 Bottom air outlet.

.2 Heating elements:

.1 Sealed tubular heating element with stainless steel fins.

.3 Fan:

.1 Direct drive propeller type, factory balanced, delayed-action.

.4 Motor:

.1 Totally enclosed, permanently lubricated ball bearings with thermal overload protection.

.5 Air outlet:

.1 Fixed, downward facing louvers.

.6 Temperature hi-limit:

.1 Automatic reset.

.7 Disconnect Switch:

.1 Factory installed.

.8 Contactor:

.1 Factory installed.

.9 Thermostat:

.1 PCS direct control.

.2 Back up built-in local control.

2.7 Duct Mounted Electric Coil

.1 Heater to comply with UL 1996.

.2 Nickel-chromium elements.

.3 Automatic thermal reset.

.4 Secondary thermal cut-out.

.5 Airflow switch.

.6 SCR control with discharge air temperature sensor.

.7 Hinged access door.

.8 Single point electrical connection.

2.8 Hydronic Unit Heaters (Non-Classified Areas)

.1 General:

.1 All units are CSA certified and comply with UL 1995 and CSA C22.2 No. 236-95 requirements.

.2 Coil:

.1 Heating element shall be designed for hot water heating system.

.2 Coils shall be made up of 13 mm (½ inch) nominal diameter seamless copper tubing and aluminum fins (12 fins per inch) which are die-formed with a thickness of no less than 0.25 mm (0.010 inch).

.3 The tubes are to be mechanically bonded to the fins.

.4 Fins are to be continuous across width and depth of coil and vertically oriented to resist collection of dirt and foreign particles.

.5 Coils are of non-ferrous construction and serpentine design with steel header and external threaded NPT connections.

.6 Coils are to be tested at 1551 kPa (225 PSIG) air under water.

.7 Coils are to be suitable for operating up to 1240 kPa (180 PSIG) and 182ºC (360ºF).

.3 Casings:

.1 1.21mm (18-gauge steel). Casing is to be furnished with threaded hanger connections for suspension of unit.

.4 Finish:

.1 Degreased and chemically phosphatised prior to the application of a standard textured grey epoxy powder coating.

.5 Motor:

.1 Totally enclosed, split capacitor with thermal overload protection.

.6 Fans:

.1 Aluminum blades, with a steel hub.

.7 Fan Guard:

.1 Finger-proof constructed of steel rod, approved by WSHA.

.8 Pattern Control:

.1 Horizontal louvers.

.9 Disconnect switch:

.1 Factory installed.

.10 Fan-only switch:

.1 Factory Installed.

.11 Thermostat:

.1 PCS direct control.

.2 Back up wall mounted local control.

2.9 Hydronic Unit Heaters (Classified Areas)

.1 General:

.1 All units are CSA certified and comply with UL 1995 and CSA C22.2 No. 236-95 requirements.

.2 Rated and labeled for Zone 1 and Zone 2 applications.

.3 Provide Herisite coating in corrosive environment Category 2 areas as defined by the Canadian electrical code.

.2 Coil:

.1 Heating element shall be designed for hot water heating system.

.2 Coils shall be made up of 13 mm (½ inch) nominal diameter seamless copper tubing and aluminum fins (12 fins per inch) which are die-formed with a thickness of no less than 0.25 mm (0.010 inch).

.3 The tubes are to be mechanically bonded to the fins.

.4 Fins are to be continuous across width and depth of coil and vertically oriented to resist collection of dirt and foreign particles.

.5 Coils are of non-ferrous construction and serpentine design with steel header and external threaded NPT connections.

.6 Coils located were they may be exposed to or handle air with corrosive contaminates, including but not limited to H2S will be fully Heresite coated or constructed of minimum 316 stainless steel.

.7 Coils are to be tested at 1551 kPa (225 PSIG) air under water.

.8 Coils are to be suitable for operating up to 1240 kPa (180 PSIG) and 360ºF.

.3 Casings:

.1 1.21mm (18-gauge steel). Casing is to be furnished with threaded hanger connections for suspension of unit.

.4 Finish:

.1 Degreased and chemically phosphatised prior to the application of a standard textured grey epoxy powder coating.

.5 Motor:

.1 Totally enclosed, split capacitor with thermal overload protection.

.2 Explosion-proof for Zone 1 and Zone 2 applications.

.6 Fans:

.1 Aluminum blades, with a steel hub.

.7 Fan Guard:

.1 Finger-proof constructed of steel rod, approved by WSHA.

.8 Pattern Control:

.1 Horizontal louvers.

.9 Disconnect switch:

.1 Factory installed.

.10 Fan-only switch:

.1 Factory Installed.

.11 Thermostat:

.1 PCS direct control.

.2 Back up wall mounted local control to be suitable for Class 1 Zone 2 Hazardous Locations per NFPA 70.

2.10 Hydronic Cabinet Unit Heaters (Non-Classified Areas)

.1 Casing:

.1 Steel, minimum 1.2 mm thickness, white polyester powder paint finish, bottom air outlet, high limit temperature control with automatic reset.

.2 Heating Coils:

.1 Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 2.1 mm, rated for a minimum working pressure of 2067 kPa and a maximum entering-water temperature of 104ºC. Minimum copper tube thickness shall be 0.4 mm. Minimum fin thickness shall be 0.11 mm. Lanced fins shall not be acceptable. Coils shall be circuited for counter flow to maximize unit efficiency. Coil casing shall be fabricated from galvanized steel. Include manual air vent and drain valve.

.3 Fan:

.1 Plate axial, closed, factory lubricated motor, 55 dbA @ 1 m in free field conditions at a flow rate of 75 l/s.

.4 Controls and Valves:

.1 Remote thermostat to control fan and motorized valve.

.1 PCS direct control.

.2 Back up wall mounted local control.

.2 Control knob for three (3) fan speeds.

.3 Two-Piece Ball Valves: Forged brass body with full-port, chrome-plated brass ball; PTFE seats; and 4140 kPa minimum CWP rating and blowout-proof stem.

.4 Calibrated-Orifice Balancing Valves: Bronze body, ball type; 1376 kPa working pressure, 121ºC maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.

.5 Y-Pattern Hydronic Strainers: Forged brass body; 4140 kPa working pressure; with sweat connections and perforated stainless-steel basket.

.6 Forged Brass Unions: ASME B16.22.

2.11 Fan Coil Unit (Non-Classified Areas)

.1 Cabinet: Fabricate of 16-gauge steel with exposed edges rounded and removable panels, 75 mm fibreglass internal insulation throughout, air inlet and outlet *duct collars *grilles, finished with baked on enamel.

.2 Fans: Centrifugal forward curved double width wheels, statically and dynamically balanced, belt driven, on ball bearings resiliently mounted with adjustable motor pulleys.

.3 Filters: Easily removed 25 mm thick glass fibre throw-away or permanent washable type, filtering air before unit coil.

.4 Hydronic Heating and Cooling Coils: See section 15750 – Hydronic Coils for construction and application requirements Provide 16-gauge galvanised steel drain pan under cooling coil, easily removed for cleaning and with drain connection.

.5 Direct Expansion Coils: See section 15752 – Direct Expansion Coils for construction and application requirements. Provide 16-gauge galvanised steel drain pan under cooling coil, easily removed for cleaning and with drain connection.

.6 Drain pans must be connected to nearest drain.

.7 Wiring: Factory installed; CSA approved.

.8 Filters: Average capture efficiency of 70 percent in the 3-10 micron particle range. Minimum Efficiency Reporting Value (MERV) 8 at 2.5 m/s per ASHRAE 52.2. Diamond grid with 98 percent open area to provide support for the media. Bond the media-to-media support to ensure pleat stability enclosure the media with a rigid moisture resistant, heavy duty kraft board. Bond the filter pack to the inside periphery of the frame to eliminate air bypass. Material: Non-Woven Reinforced Cotton Rayon.

.9 Controls and Valves:

  .1 Remote thermostat to control fan and motorized valve.

    .1 PCS direct control.

    .2 Back up wall mounted local control.

  .2 Control knob for three (3) fan speeds.

  .3 Two-Piece Ball Valves: Forged brass body with full-port, chrome-plated brass ball; PTFE seats; and 4140 kPa minimum CWP rating and blowout-proof stem.

  .4 Calibrated-Orifice Balancing Valves: Bronze body, ball type; 1376 kPa working pressure, 121ºC maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.

.5 Y-Pattern Hydronic Strainers: Forged brass body; 4140 kPa working pressure; with sweat connections and perforated stainless-steel basket.

.6 Forged Brass Unions: ASME B16.22.

2.12 Gas-fired Unit Heaters (Non-Classified Areas)

.1 General:

.1 Condensing furnace section with 93% minimum efficiency provided by an indirect-fired tubular heat exchanger with individually fired tubes coupled to a secondary recuperative heat exchanger for maximum heat recovery.

.2 Approved by Manufacturer for installation in the intended type of occupancy and space electrical category.

.2 Unit Casing:

.1 Constructed of 20 gauge aluminized steel with minimization of exposed fasteners.

.2 Exterior cleaned of all oils and a phosphate coating applied prior to painting.

.3 Exterior painted with an electrostatically applied baked-on polyester powder paint for corrosion resistance.

.4 Furnished with horizontal adjustable air deflectors.

.3 Furnace Section:

.1 Primary heat exchanger constructed of 18 gauge aluminized steel tubes and headers.

.2 Secondary heat exchanger constructed of AL29-4C stainless steel.

.3 Heat exchanger tubes individually and directly flame-fired.

.4 Heat exchanger tubes crimped to allow for thermal expansion and contraction.

.5 Flue collector box constructed of AL29-4C stainless steel.

.6 Thermal efficiency minimum of 93% efficient for all air flow ranges.

.7 Heat exchanger seams and duct connections certified to withstand 225 Pa external static pressure without burner flame disturbance.

.8 Burners are in-shot type, directly firing each heat exchanger tube individually.

.9 Ignition controller 100% shut-off type with continuous retry.

.10 Suitable for gas pressure between 1.5 – 1.7 kPa.

.11 Solid state ignition system directly lights the gas by means of direct spark igniter each time the thermostat calls for heat.

.12 Unit gas controls are be provided with the following:

.1 Single-stage gas controls with a single-stage combination gas control.

.2 Ignition control.

.3 Single-stage low voltage thermostat.

.13 Unit fires at 100% full fire based on a call for heat from a room thermostat.

.14 Automatic reset high limit switch mounted in air stream to shut off the gas supply in the event of overheating.

.15 Automatic reset high limit switch mounted on the power exhauster housing to shut off the gas supply in the event of overheating flue gas temperatures.

.16 Condensate drain line overflow switch that senses if the condensate line is clogged and shuts the unit heater down.

.17 Time delay relay delays the start of the fan to allow the heat exchanger a warm-up period after a call for heat.

.18 Time delay relay also continues the fan operation after the thermostat has been satisfied to remove any residual heat on the heat exchanger.

.4 Supply Fan:

.1 Blower Type: Centrifugal type rubber mounted with belt drive, adjustable variable pitch motor pulley and TEFC motor. Rubber isolated hinge mounted motor.

.2 Standard Type: Propeller fans to be direct drive rubber mounted, overload protected TEFC motor.

.5 Venting/Combustion Air:

.1 Power vented/exhausted.

.2 Separate combustion air intake pipe.

.3 Unit tested for proper ignition with 64 km/h outdoor wind velocities.

.4 Unit contains a factory mounted differential pressure switch designed to prevent main burner ignition until positive venting has been proven.

.5 Venting approved to ULC S636.

.6 Manufacturer’s recommended product and installation.

.7 To requirements of all codes and of the Authority Having Jurisdiction.

.6 Thermostat:

.1 PCS direct control.

.2 Back up wall mounted local control.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Provide each terminal heat transfer unit with shut-off valve on supply and lock shield balancing valve on return piping.

.4 Provide each unit at high points with easily accessible manual air vent. If not easily accessible, extend vent to exterior surface of cabinet for each servicing.

.5 Copper tube elements to be joined by sweat solder joints using 95-5 solder for working pressure of 345 kPa and less, and silver brazing for higher pressures.

.6 Grade piping to allow for air elimination.

END OF SECTION

REFRIGERANT PIPING

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for the supply, installation, testing and commissioning of refrigerant pipework, valves and appurtenances.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B16.22 - Wrought Copper And Copper Alloy Solder-Joint Pressure Fittings.

.2 ASME B16.24 - Cast Copper Alloy Pipe Flanges, Flanged Fittings, And Valves: Classes 150, 300, 600, 900, 1500, And 2500.

.3 ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).

.2 ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA):

.1 CSA B52 - Mechanical refrigeration code.

.4 MIL-DTL-1183 - Fittings, Pipe, Cast Bronze, Silver-Brazing.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Refrigerant piping layout, oil traps, pipe sizing according to site conditions, valves, accessories, supports to be submitted in Shop Drawings, inclusive of power and control wiring diagrams.

2. PRODUCTS

2.1 Refrigerant Tubing

.1 Provide processed tubing for refrigeration installation, deoxidized, dehydrated and sealed.

.2 Hard copper tube, type L, to ASTM B88M.

.3 Annealed copper tube to ASTM B280, with minimum wall thickness as per CSA B52.

2.2 Fittings

.1 Service: design pressure 2070 kPa and temperature 121°C.

.2 Brazed: wrought copper to ASME B16.22 or cast bronze to MIL-DTL-1183.

.3 Flanged: bronze or brass, Class 150 and Class 300 to ASME B16.24.

.4 Flare: Bronze or brass, for refrigeration, to ASME B16.26.

.5 Long radius type for elbows and return bends.

2.3 Joints

.1 Brazing materials to be SIL-FOS-15 phosphor-copper-silver alloy for copper piping jointed by copper fittings and silver solder for brass fittings.

.2 Flexible connections: 9.5 mm nominal or less to be made using coiled soft copper tubing. For larger sizes, use seamless flexible bronze hose with bronze wire braid covering. Use factory sealed neoprene jacket unit where freezing may occur.

2.4 Valves

.1 Shut-Off Valves:

  .1 Select line size for low pressure drop.

  .2 Acceptable Products:

    .1 Sizes 6 mm to 16 mm dia.

      .1 Henry Standard.

      .2 Mueller Linemaster Special.

      .3 Or approved equivalent.

    .2 Sizes 22 mm dia. and larger:

      .1 Henry Wing Cap.

      .2 Mueller Globemaster.

      .3 Or approved equivalent.

    .3 All sizes may be Henry or Mueller ball valves.

.2 Solenoid Valves:

  .1 With field replaceable coil, serviceable without removing valve from line.

.2 Coil voltage to suit field requirements.

.3 Provide upstream of thermostatic expansion valves.

.4 Acceptable Products:

.1 Alco 240 RA series.

.2 Or approved equivalent.

.3 Expansion Valves:

.1 Thermostatic type with external equalizer, adjustable superheat setting, capacity and bulb charge to suit operating conditions.

.4 Charging and Purging Valves:

.1 Valves to be the same size as line size into which they are connected or 12 mm whichever is the larger.

.2 Valve complete with a removable seal cap chained to the valve body.

.3 Acceptable Products:

.1 Henry Standard Type.

.2 Mueller Linemaster Special.

.3 Or approved equivalent.

2.5 Sight Glass

.1 Provide sight glass in liquid line following filter drier.

.2 Sight glass to be combination moisture-liquid indicator and with a protective removable cap.

.3 Sight glass to be fitted in-line.

.4 Acceptable Products:

.1 Henry Dri-Vue.

.2 Mueller Vuemaster.

.3 Sporlan See All.

.4 Or approved equivalent.

2.6 Access Fittings

.1 Provide Schraeder access fittings in each suction connection from an evaporator, located adjacent to the superheat sensing element of the expansion valve.

.2 Fittings to be used for checking the superheat of the suction gas.

.3 Solder access fittings into a tee and complete with a quick-seal cap.

2.7 Filter Driers

.1 Provide a filter drier in the liquid line from the condenser. Provide shut-off valves on each side of drier and sight glass.

.2 Select filter drier with a pressure drop of a maximum 13 kPa when passing 150 percent of the system flow rate.

.3 Removable core with flare connections.

.4 Provide replaceable desiccant drier material.

.5 Acceptable Products:

  .1 Alco Extra-Klean.

  .2 Catch-All.

  .3 Henry Dri-Cor.

  .4 Mueller Drymaster II.

  .5 Sporlan.

  .6 Or approved equivalent.

2.8 Refrigerant Driers

.1 Provide in-line or angle type driers with copper or brass shell.

.2 Provide replaceable desiccant drier material.

2.9 Strainers

.1 Provide replaceable cartridge type refrigerant strainers with brass shell.

.2 Provide cartridge material and screen size suitable for the refrigerant and piping material utilized in the system.

2.10 Pressure Gauges - Refrigeration

.1 Acceptable Manufacturers:

.1 Marsh.

.2 Moeller.

.3 Trerice.

.4 Weiss.

.5 Weksler.

.6 Winters.

.7 Or approved equivalent.

.2 Minimum Requirements:

.1 Panel surface mounting type, flanged type.

.2 Flush panel mounting type, flush mount case style.

.3 Seamless phosphor bronze Bourdon tube type, with minimum 65 mm dia. dial, unless otherwise indicated.

.4 Cast aluminum, black steel or stainless steel case, with stainless steel or chrome plated face ring.

.5 Accuracy plus or minus 2 percent of scale range.

.6 Scales to be calibrated in both pressure and corresponding temperature of refrigerant.

.7 Scale Range:

.1 Operating Pressure: -50 to 690 kPa
Scale Range: -100 to 1035 kPa

.2 Operating Pressure: 690 to 2750 kPa
Scale Range: 0 to 3450 kPa

.3 Note:

.1 Gauges complete with recalibrator and restrictor.

.2 Install a needle valve (carp) ahead of each gauge.

2.11 Evaporator Drains

.1 Fit each evaporator with a copper drain line.

.2 Provide drain line with a running trap.

2.12 Flexible Connections

.1 Braided tin-bronze convoluted flexible connections.

.2 Design pressure 2070 kPa.

.3 Acceptable Products:

  .1 Anaconda.

  .2 Or approved equivalent.

2.13 Refrigerant Tube Supports

.1 Middle Attachments (Rod):

  .1 Carbon steel black (electro-galvanized for mechanical rooms) continuous threaded rod.

    .1 Acceptable Products:

      .1 Grinnell Fig. 146.

      .2 Myatt Fig. 434.

      .3 Or approved equivalent.

.2 Pipe Hangers:

  .1 Uninsulated pipe, up to 40 mm:

    .1 Acceptable Product:

      .1 Grinnell 97C.

      .2 Or approved equivalent.

  .2 Insulated pipe, up to NPS 25 mm:

    .1 Acceptable Products:

      .1 Grinnell fig. 269.

      .2 Myatt fig. 120.

      .3 Or approved equivalent.

  .3 Insulated pipe, NPS 40 mm.

    .1 Acceptable Products:

      .1 Grinnell Figs. 65 or 260.

.2 Myatt Figs. 122 or 124.

.3 Or approved equivalent.

.4 Maximum horizontal pipe hanger spacing:

Pipe Size	Maximum Spacing	Rod Diameter
up to 20 mm	1.5 m	10 mm
25 mm & NPS 30 mm	1.8 m	10 mm

.3 Wall Supports:

.1 Horizontal pipe adjacent to wall; angle iron wall brackets with specified hangers.

.2 Vertical pipe adjacent to wall; exposed pipe wall support for lateral movement restraint.

.1 Acceptable Products:

.1 Grinnell Figs. 262 or 263.

.2 Or approved equivalent.

.4 On insulated piping, where the insulation is specified to have a continuous sealed vapour barrier, (cold services) install oversized clevis hangers and insulation protection shields with metal thickness and lengths as recommended by the Manufacturer.

.1 Acceptable Products:

.1 Grinnell Fig. 167.

.2 Or approved equivalent.

.2 Hangers for copper pipe to be copper plated or plastic dipped unless pipe hangers bear on piping insulation (cold services).

.3 Cold services - refrigerant suction lines.

2.14 Extended Warranty

.1 provide a five (5) year unconditional warranty for refrigerant piping system loss of refrigerant from Final Completion Date.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Follow unit Manufacturer’s sizing and installation recommendations.

.4 Fittings to be "Sil-Fos" brazed or silver soldered. Special precautions to be taken to prevent the overheating of copper tube. No joint is to be made without a pressurized nitrogen flow through the joint.

.5 Tubing to be cut square and have all burrs removed.

.6 Piping to be kept meticulously clean. All cleaned piping in the process of erection, whether installed or awaiting installation to be capped or plugged.

.7 Piping to be installed in true vertical and horizontal planes close to walls and ceilings, with specified pitch. Provide suitable offsets to account for expansion.

.8 Piping connections to equipment and terminal apparatus to be supported independently and arranged to give easy access for maintenance.

.9 Provide rubber grommets where refrigerant piping passes through a metal surface.

.10 Grade horizontal pipe carrying gases 1:240 down in direction of flow.

.11 Locate trap every 4.5 m of vertical rise in any suction riser 9 m or more in length.

.12 Install piping to prevent condensate or oil from flowing back into compressor or evaporator.

.13 Provide full size strainer ahead of each automatic valve. Where multiple expansion valves with integral strainers are used, install single main liquid line strainer.

.14 On steel piping systems provide adequate strainer in suction line to remove scale and rust inherent in steel pipe.

.15 Provide shut-off valve on each side of strainer to facilitate maintenance.

.16 Provide full flow permanent refrigerant drier in low temperature systems and systems utilizing hermetic compressors.

.17 Mount drier vertically in liquid line adjacent to receiver with three valve bypass assembly to permit isolation of drier for servicing.

.18 Filter-driers may be used in systems instead of separate strainers and driers.

.19 Install with three valve bypass assembly to permit isolation for servicing.

.20 Provide solenoid valves in liquid line of system operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

.21 Provide solenoid valves with manually operated stems.

.22 Size expansion valves properly to avoid penalty of being undersized at full load and of being excessively oversized at partial load.

.23 Properly evaluate refrigerant pressure drop through system to determine the available pressure drop across the valve.

.24 Select valves for maximum load at design operating pressure and minimum 42°C of superheat.

.25 Locate remote expansion valve sensing bulb immediately after evaporator outlet and suction line.

.26 Provide refrigerant charging connections in liquid line between receiver shut-off valve and expansion valves.

.27 In general install suction and hot piping connections to compressors with three (3) directional changes for distance of minimum six pipe diameters before reaching point of support.

.28 Flexible connectors only to be utilized at or near compressor where it is not physically possible to absorb vibration within piping configuration.

.29 Seal inside on conduit at point where it penetrates wall.

3.2 Equipment Check

.1 Perform the following testing activities:

.1 Each refrigerant system to be tested as follows before operation with dry nitrogen gas to a pressure not less than 1.5 times the system working pressure. During the test, each joint to be tested for leaks with a solution of soap and water. Compressors with refrigerant holding charge to remain isolated from system.

.2 The system to be evacuated to not less than 33.25 Pa absolute and left for twenty-four (24) hours, during which time the pressure to not have increased more than 33.25 Pa. The system to then be pressurized to 14 kPa with refrigerant to be used and to be evacuated to 66.5 Pa absolute and then to be immediately fully charged with the refrigerant to be used in the system and each joint checked with an electronic testing device. Tests to be performed before insulation is applied. The refrigerant charge to be applied immediately after acceptance of tests by Professional of Record. In the event of any tube or any other component failure resulting in the loss of any part of the refrigerant charge, another charge to be applied.

.3 All damaged or defective components to be replaced with new (not reconditioned) components. A cracked or defective tube to be replaced. If a defect of any description occurs in an insulated tube, the insulation to be stripped to localize the leak. The amount of insulation so stripped to be replaced with new - to be finished as specified.

.4 Test and record voltage and running amperes and compare to motor nameplate data, and starter heater rating against design requirements.

.5 Ensure that refrigerant temperatures are accurate to within 0.5°C of design requirements.

.6 Set and adjust automatic control system to achieve required sequence of operations.

.7 Bring equipment into operation, trial run and make up any loss of oil and refrigerant.

.8 Test reports to be submitted for inclusion in Maintenance Manuals.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for high efficiency condensing gas fired boilers sized 1000 kW input or less.

1.2 Standards

.1 American Society of Mechanical Engineers (ASME):

.1 ASME Section IV – Heating Boilers.

.2 ASME CSD-1 – Controls and Safety Devices.

.2 American National Standards Institute (ANSI):

.1 ANSI Z21.13 – Gas Fired Low Pressure Boilers.

.3 National Fire Protection Association (NFPA):

.1 NFPA 64/ANSI Z221.3 – National Fuel Code.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Schematic wiring diagram of boiler control system of the ladder-type showing all components, and interlocks. Schematic wiring diagram is to clearly identify factory wiring and field wiring.

.3 The boiler, burner, and other associated mechanical and electrical equipment have been properly coordinated and integrated to provide a complete and operable boiler package.

.4 ASME Certification in the form of ASME Stamp on the product and completed and signed data sheet.

.5 ASME CSD-1 Certification, in the form of completed data sheet.

.6 The specified factory tests have been satisfactorily performed.

.7 The specified field tests have been satisfactorily performed.

1.4 Quality Assurance

.1 The equipment is to, as a minimum, be in strict compliance with the requirements of this Specification and is to be the Manufacturer's standard commercial product unless specified otherwise. Additional equipment features, details, accessories and appurtenances which are not specifically identified but which are a part of the Manufacturer's standard commercial product, is to be included in the equipment being furnished.

.2 The equipment is to be of the type, design, and size that the Manufacturer currently offers for commercial sale and appears in the Manufacturer's current catalogue. The equipment is to be new and fabricated from new materials and is to be free from defects in materials and workmanship.

.3 All units of the same classification are to be identical to the extent necessary to ensure interchangeability of parts, assemblies, accessories, and spare parts wherever possible.

2. PRODUCTS

2.1 Performance Criteria

.1 "Near condensing" copper fin designs, cast iron or "add-on" secondary condensing exchangers are not acceptable.

.2 Each unit is to be a down-fired firetube type complete with boiler fittings and automatic controls. The boiler, with all piping and wiring, is to be factory package. Each boiler is to be neatly finished, thoroughly tested and properly packaged for shipping. Boiler design and construction is to be in accordance with Section IV of the ASME Code for hot water heating boilers with a maximum working pressure of 860 kPag.

2.2 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Cleaver Brooks Model.

.2 Lochnvar.

.3 Viessman.

.4 Aerco.

.5 Or approved equivalent.

2.3 Boiler Design

.1 Boiler is to be a compact, single-pass, vertical down-fired firetube type, with stainless steel tubes, tube sheets, and combustion chamber. The boiler pressure vessel is to be completely insulated with a minimum of 50 mm of insulation and is to be encased in an heavy gauge metal cabinet with powder coated finish.

.2 Boilers containing copper, cast aluminum, or derivative allows in flue passages, Type 439 stainless steel, cast iron and carbon steel are not permitted.

.3 The vessel is to be mounted on a structural steel stand with exhaust gasses collected in a polymer drain collection box complete with drain fitting for draining condensation from the products of combustion. A condensate neutralizing box complete with limestone chips to be shipped loose for field installation. Condensate neutralizing box is to be sized for minimum of one year of operation before media change is required. A condensate trap assembly is to be furnished if a condensate collection tray is not provided due to operating conditions.

.4 The top tubesheet is to be fully accessible without burner disassembly or removal from the boiler. The burner assembly is to be complete with lifting hinges and pneumatic lifters. The boiler is to have a built in hinged platform allowing the operator to access the tubesheet, burner, ignition assembly and flame rod without the use of a ladder.

.5 The vessel is to be fully insulated with a minimum of 50 mm of insulation, guaranteeing external convection and radiation heat losses to the boiler room from the boiler is to be less than 0.5 percent of the rated input.

.6 The condensing capability is to allow the boiler to be operated without the use of a 3-way valve for the boiler supply water temperature reset. No minimum boiler return water temperature or secondary pump or minimum flow rate is to be required to protect the boiler against thermal shock or for minimum temperature water.

.7 Boiler is to be built to seismic zone requirements and Manufacturer is to provide seismic calculations showing tie-down requirements for bolt diameters. Provide bolts and tie-downs.

.8 Each boiler is to be constructed in accordance with the ASME Section IV Code and bear the “H” stamp and is to be manufactured within an ISO 9001 Certified facility to ensure high quality standards.

.9 The boiler is to be equipped with flanged supply and return water connections.

.10 The boiler is to be equipped with a second water return connection that permits low temperature returns to be utilized for condensing, regardless of the primary return temperature water above condensing conditions.

.11 A threaded air vent connection is to be furnished at the top rear of the boiler for field piping to an expansion tank or for the addition of an auto-vent valve when a bladder type expansion tank is utilized.

.12 Provide a bottom-threaded connection at the front of the boiler to drain the boiler. Field pipe with a full size manual shutoff valve to drain.

2.4 Burner Design

.1 Provide a forced draft burner mounted in and integral with the boiler hinged top door so when the door is opened the burner head, furnace, tubesheet, and tubes are exposed. The burner door is to utilize easy removable threaded handles, and the burner is to swing upward on hydraulic piston arms, one on each side to provide open support of the burner assembly.

.2 A drop down hinged service platform is to be furnished to provide service personnel an easy means of accessing the burner and controls for service and maintenance. When out of use, this platform is to fold up beneath the front service boiler panel.

.3 The burner is to be of the unitized venturi, gas valve, blower, and burner head design. This pre-mix design is to utilize a variable speed fan connected to a venturi to simultaneously modulate fuel and air for a minimum a 5:1 turndown ratio. The venturi design is to also act as a method for compensating for changes in barometric pressure, temperature and humidity so the excess air levels are not adversely affected by changes in atmospheric conditions. External linkages, damper motor drives and single speed fans are not acceptable.

.4 Burner head is to be constructed of a fecralloy-metal fiber for solid body radiation of the burner flame. Combustion is to take place on the surface of the burner mantle, which is to be constructed of a woven fecralloy material creating a 360 degree low temperature radiant flame.

.5 Provide equipment that is guaranteed to limit NOx emissions to 20 PPM or less. Test emission by a certified independent testing lab. NOx emission levels are not to be exceeded at full operating conditions and at designed turndown of the burner. Proof of such emissions certification is to be submitted to the Professional of Record and demonstrated at the time of start-up. External flue gas recirculation is to not be accepted for emission control.

.6 Gas train: As a minimum, the gas train is to meet the requirements of ASME CSD-1 and is to include:

.1 Low gas pressure Interlock, manual reset.

.2 High gas pressure Interlock, manual reset.

.3 Upstream and downstream manual test cocks.

.4 Ball type manual shutoff valve upstream of the main gas valve.

.5 Unibody double safety gas valve assembly.

.6 Gas pressure regulator.

.7 Union connection to permit burner servicing.

.7 Combustion air proving switch is to be furnished to ensure sufficient combustion airflow is present for burner ignition firing.

.8 To ensure that proper draft is not blocked in the stack, the burner is to include a high air pressure switch sensing the outlet pressure connection relative to stack back draft.

2.5 Boiler Trim

.1 Safety valve(s) are to be ASME Section IV approved side outlet type mounted on the boiler air vent outlet. Size is to be in accordance with code requirements and set to open at a suitable pressure for the hot water system.

.2 Temperature and pressure gauge is to be mounted on the water outlet.

.3 Solid state low water cut-off probe with manual reset and test switch.

.4 Manual reset high limit temperature sensor; range not to exceed 99°C and is to be an integral device of the boiler burner control and UL recognized as a limit control.

.5 Outlet water supply sensing probe for operating water limit setpoint.

.6 Return water-sensing probe for operating water limit setpoint.

2.6 Boiler Controls

.1 The boiler is to include a local controller based boiler burner control. Mount the local controller at the front of the boiler panel for easy access and viewing.

.2 The boiler controls are to communicate with the PCS and be capable of communicating boiler status and alarms.

.3 Local controller is to provide for both flame safeguard and boiler control through separate power supplied CPU's (to meet NFPA) and is to perform the following functions:

.1 Burner sequencing with safe start check, pre-purge, electronic direct spark ignition or pilot ignition and post purge. Flame rod or UV scanner to prove combustion.

.2 Flame supervision: The control is to provide pre-purge and post-purge and is to maintain a running history of operating hours, number of cycles, and the most recent six faults. The control is to be connected to a keyboard display module that retrieves this information.

.3 Safety Shutdown with display of error.

.4 Modulating control of the variable speed fan for fuel/air input relative to load requirements.

.5 Gas pressure supervision, high and low.

.6 Combustion air proving supervision.

.7 High air pressure (back draft too high) supervision.

.8 The supply temperature and set-point temperature is to be displayed at all times on the touch screen display.

.9 Controller is to be equipped with a touch screen display for set up, trouble shooting, and operational display, and is to include communication capability of this information to the PCS. Coordinate PCS protocol with the PCS Manufacturer.

.10 Include the programming of system circulating pump.

.4 All parameter input control set-points are to be factory downloaded with jobsite conditions programmed at the time of initial jobsite operation.

.5 All controls to be panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls and also located to prevent possible damage by water.

.6 Electrical power supply is to be 120 VAC, 60 cycle single phase or 208/3/60 Hz for the fan and 120 VAC for control circuit requirements.

.7 When multiple boilers are to be installed together, a system integration control is to be provided to stage up to 8 boilers. The control is to include automatic selection of needed boilers based on energy demand, an adjustable outdoor reset schedule, domestic hot water priority, and a system digital display. The control is to force each boiler to a lower fire, before allowing any boiler to operate at high fire. This allows for inverse efficiency (lower fire rate, higher efficiency). The control is to monitor supply water temperature, return water temperature and is to communicate between boilers.

2.7 Controller Communication

.1 The communication protocol to be used for communication with the PCS is Ethernet IP.

.2 PCS interface to provide monitoring of all key operational functions and statuses as well as alarms, faults and historical data including but not limited to:

- .1 Status.
- .2 Boiler temperatures.
- .3 Boiler pressures.
- .4 Water levels.
- .5 Burner management:
  - .1 Firing rate.
  - .2 On / off points.
- .6 Data as required by the PCS to generate hourly, daily, monthly and annual reports on:
  - .1 Fuel consumption.
  - .2 Runtime per fuel per boiler.
  - .3 Alarm and fault history.

2.8 Boiler Flue Venting

.1 Provide a boiler that is UL certified as an indirect or direct vent boiler. Refer to Manufacturer's venting requirements and recommendations and Section 15860 – Breeching and Chimneys.

.2 Combustion air supply is to be by means of a direct vent to outdoors and is to provide sealed combustion. Refer to Manufacturer's recommendations for combustions air venting.

2.9 Extended Warranty

.1 In addition to the Warranties requirements as set out in the DBA, provide the following extended warranties from Final Completion:

.1 A twenty (20) year warranty for pressure vessels against thermal shock when utilized in a closed loop hydronic heating system with a temperature differential of 49°C or less. The boiler pressure vessel is to be guaranteed accordingly without a minimum flow rate or return water temperature requirement. The boiler is to not require the use of flow switches or other devices to ensure minimum flow.

.2 A ten (10) year warranty for the pressure vessel, tubes and tube sheets (heat exchanger) against flue gas corrosion and materials/workmanship.

.3 A twenty (20) year warranty for the condensate collection box.

.4 A five (5) year warranty for the burner cylinder.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.1 General: The boiler supplier's factory authorized service organization is to be responsible for performance of inspections, start up and testing of the package boiler, and accessory equipment and materials furnished under this section. A detailed written record of the start-up performance, including burner setting data over the entire load range is to be furnished to the Professional of Record.

.2 Readings at different firing rates (20, 50, 75 and 100 percent) of load for the modulating burner are to be taken with a written report of the tests submitted to Professional of Record. The reports are to include readings for each firing rate tested and include stack temperatures, O_2, CO, NOx, and overall boiler efficiency.

.3 Auxiliary Equipment and Accessories: Observe and check all valves, draft fans, electric motors and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctioning, defects, and non-compliance with referenced standards or overloading as applicable.

.3 Complete the following activities:

.1 Fireside inspection.

.2 Set up fuel train and combustion air system.

.3 Set up operating set points.

.4 Check all safeties, including flame safeguard, LWCO, Airflow, Fuel pressures, High limits.

.5 Set up and verify efficiencies at 20, 50, 75, and 100 percent.

.6 Set up and verify burner turndown.

.4 Confirm boiler operation meets all temperature demands during all design conditions.

.5 Demonstrate operation of emergency stop button.

.6 Demonstrate that communication between the boiler and the PCS meets the requirements of the Design and Construction Specifications and the Final Design.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies high efficiency condensing gas fired boilers sized larger than 1000 kW input.

1.2 References

.1 American Society of Mechanical Engineers (ASME):

  .1 ASME Section IV – Heating Boilers.

  .2 ASME CSD-1 – Controls and Safety Devices.

.2 American National Standards Institute (ANSI):

  .1 ANSI Z21.13 – Gas Fired Low Pressure Boilers.

.3 National Fire Protection Association (NFPA):

  .1 NFPA 64/ANSI Z221.3 – National Fuel Code.

.4 FM – Factory Mutual.

.5 Underwriters Laboratories UL or CSA Standards for Gas Fired Boilers.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

.2 Shop Drawings to include:

  .1 Schematic wiring diagram of boiler control system of the ladder-type showing all components, interlocks, etc. Schematic wiring diagram to clearly identify factory wiring and field wiring by others.

.3 The boiler, burner, and other associated mechanical and electrical equipment have been properly coordinated and integrated to provide a complete and operable boiler package.

.4 ASME Certification in the form of ASME Stamp on the product and completed and signed data sheet.

.5 ASME CSD-1 Certification, in the form of completed data sheet.

.6 CSA or UL Certification in the form of an affixed label to the equipment.

.7 The specified factory tests have been satisfactorily performed.

.8 The specified field tests have been satisfactorily performed.

2. PRODUCTS

2.1 Performance Criteria

.1 Each boiler is to be a single pass, large mass firetube type complete with factory fabrication and assembly of burner, boiler, fittings, and automatic controls. The boiler, with all piping and wiring, to be a complete factory integrated package. Each boiler to be neatly finished, safety and fire tested, and properly packaged for shipping.

.2 The entire boiler design and construction is to be in accordance with Section IV of the ASME Code for hot water heating boilers with a maximum operating temperature of 121°C (250°F) and maximum working pressure of 1103 kPa (160 PSIG). The boiler is to be cUL certified as an indirect or direct vent boiler and comply with ASME CSD-1 Code requirements.

2.2 Manufacturers

.1 Furnish and install full condensing boilers.

.2 "Near condensing" copper fin designs, cast iron or "add-on" secondary condensing exchangers will not be considered.

.3 Manufacturers: Standards of acceptance are listed below.

.1 Cleaver Brooks.

.2 Aerco.

.3 Fulton.

.4 Viessman.

.5 Or approved equivalent.

2.3 Boiler Design

.1 Provide large mass, low pressure drop, firetube boiler design with extended heating surfaces and water-backed furnace, suitable for primary flow or primary-secondary piping arrangements. Condensing section consists of UNS S32101 Duplex stainless steel AluFer firetubes and tube sheets, along with stainless steel flue gas-condensate collection chamber. The design to be true counter-flow arrangement for maximum condensing and heat transfer effectiveness.

.2 Boiler to be suitable for variable flow primary pumping systems without the need for a dedicated boiler circulating pump.

.3 Vessel to be mounted on a structural steel base with exhaust gases and condensate collected in a SS flue-gas/condensate chamber complete with drain trap and connection provisions for draining condensation from the products of combustion. A condensate neutralizing box complete with neutralization media to be shipped loose for field installation.

Condensate neutralizing box to be sized for minimum of one year of operation before media change is required. Note: A minimum 150 mm condensate drain trap to be piped at installation if a condensate collection box is not provided.

.4 Vessel to be fully insulated with a minimum of 50 mm of insulation, guaranteeing external convection and radiation heat losses to the boiler room from the boiler to be less than 0.25 percent of the rated capacity.

.5 Boiler pressure vessel to be completely factory cased and insulated with a minimum of 50 mm of insulation and to be encased in an 18 gauge metal cabinet with powder coated finish.

.6 The furnace and firetubes to be fully accessible without burner disassembly or removal from the boiler. The burner assembly to be complete with davit arm and hinges for serviceability.

.7 Boiler to be designed to operate in condensing mode at all firing rates in order to extract the latent heat from the combustion products of natural gas. Boiler to have an inverse efficiency characteristic: lower the firing rate, the higher the efficiency. With a return water temperature of 26.7 °C, the boiler to have a minimum acceptable fuel-to-water efficiency of 93 percent and up to 99 percent at minimum firing capacity.

.8 With a return temperature of 60°C, the boiler to have a minimum acceptable fuel-to-water efficiency of 88%. Boiler is not to have minimum return temperature limit for the boiler.

.9 Each boiler to be constructed in accordance with the A.S.M.E. Section IV Code and bear the "H" stamp and be manufactured within an ISO 9001 Certified facility to ensure high quality standards.

.10 Boiler to be equipped with flanged supply and return water connections.

.11 The maximum pressure drop through the boiler is not to exceed 3.4 Pa with an 11.1°C differential and less than 0.7 Pa with a 33.3°C differential.

.12 Boiler to be equipped with a second water return connection that will permit low temperature returns to be utilized for condensing, regardless of the primary return temperature water above condensing conditions.

.13 A threaded air vent connection to be furnished at the top of the boiler for field piping to an expansion tank, air separator, or for the addition of an auto-vent valve when a bladder type expansion tank is utilized.

.14 Provide bottom-threaded connection to drain the boiler at the rear of the boiler and field piped with a manual full size shutoff valve to drain.

2.4 Burner Design

.1 General: Forced draft, gas-fired premix surface combustion burner mounted in and integral with the boiler. A hinged swing-out burner assembly is provided for ease of service and inspection of burner, as well as the fireside of heat exchanger.

.2 Burner to be of the gas-fired premix surface combustion design for ultra-low emissions. Combustion control to be zero-governor Venturi-Gas Valve system with premixing of fuel and air in the combustion air blower.

.3 The pre-mix design to utilize a PID loop controlled modulating variable speed fan connected to a venturi to simultaneously modulate fuel and air for a minimum 5:1 turndown ratio. Exclusively variable speed blower-venturi modulation delivers a linear modulation characteristic for precise set point control and minimum cycling. External linkages, damper motor drives, and single speed fans are not permitted. Staged and/or stepped modulation at any point in the modulation range are not permitted.

.4 Burner head to be constructed of a stainless steel alloy metal fiber for solid body radiation of the burner flame. Combustion to take place on the surface of the burner mantle, which is to be constructed of a woven stainless steel alloy material creating a 360 degree low temperature radiant flame.

.5 Emissions: Guaranteed NOx emissions to 20 PPM or less. External flue gas recirculation is not permitted for emission control.

.6 The combustion air delivery system to be of spark resistant construction and suitable for handling a mix of fuel and air.

.7 Burner to include a variable speed motor drive control driven by PID modulation signal from boiler control with UL Recognized limit functions.

.8 Gas Train - As a minimum, the gas train to meet the requirements of cUL and ASME CSD-1 and include:

.1 Low Gas Pressure Interlock, manual reset.

.2 High Gas Pressure Interlock, manual reset.

.3 Upstream and downstream manual test cocks.

.4 Ball Type manual shutoff valve upstream and downstream of the main safety shut-off gas valve(s).

.5 Unibody, motorized double safety gas valve-regulator combination or motorized single safety gas valve-regulator combination with proof-of-closure.

.6 Gas Pressure Regulator as required for job site conditions.

.7 Pilot gas train with pilot regulator and solenoid safety shut-off valve.

.8 Union connection to permit burner servicing.

.9 Combustion air proving switch so be furnished to ensure sufficient combustion airflow is present for burner ignition firing.

.10 Burner to have provision for safe operation and/or shut down in the case of a blocked flue or blocked condensate situation.

2.5 Boiler Trim

.1 Safety valve(s) to be ASME Section IV approved side outlet type mounted on the boiler air vent outlet. Size in accordance with code requirements and set to open at a suitable pressure for the particular hot water system.

.2 Temperature and pressure gauges to be mounted on the water outlet.

.3 Solid State Low water cut-off probe with manual reset and test switch.

.4 Manual Reset High Limit Temperature sensor; range not to exceed 121.1°C and to be an integral device of the Boiler Burner Control and UL recognized as a limit control.

.5 Outlet water supply temperature sensing probe for modulation and operating water limit setpoint.

.6 Return temperature water-sensing probe for operating water limit setpoint and enhanced control functionality.

2.6 Boiler Controls

.1 Boiler to include a Computerized Boiler-Burner- System control which is to be an integrated, solid state digital micro-processing modulating device, complete with sequence indication, fault reset, mode selection, and parameterized set- points. Mount at the front of the boiler panel for easy access and viewing.

.2 The boiler controls are to communicate with the PCS and be capable of communicating boiler status and alarms.

.3 Controller to provide for both flame safety and boiler control through separate power supplied CPU's (to meet NFPA) and perform the following functions:

   .1 Burner sequencing with safe start check, pre-ignition interlock, pre-purge, electronic gas pilot ignition with UV flame sensing to prove combustion.

   .2 Flame and Running Interlock Supervision. The control is to provide pre-purge and post-purge and maintain a running history of operating hours, number of cycles, and the most recent 15 lockouts. Each lockout message in history to include boiler sequence status and multi-point diagnostic details at time of lockout, including First Out Annunciation of Running Interlock lockout.

   .3 Control to be connected to a color touchscreen display interface that will retrieve lockout history information and allow for user and service access to all diagnostic information.

   .4 Safety Shutdown with display of lockout and Soft Shutdown of any non-safety related disabling of boiler operation.

   .5 PID Modulating control of the variable speed fan for fuel/air input relative to load requirements.

.6 Gas pressure supervision, high and low.

.7 Combustion Air Proving Supervision.

.8 High Air Pressure (blocked flue or blocked condensate drain) Supervision.

.9 Display supply temperature, return temperature, and set-point temperature at all times on the boiler overview of the touch screen display.

.10 Include the control of system circulating pump, isolation valve, start permissive interlock, boiler primary pump, DHW pump, and provide the control of multiple heating loops.

.11 Controller is to be equipped with a touch screen display for set up, trouble shooting, and operational display, and is to include communication capability of this information to interface with the PCS.

.4 All boiler parameter input control set-points to be factory configured with starting conditions programmed at the time of initial operation.

.5 All controls to be panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls and also located to prevent possible damage by water according to CSA requirements.

.6 When multiple boilers are to be installed together, a system integration control is to be provided to stage up to eight (8) boilers. The control is to include automatic selection of needed boilers based on energy demand, an adjustable outdoor reset schedule, domestic hot water priority, and a system digital display. The control is to force each boiler to a lower fire, before allowing any boiler to operate at high fire. This allows for inverse efficiency (lower fire rate, higher efficiency). The control is to monitor supply water temperature, return water temperature and is to communicate between boilers.

2.7 Controller Communication

.1 The communication protocol to be used for communication with the PCS is Ethernet IP.

.2 PCS interface to provide monitoring of all key operational functions and statuses as well as alarms, faults and historical data including but not limited to:

.1 Status.

.2 Boiler temperatures.

.3 Boiler pressures.

.4 Water levels.

.5 Burner management:

.1 Firing rate.

.2 On / off points.

.6 Data as required by the PCS to generate hourly, daily, monthly and annual reports on:

.1 Fuel consumption.

.2 Runtime per fuel per boiler.

.3 Alarm and fault history.

2.8 Boiler Flue Venting

.1 Provide a boiler that is UL certified as an indirect or direct vent boiler. Refer to Manufacturer's venting requirements and recommendations and Section 15860.

.2 Combustion air supply is to be by means of a direct vent to outdoors and is to provide sealed combustion. Refer to Manufacturer's recommendations for combustions air venting.

2.9 Extended Warranty

.1 In addition to the Warranties requirements as set out in the DBA, provide the following extended warranties from Substantial Completion:

.1 A twenty (20) year warranty for pressure vessels against thermal shock when utilized in a closed loop hydronic heating system with a temperature differential of 49°C or less. The boiler pressure vessel is to be guaranteed accordingly without a minimum flow rate or return water temperature requirement. The boiler is to not require the use of flow switches or other devices to ensure minimum flow.

.2 A ten (10) year warranty for the pressure vessel, tubes and tube sheets (heat exchanger) against flue gas corrosion and materials/workmanship.

.3 A twenty (20) year warranty for the condensate collection box.

.4 A five (5) year warranty for the burner cylinder.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 General: The boiler supplier's factory authorized service organization is to be responsible for performance of inspections, start up and testing of the package boiler, and accessory equipment and materials furnished under this section. A detailed written record of the start-up performance, including burner setting data over the entire load range is to be furnished to the Professional of Record before final acceptance. All labour, equipment, and test apparatus are to be furnished by the authorized service organization. All equipment Defects discovered by the tests are to be rectified either by the service organization or boiler Manufacturer.

.4 Equipment inspection: Boiler representative to provide jobsite assistance to inspect boilers and other equipment upon arrival, verifying completeness of equipment supplied and potential damages.

.5 Readings at different firing rates (20, 50, 75 and 100 percent) of load for the modulating burner are to be taken with a written report of the tests submitted to Professional of Record. The reports are to include readings for each firing rate tested and include stack temperatures, O2, CO, NOx, and overall boiler efficiency.

.6 Auxiliary Equipment and Accessories: Observe and check all valves, draft fans, electric motors and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctioning, defects, and non-compliance with referenced standards or overloading as applicable.

.7 Complete the following activities:

  .1 Fireside inspection.

  .2 Set up fuel train and combustion air system.

  .3 Set up operating set points.

  .4 Check all safeties, including flame safeguard, LWCO, Airflow, Fuel pressures, High limits.

  .5 Set up and verify efficiencies at 20, 50, 75, and 100 percent.

  .6 Set up and verify burner turndown.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies materials, installation and testing of water coils for HVAC service.

1.2 Standards

.1 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

  .1 AHRI 410 – Standard for Forced-Circulation Air-Heating and Air-Cooling Coils.

.2 American Society for Testing and Materials (ASTM):

  .1 ASTM A480/A480M – Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

  .2 ASTM B75/B75M – Standard Specification for Seamless Copper Tube.

  .3 ASTM B117 - Standard Practice for Operating Salt Spray Apparatus.

1.3 Definitions

.1 Fouling Factor: A mathematical characterization of the performance lost due to corrosion, scale build-up, and debris built up in the coil.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

  .2 Computer selection sheet indicating performance including hot and cold side entering and leaving fluid/air conditions, flows, pressure drops, square feet of heating surface, fouling factor, and heat transfer surface dimensions and configuration.

  .3 Performance will reflect the heating medium used, water or glycol.

1.5 Quality Assurance

.1 Certifications: Coil capacity certified in accordance with AHRI 410.

2. PRODUCTS

2.1 Design Criteria

.1 Design Requirements:

  .1 General: Coils to be AHRI certified. Extended surface type consisting of copper tubing mechanically expanded to bond with plate fins. Design for serpentine flow with one or more feeds from common supply and return headers. Arrange for counter flow operation with supply connections at the bottom.

.2 Factory Testing: Leak test coils under water at 2100 kPa minimum.

.3 Working Pressure: 1050 kPa.

2.2 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Pace.

.2 Trane.

.3 McQuay.

.4 Colmac.

.5 Engineered Air.

.6 USA Coil.

.7 Temtrol.

.8 Or approved equivalent.

2.3 Materials

Component	**Material**
Tubing	ASTM B75/B75M, Seamless Copper
Headers	ASTM B75/B75M, Seamless Copper
Casing	ASTM A480 Type 316, Stainless Steel, 16 gauge

.1 Fabrication:

.1 Fins: copper die formed plates. Continuous within the coil casing.

.2 Headers: Brazed to heat transfer tubes. Provide high point air vent fitting and low point drain fitting.

.3 Connections: Same end for supply and return unless noted otherwise.

.4 Intermediate Supports: Provide for coils with finned length greater than 1120 mm, with maximum spacing of 1067 mm.

2.4 Finishes

.1 Corrosion Protection: Baked on phenolic coating suitable for three thousand (3000) hours salt spray per ASTM-B117.

.1 Acceptable Products:

.1 Heresite P413.

.2 Or approved equivalent.

2.5 Extended Warranty

.1 In addition to the Warranties requirements as part of the DBA, provide the following:

.1 A five (5) year unconditional warranty for HVAC service water coils against defects in materials and workmanship from Substantial Completion.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Comb damaged and bent fins.

.4 Install coils to drain in accordance with Manufacturer's recommendations.

.5 Install filters upstream of supply and exhaust air handler coils prior to fan operation.

.6 For duct mounted water coils, provide freeze-stat low temperature switch.

.7 Coils exposed to outside airflow will use 50 percent propylene glycol.

.8 Corrosion protection requirements will include but not be limited to all classified and Category 2 areas.

END OF SECTION

DIRECT EXPANSION COILS

1. GENERAL

1.1 Summary

.1 This Section specifies materials, installation and testing of Direct Expansion Coils for HVAC service. The equipment specified in this section is part of packaged systems and is to be included in the unit responsibility with the matching air handlers.

1.2 Standards

.1 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

.1 !pîu410 – Standard for Forced-Circulation Air-Heating and Air-Cooling Coils.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A480/A480M – Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

.2 ASTM B75/B75M – Standard Specification for Seamless Copper Tube.

.3 ASTM B117 - Standard Practice for Operating Salt Spray Apparatus.

.3 American National Standards Institute (ANSI)/ American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 ANSI/ASHRAE 15 - Safety Standard for Refrigeration Systems.

1.3 Definitions

.1 Fouling Factor: A mathematical characterization of the performance lost due to corrosion, scale build-up, and debris built up in the coil.

.2 DX: Direct Expansion.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Computer selection sheet indicating performance including hot and cold side entering and leaving fluid/air conditions, flows, pressure drops, square feet of heating surface, fouling factor, and heat transfer surface dimensions and configuration.

1.5 Quality Assurance

.1 Certifications: Coil capacity certified in accordance with ARI 410, latest edition.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Engineered Air.

.2 Trane.

.3 McQuay.

.4 Carrier.

.5 Colmac.

.6 Or approved equivalent.

2.2 Construction

.1 General:

.1 Extended surface type consisting of copper tubing mechanically expanded to bond with plate fins. Design for serpentine flow with one or more feeds from common supply and return headers.

.2 Factory Testing: Leak test coils under water at 4200 kPa minimum.

.3 Working Pressure: 2100 kPa.

2.3 Materials

Component	Material
Tubing	ASTM B75/B75M, Seamless Copper
Fins	Aluminum or copper
Headers	ASTM B75/B75M, Seamless Copper
Casing	ASTM A480 Type 316, Stainless Steel, 16 gauge

2.4 Fabrication

.1 Fins: die formed plates, continuous within the coil casing.

.2 Headers: Brazed to heat transfer tubes. Refrigeration distributers for even loading to circuits.

.3 DX coils are to be provided with pressure-type brass distributors with solder-type connections. Coils are to be designed and tested in accordance with ANSI/ASHRAE 15.

.4 Intermediate Supports: Provide for coils with finned length greater than 1120 mm, with maximum spacing of 1067 mm.

2.5 Finishes

.1 Corrosion Protection: Baked on phenolic coating suitable for 3000 hours salt spray per ASTM-B117.

.1 Acceptable Product:

.1 Heresite P413.

.2 Or approved equivalent.

2.6 Extended Warranty

.1 In addition to the Warranties requirements as part of the DBA, provide the following from Substantial Completion:

.1 A five (5) year unconditional warranty on DX coils for HVAC service against defects in materials and workmanship.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Comb damaged and bent fins.

.4 Coils with damaged corrosion protection coatings will be replaced.

.5 Install coils to drain in accordance with Manufacturer's recommendations.

.6 Install filters upstream of supply and exhaust air handler coils prior to fan operation.

.7 Pipe drain connections to floor drain.

.8 For duct mounted cooling coils, provide drain pan.

END OF SECTION

PACKAGED HEATING AND COOLING UNITS

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for product selection, installation and testing of HVAC packaged heating and cooling units.

  .1 Packaged heating and cooling units used in split system air conditioning systems.

1.2 Standards

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

  .1 AMCA 99, Standard Handbook.

  .2 AMCA 210, Laboratory Methods of Testing Fans for Rating Purposes.

  .3 AMCA 300, Reverberant Room Methods for Sound Testing of Fans.

  .4 AMCA 301, Method of Calculating Fan Sound Ratings from Laboratory Test Data.

  .5 AMCA 99-2408: Operating Limits for Centrifugal Fans.

.2 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

  .1 AHRI 260, Sound Rating of Ducted Air Moving and Conditioning Equipment.

  .2 AHRI 270, Sound Performance Rating of Outdoor Unitary Equipment.

  .3 AHRI 410, Standard for Forced Circulation Air-Cooling and Air-Heating Coils.

  .4 AHRI 430, Performance Rating of Central Station Air-Handling Units.

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

  .1 ASHRAE 33, Methods of Testing Forced-Circulation Air-Cooling and Air-Heating Coils.

  .2 ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

  .3 ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.

  .4 ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

  .5 ASHRAE 111, Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

.4 American Society for Testing and Materials (ASTM):

.1 ASTM A36, Standard Specification for Carbon Structural Steel.

.2 ASTM A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A568, Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.

.4 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM B88, Standard Specification for Seamless Copper Water Tube.

.6 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

.7 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.8 ASTM C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.9 ASTM D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

.10 ASTM D3359, Standard Test Methods for Rating Adhesion by Tape Test.

.11 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 City of Winnipeg:

.1 Winnipeg Sewage Treatment Program (WSTP) Building Mechanical Design Guideline.

.6 National Fire Protection Association (NFPA):

.1 NFPA 70, National Electrical Code.

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

.3 NFPA 90B, Standard for Installation of Warm Air Heating and Air Conditioning Systems.

.7 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG 1, Motors and Generators.

.8 Underwriters Laboratories of Canada (ULC):

.1 UL 181, Standard for Safety Factory-Made Air Ducts and Connectors.

.2 UL 705, Power Ventilators.

.3 UL 1995, Standard for Safety Heating and Cooling Equipment.

.9 Manitoba Workplace Safety and Health Act (WSHA).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

.2 Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

.3 Include unit dimensions and weight.

.4 Include cabinet material, metal thickness, finishes, insulation, and accessories.

.5 Fans:

.1 Include certified fan-performance curves with system operating conditions indicated.

.2 Include certified fan-sound power ratings.

.3 Include fan construction and accessories.

.4 Include motor ratings, electrical characteristics, and motor accessories.

.6 Include certified coil-performance ratings with system operating conditions indicated.

.7 Include filters with performance characteristics.

.8 Include dampers, including housings, linkages, and operators.

.9 Submit certified sound power levels for unit inlet and outlet and casing radiation at rated capacity in accordance with AMCA.

.10 Control descriptions for internal equipment control and interface with PCS.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Engineered Air.

.2 Daikin.

.3 Carrier.

.4 Trane.

.5 Price.

.6 Nortek Air Solutions.

.7 Haakon.

.8 Or approved equivalent.

2.2 Performance Criteria

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

.3 ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

.4 ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

.5 Structural Performance: Casing panels shall be self-supporting and capable of withstanding positive/negative 10-inch wg of internal static pressure, without exceeding a midpoint deflection of 0.0042 inch/inch of panel span.

.6 Casing Leakage Performance: ASHRAE 111, Class 6 leakage or better at +/- 8 inch wg.

2.3 Construction

.1 Cabinet:

.1 Frame:

.1 Modular and providing overall structural integrity without reliance on casing panels for structural support.

.2 Walls, Ceilings, and Base:

.1 Double-wall construction.

.2 Outside Casing Wall:

.1 Standard Material, Galvanized Steel: Minimum 18 gauge thick.

.2 Alternate Material, Aluminum: Minimum 16 gauge thick when required.

.3 Alternate Material, Stainless Steel: Minimum 18 gauge thick when required.

.3 Inside Casing Wall:

.1 Standard Material, Solid galvanized Steel: Minimum 18 gauge thick.

.2 Alternate Material, Solid aluminum: Minimum 16 gauge thick when required.

.3 Alternate Material, Solid stainless Steel: Minimum 18 gauge thick when required.

.4 Interlocking formed construction with at least two breaks at each interlocking joint. Wall and ceiling joints shall be broken outward. All panel joints shall be hermetically sealed at each corner and around entire perimeter.

.5 Roof shall be pitched slightly (minimum 2 percent) to prevent water pooling.

.6 The casing depth shall match the specified insulation thickness.

.7 Inside surfaces shall be clean and flush, free of exposed flanges.

.8 Provide min. 25 mm x 25 mm drip channels over all access doors.

.9 Floor structure shall be constructed from structural galvanized steel channel iron around perimeter with intermediate channel and angle iron supports. Floor plate shall be 2.0 mm satin coat galvanized steel.

.10 Provide floor bracing channels at maximum 300 mm on centre.

.3 Exterior Panels:

.1 Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.

.2 Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow.

.3 Gasket: Neoprene, applied around entire perimeters of panel frames.

.4 Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components.

.5 Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer.

.6 Exterior finish coat shall be electrostatically applied enamel, to all exposed surfaces custom colour finish, Colour to be confirmed.

.7 Interior surfaces and unit underside are to be coated in a two-part 0.1524 mm epoxy finish.

.8 All unprotected metal and welds shall be factory coated.

.4 Doors:

.1 Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing complete with viewing window.

.2 Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.

.3 Gasket: Neoprene, applied around entire perimeters of panel frames.

.4 Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 72 inches.

.5 Locations and Applications:

.1 Fan Section: Doors, with windows.

.2 Coil Section: Panels.

.3 Access Sections Immediately Upstream and Downstream of Coil Sections: Doors, with windows.

.4 Damper Section: Doors, with viewing windows.

.5 Filter Section: Doors large enough to allow periodic removal and installation of filters.

.6 Access Sections Immediately Upstream and Downstream of Filter Sections: Doors, with windows.

.7 Mixing Section: Doors, with windows.

.5 Windows:

.1 Construction: Fabricate windows in access panels and doors of double-glazed, safety glass with an airspace between panes and sealed with interior and exterior rubber seals.

.2 Size: Minimum 8 inches, square or round.

.6 Service Lights: 100 Watt equivalent LED vaporproof luminaire with individual switched junction box located outside, adjacent to each access door and panel.

.1 Locations: Each section accessed with door or panel.

.7 Convenience Outlets: One 20-A duplex GFCI receptacle per location with junction box located on outside casing wall.

.8 Condensate Drain Pans:

.1 Single-wall, dual sloped, stainless-steel sheet.

.2 Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

.3 Slope: Slope is to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends and to direct water toward drain connection.

.4 Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.

.5 Width: Entire width of water producing device.

.6 Depth: A minimum of 2 inches deep.

.7 Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

.9 Insulation and Liner:

.1 Insulate all exterior walls and roof with 50 mm (100 mm for exterior applications) thick injected polyurethane foam insulation. Line interior of all panels with 0.71 mm galvanized steel liner.

.2 Insulate underside of unit floor with 50 mm (100 mm for exterior applications) thick injected polyurethane foam insulation.

.3 Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

.10 Outdoor Air Hood (exterior applications):

.1 Hood to be furnished from the same material as the exterior walls of the unit. Finish to match unit. Provide 25 mm x 25 mm galvanized mesh over unit opening.

.2 Fan:

.1 Belt drive:

.1 Provide variable sheaves for motors 11 kW and under and fixed sheaves for motors 15 kW and over.

.2 A WSHA compliant belt guard shall be included to completely cover the sheaves and belt assembly.

.2 Direct drive:

.1 Integral speed control for air balancing.

.3 Fans to be double width forward curved centrifugal type. Fan to be both statically and dynamically balanced.

.4 Fan total static pressure will be based on a filter dirty condition of 135 Pa.

.5 Mount fans on common steel shaft, on L50 - 200,000 hours self-aligning, single row, deep groove ball bearings in a pillow block cast iron housing. Provide extended lube lines to outside of casing.

.6 Entire fan assembly including fan scroll, wheel and motor to be integrally mounted on a unitary fan and motor base and to be separated from unit casing with flexible connections and spring isolators.

.3 Motor:

.1 Motor to be Premium Efficient motors as defined in NEMA MG 1 for inverter duty.

.2 Enclosure Type: Totally enclosed, fan cooled.

.3 Provide full voltage non-reversing motor starters.

.4 Mount unit-mounted disconnect switches on exterior of unit.

.4 Heating Section:

.1 Heating source (hydronic, gas-fired, electric) to be in accordance with Section 3.4.2 of the WSTP Building Mechanical Design Guideline.

.2 Hydronic coil:

.1 Reference Section 15750 for requirements.

.3 Indirect Gas Fired Heat Exchanger (if allowed per City of Winnipeg Sewage Treatment Program Building Mechanical Design Guide):

.1 General:

.1 Heating units to be indirect natural gas fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories to be approved by an independent testing authority, and carry the approval label of that authority as a complete operating package.

.2 All units to exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire.

.3 Operating natural gas pressure at unit(s) manifold to be 1.75 to 3.50 kPa.

.4 Gas manifolds to be provided to FM standards.

.5 Gas fired units to be approved for operation in minus 20°C spaces.

.2 Heat Exchanger:

.1 Heat exchanger to be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane turbulators and to be of a floating stress relieved design. Heat exchanger to be provided with condensate drain connection. The heat exchanger casing is to have 25 mm of insulation between the outer cabinet and inner liner. Blower assemblies close coupled to duct furnace type heat exchangers are not permitted.

.2 Heat exchangers to be tested and certified to CSA standards to provide a minimum ETL certified 90 percent efficiency throughout the entire operating range.

.3 Burner:

.1 The burner assembly to be a blow through positive pressure type with an intermittent pilot ignition system to provide a high seasonal efficiency. Flame surveillance to be with a solid state programmed flame relay complete with flame rod. The burner and gas train to be located inside a cabinet enclosure. Insulation in the burner section to be covered by a heat reflective galvanized steel liner. Atmospheric burners or burners requiring power assisted venting are not permitted.

.2 Provide discharge air temperature control with 15:1 turndown capability for all input capacities in range from 29.3 kW to 410 kW. The high turndown burner minimum input to be capable of controlling at 6.7 percent of its rated input without on-off cycling and include built in electronic linearization of fuel and combustion air. Efficiency is to increase from high to low fire.

.4 Venting:

.1 Installation and venting provisions to be in accordance with CGA Standard B149.1, ANSI Z223.1-NFPA54, and local authorities have jurisdiction. Type A, L, and/or PS venting is required.

.5 Burner Controls:

.1 The gas fired heating controller to be a fuel/combustion air local controller. The controller is to incorporate a solid state analyzer complete with proportional and integral control and with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions.

.2 Combustion efficiency of high efficiency heat exchangers is to increase 4 to 5 percent from high fire to low fire. Heat exchangers are to provide a minimum of 90 percent efficiency throughout the entire operating range.

.3 As an alternative to variable speed combustion air blower, the burner control may include a modulating gas valve and a combustion air damper with a linear linkage connected to an actuator which has a minimum of 100 steps of control.

.6 Burner controls are to include the following standard features:

.1 Linear gas and combustion air flow obtained via a built-in solid state linear algorithm.

.2 Minimum operating ambient temperature: minus 40°C.

.3 Four (4) air change pre-purge on units with over 117 kW input.

.4 Post purge.

.5 Interrupted pilot.

.6 Self-check on start-up to make sure air proving and discharge air sensors are operating within design tolerances.

.7 Low fire start.

.8 Controlled burner start-up and shut down.

.9 Diagnostic lights for ease of set-up and service.

.10 Blower contactor that starts fan after burner pre-purge.

.11 Damper contact that allows fan to start after damper opens, damper to close after fan stops and damper to close on flame failure.

.12 Non-recycling auto by-pass low limit that has built-in sensor checking.

.7 Burner controller to modulate heating output to maintain supply air temperature setpoint. Refer to Sections 15910 and 15920 for control system requirements.

.8 Condensate Neutralization Tank:

.1 Condensate neutralization tank to include of a 20 L tank made from one-piece seamless polyethylene construction with 125 mm media fill/access opening, 40 mm FIP inlets on the top and the side, 40 FIP side outlet, and 40 mm FIP top vent.

.2 Acceptable Product:

.1 Axiom Industries Ltd. - Model NT20.

.2 Or approved equivalent.

.3 Supply complete with initial charge of neutralizing media.

.9 Condensate Pump:

.1 Provide a fully automatic condensate removal pump rated for the removal of acidic condensate with 1.9 L capacity tank manufactured from acrylonitrile butadiene styrene (ABS), a vertical-type pump with stainless steel motor shaft, high-impact ABS volute and motor cover, 3 drain holes, removable 10 mm O.D. barbed check valve. The motor to be thermally protected and cUL and CSA listed. Provide an overflow safety switch for connection to the PCS.

.2 Acceptable Product:

.1 Little Giant VCMA-20 Series.

.2 Or approved equivalent.

.4 Electric-Resistance Heating Coils (if allowed per City of Winnipeg Sewage Treatment Program Building Mechanical Design Guide):

.1 Casing Assembly: Galvanized-steel frame.

.2 Removable for replacement or service without further disassembly of the air handler.

.3 Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.

.4 Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.

.5 Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

.6 Control Panel: Unit mounted with disconnecting means and overcurrent protection.

.1 Full modulation capacity controlled by SCR.

.2 0-10 VDC heating control signal.

.3 Airflow proving switch.

.5 Cooling Coil:

.1 Refer to Section 15752.

.6 Hot Gas Bypass Coil (humidity control applications):

.1 Construction: Refer to Section 15752.

.2 Installed downstream of cooling coil.

.7 Filters:

.1 Replaceable.

.2 Summer and winter positions.

.3 Reference Section 15855 for filter performance and construction criteria.

.4 Provide one (1) Dwyer 2000 magnehelic (or approved equivalent) filter gauge for each bank of filters. Gauge shall in SI units or dual scale. Select gauge so that normal operating pressures are approximately at the scale midpoint. Flush mount gauge on the exterior of the unit. Gauge shall be suitable for outdoor operation.

.8 Mixing Section:

.1 Configure to ensure complete mix of air. Arrange dampers to direct the air flow from set of blades into the other.

.2 Utilize damper sections which extend across unit width plane with maximum width not exceeding 1,200 mm per section.

.9 Dampers:

.1 Extruded aluminum (6063T5) damper frame shall not be less than 2.03 mm in thickness.

.2 Damper frame to be 100 mm deep and shall be insulated with polystyrofoam on four sides.

.3 Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.

.4 Blades to be extruded aluminum (6063T5) profiles, internally insulated with expanded polyurethane foam and shall be thermally broken.

.5 Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.

.6 Blade and frame seals shall be of extruded silicone and be secured in an integral slot within the aluminum extrusions.

.7 Bearings are to be composed of a Celcon inner bearing fixed to 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame.

.8 Linkage hardware shall be installed in the frame side.

.9 Dampers are to be designed for operation in temperatures ranging between minus 40°C and 85°C.

.10 Dampers shall be available with either opposed blade action or parallel blade action.

.11 Damper leakage shall be certified under the AMCA certified rating program and shall carry AMCA seal.

.12 The air dampers shall be integral part of the air handling units and shall be supplied and installed by the Manufacturer at the factory.

.13 Electronic Non-Modulating Damper Operators:

.1 Spring return, 24 VAC operating voltage, on-off operation, 70 seconds maximum running time for 90 degree opening and 30 seconds maximum closing time.

.2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

.14 Electronic Modulating Damper Operators:

.1 Spring return, 24 VAC operating voltage, 0-10 VDC input signal, 0-10 VDC position output signal, 70 seconds maximum running time for 90 degree opening and 30 seconds maximum closing time.

.2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

.10 Control Panels and Wiring:

.1 Provide control panel of unitized cabinet type construction. Mount relays, switches and control point adjustment in cabinet and pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

.2 Fabricate panels from 2.5 mm rolled sheet metal sheet with baked enamel finish, flush fitting, gasketed doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications. Panels located outdoors shall have a NEMA 4X rating.

.3 Panels located outdoor shall be manufactured as above but shall be manufactured from Type 316 stainless steel with a #2b finish. Outdoor panels shall have a NEMA 4X rated.

.4 Mount panels on vibration free wall or free standing angle iron supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.6 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 VAC supply.

.7 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.8 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.9 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one (1) terminal. Provide 20 percent spare unit terminals, with a minimum of two (2) spare terminals. Provide all necessary terminal block accessories such as Manufacturer jumpers and marking tape.

.10 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are still functioning in “Hand” mode.

.11 Control wiring for digital functions shall be 18 AWG minimum with 300 Volt insulation.

.12 Control wiring for analog functions shall be 18 AWG minimum with 300 Volts insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.13 Sensor wiring shall be 18 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.14 Transformer current wiring shall be 16 AWG minimum.

2.4 Materials

.1 Steel:

.1 ASTM A36 for carbon structural steel.

.2 ASTM A568 for steel sheet.

.2 Stainless Steel:

.1 Manufacturer's standard grade for casing.

.2 Manufacturer's standard type, ASTM A240 for bare steel exposed to airstream or moisture.

.3 Galvanized Steel: ASTM A653.

.4 Aluminum: ASTM B209.

.5 Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.

.1 Standards:

.1 ASTM B117 for salt spray.

.2 ASTM D2794 for minimum impact resistance of 100 in-lb (11.3 N-m).

.3 ASTM D3359 for cross hatch adhesion of 5B.

.2 Application: Immersion

.3 Thickness: 25 microns (1 mil).

.4 Gloss: Minimum gloss of 60 on a 60-degree meter.

2.5 Controls

.1 Control will be provided through the Plant Control System (PCS).

2.6 Source Quality Control

.1 AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.

.2 Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

.3 Water Coils: Factory tested to 2068 kPag (300 psig) according to AHRI 410 and ASHRAE 33.

.4 Refrigerant Coils: Factory tested to minimum 3101 kPag (450 psig) internal pressure and to minimum 2068 kPag (300 psig) internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Provide and install all necessary refrigerant piping and electrical connection between unit and condenser unit.

.4 Piping connections to units to be made with flexible hoses.

.5 Provide a balancing valve in the return piping connection and an isolating valve in the supply piping connection to each unit.

.6 Provide a condensate drain trap at each unit. The inlet leg of the traps to be a minimum of 25 mm higher than the outlet leg.

.7 Condensate drain piping to be graded towards the drain at minimum 1:200.

.8 Provide P/T plugs on the supply and return piping connections to each unit.

.9 Install temporary bypass piping arrangement, using flexible hoses, before piping is to be chemically cleaned. Replace permanent connections after piping has been flushed out.

END OF SECTION

HVAC DISTRIBUTION PUMPS

1. GENERAL

1.1 Summary

.1 This Section covers the selection, supply, testing, and commissioning of the HVAC hot water distribution pumps.

.2 The pump sets and components are to be provided in accordance with this Section are to include:

 .1 Pump and motor packages.

1.2 Standards

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

 .1 ANSI/ASME Boiler and Pressure Vessel Code, Section VIII.

 .2 ANSI/ASME Code for Pressure Piping, B31.1.

.2 Canadian Standards Association (CSA):

 .1 CSA B51 – Latest Edition, Boiler, Pressure Vessel, and Pressure Piping Code.

 .2 CAN/CSA – C390, Energy Efficiency Test Methods for Three-Phase Induction Motors.

 .3 CSA-B214 - Installation Code For Hydronic Heating Systems.

.3 Hydraulic Institute.

.4 International Electrotechnical Commission (IEC):

 .1 IEC 61800-3 - Adjustable Speed Electrical Power Drive Systems - Part 3: EMC Requirements and Specific Test Methods for PDS And Machine Tools.

.5 National Electrical Manufacturers Association (NEMA).

.6 Underwriters Laboratories Inc. (UL).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

 .1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Performance Criteria

.1 All components forming a skid mounted pump package to be securely attached to resist damage due to seismic induced forces acting on the equipment.

.2 Size and select components to CSA-B214.

2.2 Hot Water Distribution Pump Performance Design Requirements

.1 Service: Treated pressurized hot water and glycol.

.2 Design point not to exceed 85 percent of end of curve.

.3 Efficiency at the duty point to be a minimum 70 percent.

.4 Flanges (Suction & Discharge): ANSI Class 250 or ANSI Class 300.

.5 Designed for variable speed operation.

2.3 Vertical In-Line Circulators – Sensorless Flow Control

.1 Close-coupled, inline for vertical or horizontal installation.

.2 Cast iron construction.

.3 Suitable standard operations at 107°C and 1200 kPag working pressure. Working pressures not de-rated at temperatures up to 107°C.

.4 Pump internals capable of being serviced without disturbing piping connections.

.5 Solid alloy steel shaft integral to motor. Non-ferrous shaft sleeve employed to completely cover the wetted area under the seal.

.6 Motor bearings support shaft via heavy-duty, grease lubricated ball bearings.

.7 Mechanical seal assembly internally flushed and installed in an enlarged tapered seal chamber complete with stainless steel housing, Buna bellows and seat gasket, stainless steel spring, and be carbon ceramic design with carbon face rotating against stationary ceramic face.

.8 Stainless steel impeller keyed to shaft and secured by stainless steel locking capscrew or nut.

.9 Impeller hydraulically and dynamically balanced to Hydraulic Institute Standards.

.10 Pump volute Class 30 cast iron design with integral cast iron flanges drilled for 125# ANSI companion flanges. Include gauge ports at nozzles, vent and drain ports. Volute designed with base ring matching ANSI 125# flange to simplify pump support.

.11 Motor:

.1 Power, speed, and voltage as scheduled.

.2 Heavy-duty grease lubricated ball bearings.

.3 Non-overloading at any point on the pump curve and meet NEMA specifications.

.12 Controls:

.1 Variable speed pump with integrated sensorless load demand based control.

.2 Factory mounted, wired, with a disconnect switch and menu-driven graphical interface.

.3 Provide near unity displacement power factor (cos Ø) without need for external power factor correction capacitors at all loads and speeds using VVC-PWM type integrated controls.

.4 Includes dual DC link reactors equivalent to 5% impedance line reactors, for reduction of mains borne harmonic currents and DC link ripple current to increase DC link capacitor lifetime.

.5 EMI/RFI filters conforming to DIN EN61800-3 to ensure integrated controls meets low emission and immunity requirements.

.6 System pressure to be maintained at 10 m (adj.) head minimum.

.7 Supports direct communication with the PCS.

.8 Enclosure rated to UL Type 12 suitable for indoor operation.

.9 Supports programmable skip frequencies and adjustable switching frequency for noise and vibration control.

.10 Provide a temperature controlled fan for cooling of the heat sink in the back panel.

.11 Rated to operate in ambient working conditions of minus 10°C to 45°C.

.12 Inputs and Outputs:

.1 Two (2) analog inputs (current or voltage).

.2 One (1) current output.

.3 Six (6) programmable digital inputs with 2 configurable as outputs.

.4 Supports two (2) programmable pulse inputs and two (2) programmable relay outputs.

.5 One (1) RS485 communication port.

.13 Software capable of sensorless control in variable volume systems without need for pump mounted (internal/external) or remotely mounted differential pressure sensor.

.14 Operates under quadratic pressure control (QPC) to ensure head reduction with reducing flow conforms to quadratic control curve.

.15 Supports a minimum head of 40% of design duty head.

.16 Provide user adjustable control mode settings and minimum/maximum head set points using built-in programming interface.

.17 Software capable of controlling pump performance for non-overloading power at every point of operation.

.18 Software capable of maintaining flow rate data.

.13 Factory tested and name-plated before shipment.

2.4 Vertical In-Line Circulators – Constant Speed

.1 Close-coupled, inline for vertical or horizontal installation.

.2 Cast iron construction.

.3 Suitable standard operations at 107°C and 1200 kPag working pressure. Working pressures not de-rated at temperatures up to 107°C.

.4 Pump internals capable of being serviced without disturbing piping connections.

.5 Solid alloy steel shaft integral to motor. Non-ferrous shaft sleeve employed to completely cover the wetted area under the seal.

.6 Motor bearings support shaft via heavy-duty, grease lubricated ball bearings.

.7 Mechanical seal assembly internally flushed and installed in an enlarged tapered seal chamber complete with stainless steel housing, Buna bellows and seat gasket, stainless steel spring, and be carbon ceramic design with carbon face rotating against stationary ceramic face.

.8 Stainless steel impeller keyed to shaft and secured by stainless steel locking capscrew or nut.

.9 Impeller hydraulically and dynamically balanced to Hydraulic Institute Standards.

.10 Pump volute Class 30 cast iron design with integral cast iron flanges drilled for 125# ANSI companion flanges. Include gauge ports at nozzles, vent and drain ports. Volute designed with base ring matching ANSI 125# flange to simplify pump support.

.11 Motor:

.1 Power, speed, and voltage as scheduled.

.2 Heavy-duty grease lubricated ball bearings.

.3 Non-overloading at any point on the pump curve and meet NEMA specifications.

.12 Factory tested and name-plated before shipment.

2.5 Pump Base

.1 Pump and motor to frame mounted on a common rigid base formed from structural steel.

.2 The base steel skid to be reinforced to be sufficiently rigid to withstand twisting and bending due to normal starting/operating loads transmitted from the pump and motor.

.3 The base skid is not to be grouted to the housekeeping pad.

.4 The base skid is to be set and anchored onto a concrete filled inertial base. Pump and motor to be factory aligned and to be realigned after completing the pump and pipe connection installation.

.5 Coupling: flexible, type coupler complete with a coupler guard mounted to the base.

2.6 Variable Frequency (Speed) Drive (other than sensorless pumps)

.1 Provided by Division 16.

2.7 Motors

.1 Provide all motors for hot water distribution pumps with non-overloading service.

.2 All pump motors to be inverter rated.

2.8 Controls

.1 General:

.1 The pump control will be provided by the Plant Control System (PCS).

.2 The pump control system will follow the requirements of the Appendix 18D – City Standards and Appendix 18E – Standardized Goods.

.3 Amend these requirements as required to provide functions if using sensorless pump technology.

.2 The PCS will manage the operation of the VFD driven pumps, plus one future pump.

.3 The pump control is to receive inputs from two field located differential pressure transmitters and a flow signal from the flowmeters to provide end of curve protection for each set of pumps.

.4 Each pump to be provided with a differential pressure sensor to monitor pump status.

.5 Each pump to be provided with a motor current or power draw sensor.

.6 The PCS control is to be capable of managing duty and standby pump operations including initiating restarts due to pump failures.

.7 The PCS control system shall be capable of accepting up to two (2) separate digital analog inputs from remote mounted pressure sensor/transmitters. All sensor/transmitter inputs to be communicated to the PCS for continuous scan and comparison function.

.8 The PCS pump control is to use the analog input signal (differential pressure) as the command feedback input for a closed loop hydraulic stabilization function to minimize pump speed hunting, while maintaining differential pressure setpoint.

.9 The controller to be capable of operating in two modes (selected through local selector switch):

.1 Auto: The system is commanded on remotely from digital communication interface with the PCS. The controller is performing speed control based on differential pressure setpoints selected at panel operator interface.

.2 Local: System on/off is operated from controller local keypad/display.

.3 Remote manual: Manual control of pumps from control room.

.10 The controller to be capable of standalone control.

.11 Hardwired interfaces: Pump fail differential pressure switches (local).

.12 Digital Communication Interface: The pump controller to communicate with the PCS. Communication to include the transfer of pump controller information as well as set point information from the PCS. Communication to allow for the control of the distribution pumps.

.13 PCS monitoring and control to include:

.1 Controller enable/disable.

.2 Operating mode automatic or manual.

.3 Individual pump start – stop.

.4 Individual Pump operating status.

.5 Individual Pump Lead – lag designation.

.6 Zone differential pressure setpoint.

.7 Individual Pump speed.

.8 Individual Pump alarms.

.9 Controller alarms.

.10 Individual VFD alarms.

.11 Loss of differential pressure signal from the field – Alarm.

.12 Operator local interface to allow the programming of setpoints, monitoring of operational parameters in real time, and to provide visual feedback during unit diagnostics/alarms.

.13 Unit fail to programmable safe operating mode.

.14 Multi fault memory and recall.

.15 LED status lights.

.14 All control components required for pump control including but not limited to pressure transducers, sensors, probes and flowmeters will meet the provision and installation requirements of Division 17 and Appendix 18E – Standardized Goods.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 The pump controller/VFD package to be located in the vicinity of the variable speed distribution pumps.

.4 Installation of interconnecting wiring between the pump controller and pump motor drives to be supervised by the Manufacturer.

.5 Provide installation of control and power wiring from the PCS electrical/control system to the pump package. Final terminations to be in accordance with Manufacturer's instructions.

.6 Factory startup and testing of the pump controller.

.7 The Manufacturers to provide support to the DES control system integrator when interfacing the distribution pump control system with the DES control system.

END OF SECTION

HVAC PIPING, VALVES AND FITTINGS

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, factory testing, delivery, installation, supervision of installation, testing and commissioning of buried, pre-insulated piping for HVAC systems and interior HVAC piping, including fittings, valves, and gauges.

.2 Materials and applications for hot water distribution piping systems for buried and interior applications.

1.2 Standards

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

.1 ASTM A47/A47M, Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M, Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A105/A105M, Carbon Steel Forgings for Piping Applications.

.4 ASTM A106/A106M, Seamless Carbon Steel Pipe for High Temperature Service.

.5 ASTM A108, Steel Bar, Carbon & Alloy, Cold-Finished.

.6 ASTM A126, Gray iron Castings for Valves, Flanges, and Pipe Fittings.

.7 ASTM A181/A181M, Carbon Steel Forgings for General-Purpose Piping.

.8 ASTM A183, Standard Specification for Carbon Steel Track Bolts and Nuts.

.9 ASTM A193/A193M, Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

.10 ASTM A194/A194M, Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High Temperature Service, or both.

.11 ASTM A216/A216M, Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

.12 ASTM A234/A234M, Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

.13 ASTM A276 Standard Specification for Stainless Steel Bars and Shapes.

.14 ASTM A278/A278M, Gray Iron Castings for Pressure-Containing Parts for Temperatures Up To 650°F (350°C).

.15 ASTM A307, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

.16 ASTM A536, Standard Specification for Ductile Iron Castings.

.17 ASTM B16/B16M, “Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.”

.18 ASTM B16.34, Valves Flanged, threaded and welding Ends.

.19 ASTM B32, Standard Specification for Solder Metal.

.20 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.

.21 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.22 ASTM B88, Standard Specification for Seamless Copper Water Tube.

.23 ASTM C518 – Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.24 ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.

.25 ASTM D2996, Standard Specification for Filament-Wound ‘Fiberglass’ (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe. NPS 1” to 16”.

.26 ASTM D3567, Standard Specification for Determining Dimensions of ‘Fiberglass’ Pipe and Fittings.

.27 ASTM D3839, Standard Specification for Underground Installation of ‘Fiberglass’ Pipe.

.28 ASTM D4024, Standard Specification for Machine Made ‘Fiberglass’ Flanges. Applicable from ½” through 24” ANSI B16.5 150 lb. bolt circle flanges.

.29 ASTM D5677, Standard Specification for Molded and Filament-Wound Fittings and Flanges.

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

.1 B.16.1, Cast Iron Pipe Flanges and Flange Fittings (Class 125, 250).

.2 B16.4, Grey Iron Threaded Fittings (Classes 125 and 250).

.3 B16.3, Malleable Iron Threaded Fittings.

.4 B16.5, Pipe Flanges and Flanged Fittings.

.5 B16.9, Factory-made Wrought Steel Butt welding Fittings.

.6 B16.11, Forged Steel Fittings, Socket-Welding and Threaded.

.7 B16.8, Cast Copper Alloy Solder Joint Pressure Fittings.

.8 B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.

.9 B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.10 B16.34, Valves - Flanged, Threaded, and Welding End.

.11 B16.39, Malleable Iron Threaded Pipe Unions Classes 150, 250 and 300.

.12 B1.20.1, Pipe Threads, General Purpose, inch.

.13 B31.1, Power Piping.

.14 B31.5, Refrigerant Piping. (15-94 Safety Code for Mechanical Refrigeration).

.15 B34, Number Designation and Safety Classification of Refrigerants.

.3 MSS of the Valves and Fittings Industries Inc.:

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

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

.3 SP-67, Butterfly Valves.

.4 SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.5 SP-71, Grey Iron Swing Check Valves, Flanged and Threaded ends.

.6 SP-72, Ball Valves with Flanged or Butt-Welding Ends for General Service.

.7 SP-80, Bronze Gate, Globe, Angle and Check Valves.

.8 SP-83, Class 3000 and 6000 Pipe Unions, Socket Welding and Threaded (Carbon Steel, Alloy Steel, Stainless Steels, and Nickel Alloys).

.9 SP-85, Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends.

.4 Canadian Standards Board:

.1 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

.2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

.5 DIN - German Institute for Standardization:

.1 EN253, District heating pipes - Bonded single pipe systems for directly buried hot water networks - Factory made pipe assembly of steel service pipe, polyurethane thermal insulation and a casing of polyethylene.

.2 EN448, District heating pipes - Bonded single pipe systems for directly buried hot water networks - Factory made fitting assemblies of steel service pipes, polyurethane thermal insulation and a casing of polyethylene.

.3 EN488, District heating pipes - Bonded single pipe systems for directly buried hot water networks - Factory made steel valve assembly for steel service pipes, polyurethane thermal insulation and a casing of polyethylene.

.4 EN489, District heating pipes - Preinsulated bonded pipe systems for directly buried hot water networks - Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene.

.6 CAN/ULC S701, Standard for Thermal Insulation, Polystyrene Boards.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Prefabricated sections with field connection points.

.3 Pipe supports.

.4 Expansion loops & joints, include relevant engineering data.

.5 Steel mill test reports.

.6 Shop Drawings for alternative locations for expansion loops & joints: include calculations based on temperature between 20°C and system operating temperature plus 25 percent. Obtain Professional of Record’s approval before fabrication.

.7 Product data: items listed under Part 2 - Products, including but not limited to valves, gaskets, strainers, safety relief valves, balancing valves, gauges, sensor/transmitters, flexible connections.

1.4 Welding

.1 Refer to Pipe Welding Specifications 15086 and ASME B31.1 Section 127 Chapter V.

1.5 Quality Assurance

.1 Provide mill test certificates for all piping. Incorporate the mill test certificates into quality control records. Manufacturer’s name or trademark to appear on all fittings and on each length of pressure pipe.

.2 Provide procedure in quality control manual to identify material pieces, which have been cut from properly identified pipe to ensure all piping and fittings are traceable. Ensure that the procedure meets the approval of the authority having jurisdiction.

.3 All pipes and fittings heat trace numbers to be verified against the mill test certificates and logged into the project’s quality control reports and O&M Information.

.4 Welding materials and labour to conform to ASME Code. Use pressure welders for contained pressure in excess of 100 kPa (14.5 psi).

.5 Complete the following additional quality control tests and inspections:

.1 Weld set-up on 5 percent of all welds.

.2 Radiographic inspection on 20 percent of all welds.

.3 Visual inspection on a minimum of 20 percent of completed welds and minimum 5 percent of root passes.

.4 Visually inspect 100 percent of all welds for leaks during hydrotest.

.5 For radiographic, visual or ultrasonic inspection provide a minimum CGSB certified inspector to Level 2 or higher with the correct piping code endorsement.

2. PRODUCTS

2.1 Performance Criteria

.1 All piping, fittings, valves, strainers, heat exchangers, and other equipment on the district heating primary side to be designed and installed in accordance with ASME B31 Code for Pressure Piping.

.1 Design Code: ANSI/ASME B31.1 – POWER PIPING.

.2 Service: Pressurized Hot Water.

.3 Design Pressure: 1600 kPag (232 psig).

.4 Design Temperature: 120°C (250°F).

2.2 Exterior Buried Primary Hot Water Piping

.1 Pre-insulated Piping and Fittings:

.1 Buried hot water piping system, comprising of pre-insulated heating piping and fittings, to be an all welded system.

.2 Pipe Assemblies:

.1 EN253 Pre-insulated bonded piping system for directly buried hot water networks (European Standard). Pipe assemblies of steel service pipes to Steel 37.0 (ASTM A53 Grade B equal), polyurethane thermal insulation and outer casing of polyethylene. Complete with leak detection alarm wires.

.3 Fitting Assemblies:

.1 EN448 Pre-insulated bonded piping system for directly buried hot water networks (European Standard). Fitting assemblies of steel service pipes to Steel 37.0 (ASTM A53 Grade B equal), polyurethane thermal insulation and outer casing of polyethylene. Complete with leak detection alarm wires.

.4 Valve Assemblies:

.1 EN488 Pre-insulated bonded piping system for directly buried hot water networks (European Standard). Steel valve assembly for steel service pipes to Steel 37.0 (ASTM A53 Grade B equal), polyurethane thermal insulation and outer casing of polyethylene. Complete with leak detection alarm wires.

.5 Joint Assemblies:

.1 EN489 Pre-insulated bonded piping system for directly buried hot water networks (European Standard). Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene.

.2 Styrofoam Insulation as Separator:

.1 Application: Separation from other utilities and structures: Use 50 mm thick foam. Install between HVAC piping and other utility when clearance is less than 300 mm.

.2 Materials:

.1 CAN/ULC S701 Type 4.

.2 ASTM C518.

.3 ASTM D1621.

.4 Thermal Resistance of 0.88 m^2 C/W.

.3 Acceptable Products:

.1 Dow STYROFOAM Highload 60.

.2 Or approved equivalent.

.3 Foam Pads as Expansion Cushion:

.1 Application: to allow for free expansion of the HVAC pipe under hot water and operating conditions. Install foam pad between district energy piping and sand bedding at changes of horizontal and vertical direction. On direct buried valve stems, branches, and other fittings use 40 mm thick foam pads in layers to achieve specified thickness.

.2 Material as supplied by pipe Manufacturer.

2.3 Interior Piping (Above Ground)

.1 Hot Water Piping:

.1 To: ASTM A53 Grade B.

.2 Up to and including NPS 1: Sch. 80, seamless, plain ends.

.3 NPS 1 ½ and larger: Sch. Standard, ERW or seamless, bevelled ends.

.4 Refer to branch connection table in Part 3, Item 3.4.8.4.

.2 Pipe Fittings:

.1 Below NPS ¾: Class 3000 screwed; material: ASTM A105.

.2 NPS ¾ to and including NPS 2: Class 3000, forged socket weld ends, dimensions to ASME B16.11, material: ASTM A105.

.3 NPS 2½ and over: Sch. Standard forged steel, bevel ends, Material: A234, Grade WPB or A105.

.4 Elbows to be long radius only.

.3 Outlets for Branch Connections:

.1 Full Size; standard weight, welded tee.

.2 One size smaller; standard weight, welded reducing tee, or saddle welds.

.3 Two or more sizes smaller:

.1 NPS ≤ 2 – Use a thread-o-let or reducing tee.

.2 NPS ≥ 2½ – Use a weld-o-let or reducing tee.

.4 Caps & Plugs:

.1 NPS ½ to 2: Class 3000, screwed ends.

.2 To: ASTM A105.

.3 Dimensions per ANSI B16.11.

.5 Nipples for Drains, Vents, Pressure Gauges:

.1 Up to and including NPS 1¼: Sch. 80, screwed.

.2 NPS 1½ and larger: standard schedule.

.3 To: ASTM A53, Grade B.

.6 Unions:

.1 Up to and including NPS 2: Class 3000, socket welded ends, forged steel, steel-to-steel ground joint.

.2 To: ASTM A105; Dimensions: MSS-SP-83.

.7 Flanges:

.1 NPS ≤2: Class 150/300, raised face, socket welded ends, to: ASTM A105, and ANSI B16.5.

.2 NPS ≥2½: Class 150/300, raised face, weld neck (bored to suit pipe) to ASTM A105, and ANSI B16.5.

.3 Cast Iron flat faced flanges at pumps NPS 2½ and above: ANSI Class 250, full faced, cast iron to ASTM A126 Grade B.

.4 Use up-rated flanges as needed to match class rating and type of mating flange supplied with equipment or valves, to ASTM A105 carbon steel.

.8 Bolts and nuts:

.1 Inside Buildings – non-process areas:

.1 NPS≤2: bolts, low strength, carbon steel, semifinished with heavy hex nuts, to ASTM A307, Grade B.

.2 NPS ≥2½: Stud bolts, carbon steel, semi-finished with heavy hex nuts, to ASTM A307, Grade B.

.2 Inside Buildings – process areas:

.1 NPS≤2: bolts, stainless steel, semi-finished with heavy hex nuts, to ASTM A193.

.2 NPS ≥2½: Stud bolts, stainless steel, semi-finished with heavy hex nuts, to ASTM A193.

.3 Exterior Above Ground, direct bury, or inside chambers:

.1 NPS≤2: bolts, stainless steel, semi-finished with heavy hex nuts, to ASTM A193.

.2 NPS ≥2½: Stud bolts, stainless steel, semi-finished with heavy hex nuts, to ASTM A193.

.9 Gaskets:

.1 Raised Face Flanges (RF)/Flat Faced Flanges (FF): Nitrile-binded with aramid & glass fibre, non-asbestos standard with NST non-stick coating for ease of removal.

.2 1.6 mm (1/16 inch) thick, ringed, rated for service, temperature and pressure of fluid.

.3 Max allowable creep relaxation: 20 percent, hot compression test-maximum allowable thickness Loss: 27 percent.

.4 Dimensions: to ANSI B16.21

.5 Installation: to Manufacturer’s recommendation for bolt strength and seat stress.

.6 Acceptable Products: Klingersil C-4401, Garlock 5500/3760, or approved equivalent, to suit RF/FF flange type.

.10 Isolation Ball Valves NPS 1 to 12:

.1 Design pressure class ≥ PN 16; design conditions, sch. 40 butt welded ends (match pipe wall thickness), steel body, stainless steel ball and stem, Teflon seat, reduced bore, class 150.

.2 Valve stems to be sufficiently long to clear insulation.

.3 Manual lever actuator with memory stop for sizes NPS 6 and below.

.4 Weather proof worm gear operator to be provided for valve sizes NPS 8 and above.

.5 See Specification Section 15100 for chain wheel applications on valves in excess of 2600 mm above floor.

.6 Acceptable Products:

.1 Arinah Services – Broen Ballomax.

.2 Armour Valve – Bohmer.

.3 Or approved equivalent.

.11 Isolation Ball Valves NPS ≤¾:

.1 Socket Welded, 13,790 kPa (2,000 psig) WOG, ball valve, cold non-shock, 1,034 kPa (150 psig) saturated steam carbon steel body, stainless steel ball, RTFE seats and seals, blow-out proof steam design, lever handle.

.12 Drain and Air Vent valves:

.1 NPS ½ to 2: Full Port, Threaded, two piece design, 13,790 kPa (2,000 psig) WOG, ball valve, cold non-shock, 1,034 kPa (150 psig) saturated steam carbon steel body, Type 316 stainless steel trim, RTFE seats and seals, blow-out proof steam design, lever handle.

.2 Acceptable Products:

.1 Apollo 72-100.

.2 NIBCO T-580-CS-R-66.

.3 Or approved equivalent.

.3 Automatic float style vents to be used for system start-up. An upstream manual valve to be provided for isolation.

.13 Safety Relief Valves:

.1 Thermal Relief Hot Water Service: ASME rated direct spring loaded type, lever operated, complete with non-adjustable factory set discharge pressure.

.2 Each valve to be drained separately to floor drain.

.3 System relief valve capacity to exceed make-up capacity.

.4 Equipment relief valve capacity to exceed input rating of connected equipment.

.5 Acceptable Manufacturer:

.1 Farris.

.2 Or approved equivalent.

.14 Manual Balancing Valves:

.1 Up to NPS 12: Hydronic Balancing Valve Class 150, 1,724 kPa (250 psi) rated, ductile iron body, flanged ends, complete with sixteen (16) turn calibrated settings and hidden memory tamperproof hand wheel, self-sealing test ports for insertion probes.

.2 Acceptable Products:

.1 Victaulic Series 788.

.2 Or approved equivalent.

.15 Needle Valves:

.1 NPS ⅜ to ¾: Threaded, union bonnet, carbon steel ASTM-A108 body, needle type seating, 414 bar at 93°C (6,000 psig at 200°F) non-shock water.

.2 Acceptable Products:

.1 Kerotest N28, TYCO Anderson Greenwood H1 / H7, Century CM2.

.2 Or approved equivalent.

.16 Strainers:

.1 NPS 2½ to 8: Y-pattern strainer type; cast steel body, welded ends to match pipe, complete with valved drain connection.

.1 Stainless steel perforated basket with 3 mm (1/8 inch) perforations with additional 20 mesh (0.8 mm) liner. Screen area to be a minimum 3 X the area of the inlet pipe.

.2 Class 150.

.3 Acceptable Products:

.1 Spirax Sarco, SSI Equipment Inc., Islip Flow Controls (IFC).

.2 Or approved equivalent.

.2 NPS ≤2: Y-pattern strainer type; cast steel body, socket weld ends, complete with valved drain connection:

.1 Stainless steel perforated basket with 3 mm (1/8 inch) perforations with addition 20 mesh (0.8 mm) liner. Screen area to be a minimum 3 X the area of the inlet pipe.

.2 Class 150.

.3 Acceptable Products:

.1 Spirax CT, SSI Equipment Inc., Islip Flow Controls (IFC).

.2 Or approved equivalent.

.3 Start-up (where indicated): Removable cone style. 3.2 mm perforation size standard. Use 0.5 mm perforation size in front of plate and frame exchangers.

.17 Flexible Connections/Expansion Joints:

.1 Application to suit motion.

.2 Minimum length in accordance with Manufacturer’s recommendation to suit offset.

.3 Multi-ply stainless steel bellows.

.4 Flanged Connections, Class 150 flanges with Control Rods.

.5 Acceptable Products:

.1 Senior Flexonics.

.2 Or approved equivalent.

.18 Temperature Gauges (Thermometers):

.1 Industrial, Bi-metal Dial, 100 - 125 mm size, adjustable angle, aluminum case, comes with separate 13 mm FNPTx 13mm MNPT stainless steel thermowell, front calibrator.

.2 Units: dual scale (°Celsius/°Fahrenheit).

.3 Accuracy: within plus or minus 0.5 °C of reading.

.4 Range: 0-120 °C.

.5 Maximum 2 °C per division.

.6 Thermowell Insertion Length: 50 percent of pipe diameter.

.7 Allowance for Insulation: Thermowell extends a minimum of 50 mm (2 inch) to allow for pipe insulation.

.8 Acceptable Products:

.1 Winters TBM.

.2 Wika 32/52.

.3 Weiss 3/5VBM.

.4 Or approved equivalent.

.19 Pressure Gauges:

.1 Dial type, 110 mm diameter, Type 304 stainless steel case and ring, stainless steel tube, brass or stainless steel movement, glass or acrylic window, external recalibrator. 13 mm NPT process connection.

.2 Liquid Filled.

.3 Units: dual scale (kPa/psi).

.4 Accuracy: within 1.0 percent of full scale.

.5 Range: 0-1600 kPag.

.6 Accessories: N/A.

.7 Acceptable Products:

.1 Winters.

.2 Weiss.

.3 Taylor.

.4 Ashcroft.

.5 Wika.

.6 Or approved equivalent.

.20 Differential Pressure Gauges:

.1 Dial type, 110 mm diameter, stainless steel, aluminum or phenolic case , stainless steel wetted parts, external re-calibrator and glass or acrylic window.

.2 Accuracy: within 1.0 percent of full scale.

.3 Range: 0-175 kPa.

.4 Accessories: N/A.

.5 Acceptable Products:

.1 Taylor.

.2 Weiss.

.3 Ashcroft (Durogauge).

.4 Or approved equivalent.

2.4 Anchors, Guides & Slides

.1 Provide to details as required for the Final Design.

.2 Use standard components and assemblies by one Manufacturer.

2.5 Supports, Hangers & Inserts

.1 Provide according to details required for the Final Design. Components and assemblies to be to MSS SP-58.

.2 Use standard components and assemblies by one Manufacturer.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Preparation

.1 Lay out work in accordance with Final Design. Establish interfaces to buried piping and existing piping as indicated.

.2 Immediately report any discrepancies on plans.

.3 Field confirm size, location, type, and rating of all interface points.

.4 Exterior Piping:

.1 Verify ground profiles, grades, lines, levels, dimensions against Final Design and established benchmarks. Report discrepancies and obtain written instruction from Professional of Record.

3.3 Fabrication

.1 Joints:

.1 Above 19 mm (¾ inch) NPS; Welded throughout, except at designed flanged components.

.2 Carbon steel screwed joints:

.1 To ANSI/ASME B1.20.1., taper threads only.

.2 Provide socket fittings for all tap joints.

.3 Provide clean machine cut threads.

.4 Use Teflon tape or paste on male threads.

.5 For use up to 19 mm (¾ inch) on heating.

.3 Welding:

.1 Conform to all requirements of Pipe Welding Specification 15086.

3.4 Installation of Hot Water Piping

.1 Connections to equipment to be strain free.

.2 Maintain clearances between pipes and structures for operations and maintenance purposes.

.3 Provide manual air vents, drains, drip legs, dirt pockets as required by Final Design.

.4 Seal piping passing through walls.

.5 Provide for pipe movement as required and in accordance with installation instructions.

.6 Use eccentric reducers in horizontal piping to prevent accumulation of pockets of air and to allow the drain down of water.

.7 Weld couplings for drains into carbon steel piping to ANSI/ASME B31.1.

.8 Carbon steel branch take-offs:

.1 Use welding tees or as allowed by specification saddle welds.

.2 Where reducing tees of proper size are unavailable, use available tees with reducers. Tees with increasers are not permitted.

.3 Weldolets may be used at drip legs only provided ratio of outlet size to pipe size is 0.5 or smaller.

.4 Refer to table for approved methods of branch connections:

Branch Connection Table

Branch Size (Inches)	Header Size (inches)											
	NPS	**½**	**¾**	**1**	**1½**	**2**	**3**	**4**	**6**	**8**	**10**	**12**
	½	**T**	**TR**	**TR**	**TR**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**
	¾		**T**	**TR**	**TR**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**
	1			**T**	**TR**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**
	1½				**T**	**TR`**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**	**SO TO**
	2					**T**	**TR**	**TR**	**TR SO W**	**SO W**	**SO W**	**SO W**
	3						**T**	**TR**	**TR**	**TR W**	**TR W**	**W**
	4							**T**	**TR**	**TR**	**TR W**	**W**
	6								**T**	**TR**	**TR**	**TR**
	8									**T**	**TR**	**TR**
	10										**T**	**TR**
	12											**T**
	Table Legend: T – Tee; TO – Threadolet; W – Weldolet; TR – Reducing Tee; SO - Sockolet											

.9 Cap open ends of piping during installation. Remove all foreign material from inside piping.

.10 Remove all burrs from piping. Clean scale and dirt, inside and out before and after assembly.

.11 Grade nominally horizontal piping at 0.5 percent slope generally in direction of flow.

.12 Carbon steel Flanges: Tighten bolts evenly with torque wrench. Re-tighten bolts with torque wrench after system is in operation.

.13 Removal of a portion of pipe to facilitate welding of the joint and then replacing the cut out section, sometimes called "fish mouth" or “window" welding, is not permitted.

.14 After the welding is completed on each section of pipe and the welds have been radiographically tested and approved, the piping is subject to hydrostatic pressure testing. Hydrostatic pressure testing to be carried out.

.15 Furnish and install all temporary devices such as pressure and/or circulation pumps, gauges, valves, caps and pipes, necessary for the conducting the leak testing and flushing operations.

.16 Revisions to routing/location of piping require certification by the Professional of Record.

.17 Install piping to minimize pipe dismantling for equipment removal. This would include removable flanged spool sections as required.

3.5 Anchors and Guides

.1 Locate anchors as required.

.2 Align piping at guides so as to avoid damage by movement of piping against fixed structures.

.3 Guide expansion joints as per Manufacturer’s recommendations.

3.6 Pipe Supports

.1 Interior Piping:

.1 Install to Manufacturer's recommendations.

.2 Spring hangers to remain blocked until completion of system hydrotest, after which initial free adjustments are to be made.

.3 Adjust supports, hangers, and springs, with system at operating temperature.

.2 Install expansion loops and supports as required to maintain venting and/or drainage.

3.7 Painting

.1 Paint all hangers, supports, and all exposed steelworks with two (2) coats of rust inhibitive primer prior to commencement of insulation.

3.8 Valves

.1 Install isolating valves at all branch take-offs, at each piece of equipment and elsewhere as required.

.2 Install in accordance with Manufacturer's recommendations.

.3 Install check valves as required for flow.

.4 Install in accessible locations with stem horizontal or above.

.1 Do not orient gate valve stems horizontally in horizontal lines.

.5 Screwed and flanged valves to be accessible for removal or maintenance without removing adjacent piping.

.6 Welding to valves to be done in accordance with the Manufacturers recommendations to prevent body distortion and to maintain tight shutoff characteristics of the valve.

3.9 Strainers

.1 Install in locations to allow easy access for removal of screen.

.2 Provide drain ball valve, extend blowdown piping to a floor drain or to a convenient location at 400 mm above floor level, equipped with a hose end connection and screwed cap.

.3 For any strainers installed higher than 1800 mm above floor level, install blowdown piping with an additional ball valve at an elevation of 1000 mm above floor and a hose end connection. In this case, the screw cap is not required.

3.10 Gauges

.1 Pressure Gauges:

.1 Where fluid design temperature exceeds gauge temperature limit, install gauge with long nipple or siphon.

3.11 Valved Drains

.1 Locations:

.1 At bottom of risers.

.2 At low points in mains and branches.

.2 Discharge:

.1 Interior: Provide hose adapter on drain valves where discharge piping cannot conveniently be carried to floor drains.

.2 Exterior: Provide a standard provincial authority cast iron frame and cover for catch basin and over vent valves.

.3 Check operation after system is in use and under full pressure.

3.12 Air Vents

.1 Install at high points and elsewhere as required by the Final Design.

.2 Interior:

.1 Provide 20 mm (¾ inch) or 25 mm (1 inch) pipe and needle valves between pipe wall penetration and interior isolation ball valves for air release at high points inside buildings as required by the Final Design.

.3 Exterior:

.1 Provide concrete pad, cast iron frame and cover meeting local standard specification, and concrete enclosure for exterior high point air releases as required by Final Design.

.4 To consist of tee, pipe extension, shut off valve, and auto vent discharge pipe to 400 mm above floor. The pipe end to be provided with a threaded forged steel cap.

3.13 Safety Relief Valves

.1 Relief valve discharge piping to be piped to nearest floor drain. All relief valve discharge piping to be secured to the floor or other permanent structure to prevent movement during discharge.

3.14 Expansion Joints

.1 Install as per Manufacturer’s instructions.

.2 Remove expansion joints from piping before pressure testing. Do not expose expansion joints to test pressures.

.3 Do not subject bellows units to torsional forces.

.4 Reinstall bellows after hydro-testing. Remove shipping tie rods after completion of satisfactory pressure testing of piping system.

3.15 Installation of Pre-Insulated Hot Water Piping

.1 Verify all pipe and components are supplied and in place at the place of storage.

.2 When lowering the pipe into the trench, to prevent swinging impact or scuffing of pipe against the sides of the trench.

.3 Keep each pre-insulated piping joint free of moisture at all times until application of joint kit.

.4 Alarm Wiring:

.1 Provide installation and test procedure for Alarm Wiring prior to commencing installation of the HVAC piping.

.2 The alarm wires embedded in the polyurethane insulation to consist of two (2) copper wires, one clean and one tinned.

.3 Verify alarm wires are installed and operating in each pipe and component correctly prior to performing any work on that piece (test upon receipt of material).

.4 Locate alarm wires as per pipe supplier’s recommendations and as required by Final Design.

.5 Connect both end wires in all joints and piping ends by certified electrician.

.6 Solder each joint and use jointing clamps as supplied by the Manufacturer and 2.0 mm square copper wire.

.7 Test and record continuity of system as the Work progresses by means of high-voltage tester (Megger).

.8 Check the resistance of the connections and the resistance between the wire and steel pipe.

.9 Follow Manufacturer instruction and provide 120 V power supply to panel to central alarm panel.

.10 Do not weld any piping when leak detection units are connected to the system.

.5 Use temporary supports, if necessary, to raise the piping or to allow rotation of the pipe to facilitate welding joints. If the use of temporary supports is required, provide 100 mm x 100 mm (4 inch x 4 inch) boards and place in the trench with a maximum spacing of 300 mm (12 inch).

.6 Furnish all temporary supports and remove prior to backfilling.

.7 Ensure that one shrink sleeve is in place on the straight pipes for each joint, prior to welding the steel pipe.

.8 Prepare steel pipe with flat ends or properly bevelled, aligned and spaced for welding. All welding on pipes, fittings, and valves to be done by qualified professionals. Gas welding or electric arc welding may be used and the type of rods and filler used to be selected to match the base metal alloy analysis.

.9 Securely cap the ends of the pipe in the trench, which are not being fitted or welded, at all times to prevent the entrance of foreign matter.

.10 Make all cuts of the exterior polyethylene jacket as per Manufacturer recommendations so that no indications of fracture arise.

.11 Remove all polyethylene foam from the steel pipe before welding is started.

.12 Keep exposed PUR foam dry and covered during installation.

.13 Make branch connections only with fittings supplied by the pipe supplier.

.14 Weld earth connections to piping at all wall entrances for the leak detection system.

.15 Check alarm wires for faults before welding in sections of pipe.

.16 The welds on the exterior piping to be radiographically or ultrasonically examined as specified in ASME B31.1.

.17 After the welding is completed on each section of pipe and the welds have been radiographically or ultrasonically examined and approved the piping to be subjected to a hydro-static pressure test. The pressure test to be carried out in accordance with Part 3 - 3.19.

.18 Furnish and install all temporary devices such as pressure pumps, gauges, valves, caps and pipes necessary for the conducting of the leak testing operation.

.19 After acceptance of non-destructive examination of welds, the piping to be cleaned as described in Part 3 - 3.20.

.20 Install expansion foam cushions at bends and changes in direction strictly as required by the Final Design.

.21 Ensure that the piping is isolated from any concrete structures. In the event that the piping is to be installed in close proximity to a concrete structure, install a Styrofoam divider between the pipe outer casing and the concrete.

.22 Ensure the pre-insulated pipe is properly protected before insertion into steel or PVC buried casings. Submit procedure to the Professional of Record for protection of pipe prior to commencement of installation.

3.16 Application of Joint Kits – Insulation & Shrink Sleeves

.1 Install the shrink sleeves to the heating pipelines after pressure testing is complete, strictly in accordance with the Manufacturer specifications and after receiving training from the Manufacturer and/or personnel approved by the Manufacturer.

.2 Jointing:

.1 Take a joint kit from storage.

.2 Place the shrink sleeve on one of the pipes to be welded. Weld the steel pipes. (Joint can be pressure tested at this point if in the reviewed procedure).

.3 Cut away expanded insulation foam from the pipe ends.

.4 Cut the insulation half shells to make them fit tightly between the jacket pipes.

.5 Fit the insulation shells tightly between the jacket pipes. The pipe ends to be clean and dry.

.6 Clean the jacket pipes at least 150 mm from both pipe ends. The surface to be clean and dry.

.7 Crimp and solder alarm wires, lay them along outside of the insulation half shells.

.8 Activate the jacket pipes with a propane torch at least 150 mm from both sides of the pipe ends, until the surface has a mat, silky look.

.9 Place the shrink film so that the marking line goes around the pipe. Pull the paper off and take the film loosely around the pipe.

.10 Heat the whole film from the centre outwards just to the point that the mastic becomes visible at the edges and that the shrink film is tightly fitted.

.11 Remove packing from main shrink sleeve and ensure sleeve is clean and dry inside and out. Centre shrink sleeve on the joint. Heat shrink from the middle outwards towards one end then from the middle to the other.

3.17 Checking and Testing of Alarm Wires – Individual Components from Storage

.1 In all components the alarm sensor wires are placed at 2:00 o'clock and 10:00 o'clock positions. The two (2) wires are distinguished by one being plain copper wiring and the other being a tinned color. The two (2) wires are different so that the correct connection is made during installation.

.2 All straight pipes and bends are joined by welding in such a way that the clean copper wires are always opposite each other. Likewise for the tinned wires. Orient tinplated wires on the right with your back to the direction of the HVAC piping with the exception of fittings. Never cross over wires.

.3 Inspect each piping component for continuity and signs of damage in transit. Ensure the wires are not in contact with the steel pipe.

.4 Short-circuit the wires at one end of bends and straight components and at both ends of the main for a tee. Verify good contact between the wires and that no contact exists between wires and steel pipe.

.5 Using an ohmmeter, connect the two measuring cables to the wires that are not joined together. Verify good contact between the wires and that no contact exists between wires and steel pipe. Confirm the resistance in the wires does not exceed 0.015 ohms per metre of wire.

.6 Clean off a spot on the steel pipe and move one measuring cable to this spot. Verify that there is good contact. Confirm by means of a high voltage (Megger) that the resistance is higher than 30 MOhm at a test voltage of 500 VAC.

3.18 Checking and Testing of Alarm Wires – Components in the Field

.1 After the pipe is welded, and before the protective joint covering is installed, clean, crimp and solder alarm wires together. Perform the following test procedure:

  .1 Connect measuring cables to the two wires in the same pipe. Use a Megger to verify that resistance is higher than 20 MOhm at test voltage of 500 VAC. Locate and fix the faulty wire connection.

  .2 Clean a spot on the steel pipe. Connect one measuring cable to this spot and the other to one of the wires in the same pipe. Confirm resistance is higher than 20 MOhm at a test voltage of 500 V. Locate and fix the faulty joint connection. Check the other pipe in the same way.

.3 At the far end of the pipe connect tin plated wire in one pipe to the tinplated wire in the adjacent pipe. Similarly connect the clean copper wires together. Verify good contact at wire connections and that no contact between alarm wires and pipe wall exists.

.4 Connect the measuring cables to the tinplated wire at the free end. Ensure wire resistance does not exceed 1.5 Ohm per 100 m of wire (50 m of pipe). If resistance reading exceeds 1.5 Ohm per 100 m of wire, locate and fix the faulty wire connection. Repeat the inspection on the copper wires.

.2 When the measurements have been completed, checked and approved by the Professional of Record, the alarm wires are to be joined in accordance with the instructions for the joining method specified. Proceed to check the next assembly in the same manner. Verify that the alarm wires are installed correctly and by a qualified professional.

3.19 Pressure Tests

.1 Hydrostatically pressure test all piping after installation and before painting, insulating, or concealing in any way, in accordance with ASME B31.1.

.2 Submit test procedure to the Professional of Record a minimum of forty-eight (48) hours prior to commencement of the testing. Submittal to include:

.1 Safety procedure during pressure testing.

.2 Pre-test check list/inspection.

.3 Pressure test procedure.

.4 Current certification and calibration of meters and gauges.

.5 Copy of test certificate and record log.

.3 All instrumentation not specifically used for the testing purposes to be removed from the piping and not to be exposed to any pressure testing.

.4 Test the district heating primary piping hydraulically at a minimum test pressure of 1.5 times the design pressure for 1 hour without a drop in pressure.

.5 Any equipment not capable of withstanding test pressure to be isolated and vented. Flow meters, heat exchangers, and control valves are to be replaced with spool pieces prior to testing.

.6 Provide suitable temporary testing plugs or caps for the pipeline. Provide the necessary bracing, pressure pumps, pipe connections, meters, gauges, other required equipment, and labour required for a successful pressure test. Remove temporary equipment and fittings after completion.

.7 Provide water meter and gauge and install to allow the entire volume and pressure of water in the test section to be measured for the pressure test.

.8 Fill the section of pipe to be tested with clean, filtered fresh or potable water. Fill from system low point.

.9 Expel air from pipe.

  .1 If air releases or blow offs are not available at high points for releasing air, then make the necessary taps to properly conduct the test.

  .2 Let water to stand under pressure a sufficient time to allow the escape of air from any air pockets.

  .3 All taps to be properly plugged upon completion of the test.

.10 Joints to be kept dry during the pressure test. Visually inspect all joints during pressure test.

.11 Continuously monitor piping throughout test. Record (log) the test pressure every 15 minutes throughout the test.

.12 Submit to the Professional of Record the hydrotest examination results in a written report and include at least the following data:

  .1 Design Builder representatives.

  .2 Date of examination.

  .3 Test location.

  .4 Test section, with reference drawing.

  .5 Ambient temperature.

  .6 Fill water source.

  .7 Start test time.

  .8 End test time.

  .9 Start test pressure.

  .10 End test pressure.

  .11 Pipe sizes.

  .12 Results of examination.

  .13 Pressure record chart.

  .14 Signature of Professional Engineer registered in the Province of Manitoba.

  .15 Signature of inspector.

.13 Prepare a test certificate and be signatory to the test result and submit a copy as part of the O&M Information.

.14 Drain the system after the pressure test.

.1 Remove and clean strainers. Re-install after passing pressure test.

.2 Re-fill system with district heating water and bleed all air from the system or proceed with cleaning and flushing.

.3 Do not allow the pipe to remain empty after testing has taken place.

.15 Provide an in-service test at normal operating pressures at all tie-in points after final welds have been made.

3.20 Cleaning and Flushing

.1 Submit the proposed flushing procedure, a minimum of 20 Business Days prior to commencing the cleaning and flushing activities. Submittal to include, but is not limited to:

.1 Pump size and flow rate for the system flushing/cleaning. Provide pump curve.

.2 Size and location of bypasses/spool pieces marked on design schematic.

.3 Location of pump, test flow meter/gauge marked on design schematic.

.4 Safety procedure.

.5 Provision for addition of chemical cleaner/water treatment, if required.

.2 Notify the professional of Record forty-eight (48) hours in advance of the flushing and cleaning operation.

.3 Provide all temporary flushing bypasses, spool pieces, vents and drains, pumps and connection piping.

.4 All instrumentation including meters, gauges, transmitters, flow sensors, thermowells, switches, and control valves to be removed from the piping prior to flushing. Flushing through flow meters, heat exchangers or control valves is not permitted.

.5 Clean and flush piping system after completion of the hydrostatic pressure test, and after all piping is painted.

.6 Flush piping with clean water until such time as the flushing water is free from visible debris.

.7 Flushing velocity:

.1 Up to and including NPS 4: to be a minimum of 1.5 m/sec in all lines.

.2 For NPS 5 or larger: submit the Manufacturer’s recommended flushing velocity for as part of the detailed flushing procedure.

.8 Filling of System:

.1 Vent air from piping system at high points.

.2 Adjust supports, hangers, springs, after system is heated up and check that spring hangers are preventing undue loading on equipment nozzles.

.9 Tighten all bolts on flanges with torque wrench during commissioning.

3.21 Inspections

.1 Leave all joints in piping systems uncovered, and free from paint or insulation, until all tests are completed and the certified by the Professional of Record.

3.22 Equipment Checkout

.1 Provide continuous supervision during start-up.

.2 Upon start-up, bring all mains up to temperature and pressure slowly.

.3 Bleed air from system air vents as required.

.1 Remove strainer baskets and clean during test. Continue to clean the strainer baskets until substantial completion has been granted.

.4 Prior to circulating through plate exchangers, reconfirm screen size in permanent strainers as being 20 mesh (0.8 mm perforation size).

.5 After system is in operation and under maximum temperatures and pressures:

.1 Tighten all bolts on flanges, using torque wrench. Repeat several times during commissioning.

.2 Check operation of drain valves.

.6 Anchors, guides, supports, & expansion compensators:

.1 Monitor at all times during start-up and commissioning to ensure operation as designed.

.2 Adjust pipe supports, hangers, and springs.

END OF SECTION

HVAC PIPING THERMAL INSULATION

1. GENERAL

1.1 Summary

.1 This Section covers the thermal insulation for exposed HVAC piping and related equipment.

1.2 Standards

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE Standard 90.1, “Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).”

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A167, Standard Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip.

.2 ASTM B209M, Standard Specification for Aluminum Alloy Sheet and Plate.

.3 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.4 ASTM C411,“Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation.

.5 ASTM C449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.6 ASTM C533, Specification for Calcium Silicate Block and Pipe Thermal Insulation.

.7 ASTM C534, Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

.8 ASTM C547, Specification for Mineral Fiber Preformed Pipe Insulation.

.9 ASTM C552, Specification for Cellular Glass Block and Pipe Thermal Insulation.

.10 ASTM C553, Specification for Mineral Fiber Blanket and Thermal Insulation for Commercial and Industrial Applications.

.11 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.12 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.13 ASTM C1695, Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service.

.14 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials and Assemblies.

.3 American National Standards Institute/National Fire Protection Association (ANSI/NFPA):

.1 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.2 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 51-GP-9M, Thermal Insulation, Mineral Fiber, Sleeving for Piping and Round Ducting.

.2 CAN/CGSB 51-GP-11M, Thermal Insulation, Mineral Fiber, Blanket for Piping, Ducting, Machinery and Boilers.

.3 CAN/CGSB-51.12, Cement, Thermal Insulating and Finishing.

.4 CAN/CGSB-51.40, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.

.5 CAN/CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.6 CAN/CGSB 51-GP-53M, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

.5 Canadian Standards Association (CSA):

.1 CSA HA Series, CSA Standards for Aluminum and Aluminum Alloys.

.6 Manufacturer's Trade Associations:

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.7 Underwriters Laboratories (UL):

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings.

.4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

1.4 Insulation Fire Ratings

.1 All insulation materials to meet the requirements of NFPA 90A and have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed, as per CAN/ULC-S102.

1.5 Definitions

.1 For purposes of this Section:

.1 “Concealed” - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred-in spaces.

.2 “Exposed” - to mean “not concealed” as specified.

.3 “Removable” - means the ability to remove insulation coverings from mechanical fittings using reusable thermal blankets.

2. PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating of 25.

.2 Maximum smoke developed rating of 50.

.2 Materials to be tested in accordance with ASTM C411.

2.2 Insulation: TIAC Code A.1 Mineral Fibre – Rigid Moulded Pipe Insulation for Intermediate Temperature Range (15°C to 315°C)

.1 Application: for above ground piping, valves, and fittings in the following services:

.1 Interior DES piping.

.2 Unburied outdoor DES piping.

.3 Exception: Pre-insulated piping system.

.2 Materials: Preformed Pipe Insulation:

.1 TIAC Code A.1: rigid molded mineral fiber.

.2 Mineral fiber: to ASTM C547.

.3 Thickness as per table below.

TIAC Code A.1 Insulation for Intermediate Temperature Applications

	Thermal Conductivity (W/m°C)	Nominal Pipe Size (insulation thickness in millimeters)			
		≤ 1"	1-¼" to 2"	2-½" to 4"	≥5"
178 – 200	0.046 – 0.049	115	125	125	125
122 – 177	0.042 – 0.046	80	100	115	115
94 – 121	0.039 – 0.043	65	65	80	80
61 – 93	0.036 – 0.042	40	40	50	50
30 – 60	0.032 – 0.040	25	25	40	40

.4 For all unburied outdoor piping and piping in unheated indoor spaces use insulation thickness that corresponds to supply temperature of 178-200°C.

.5 Acceptable Products:

.1 Johns Manville Micro-Lok® HP.

.2 Manson Alley-KTM.

.3 Fibrex Coreplus 1200.

.4 Owens Corning FIBERGLAS®.

.5 Or approved equivalent.

.3 Apply outer jacket to insulated pipe in accordance with Item 2.5 of this Section.

2.3 Insulation: TIAC Code C.2 Flexible Mineral Fibre Blanket for Medium and High Temperature Applications (Removable Thermal Blanket Insulation)

.1 Application: on piping components and equipment including:

.1 Valves, strainers, flow meters, control valves, pump housings, expansion joints, expansion compensators, and flexible connectors for the following systems:

.1 DES piping, located in buried chambers and mechanical rooms.

.2 Materials:

.1 Asbestos-free removable thermal blanket insulation to withstand design temperatures.

.2 Minimum insulation thickness of 30 mm.

.3 Sewn outer jacket fabric to be coated for water and abrasion resistance.

.4 Design to allow for easy removal and reinstallation of same covering.

.5 Fabrication in accordance with ASTM C1695.

.6 Acceptable Products:

.1 Firwin Corporation.

.2 INSULTECH®.

.3 Keythermal.

.4 Or approved equivalent.

2.4 Fastenings

.1 For A.1 insulation systems (preformed mineral fibre pipe insulation):

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum. Maximum flame spread/smoke developed: to CAN/ULC-S102, less than 25 flame spread, less than 50 smoke developed.

.2 Acceptable Products:

.1 Fattal Insultape.

.2 Avery Dennison Fasson®.

.3 Or approved equivalent.

.3 Lap seal adhesive: quick setting for joints and lap sealing of vapour barriers. Flame spread 10, smoke 0.

.1 Acceptable Products:

.1 Childers CP80.

.2 Or approved equivalent.

.4 Lagging adhesive: fire retardant coating.

.1 Acceptable Products:

.1 Childers CP 50A-HV2.

.2 Or approved equivalent.

2.5 Jackets

.1 Polyvinyl Chloride (PVC) Jacketing:

.1 Apply on all exposed piping for the following services with surface temperature of jacketing between minus 20 to 65°C:

.1 Interior piping with insulation systems A.1.

.2 PVC Jacketing: to CAN/CGSB 51-GP-53M, complete with preformed shapes to set out in the Final Design and dimensions.

.3 One piece molded type fitting covers and sheet material.

.4 Fastenings standard to Manufacturer.

.5 Acceptable Manufacturer:

.1 Childers.

.2 Or approved equivalent.

.2 All Service Jacket:

.1 Apply on concealed piping only for the following services:

.1 Insulation for systems A.1.

.3 Aluminum Alloy:

.1 Apply in accordance with ASTM B209M on all piping for the following services:

.1 All above-grade interior and exterior piping.

.2 All piping located in valve chambers.

.2 Crimped or embossed jacketing 0.4 mm thick with longitudinal slip joints and 50 mm end laps with factory attached protective liner on interior surface. Aluminum alloy butt straps with mechanical fasteners.

.3 On fittings: matched pre-fabricated 0.4 mm thick, die shaped components with factory attached protective liner on interior surface.

.4 Acceptable Manufacturer:

.1 Childers.

.2 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Application

.1 Apply insulation after required system tests have been completed and certified by Professional of Record. Insulation of piping may commence prior to testing provided the joints remain un-insulated.

.2 Clean and dry surfaces during application of insulation and finishes.

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

.4 Work to be performed by qualified professional.

3.3 Installation

.1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.

.2 Pre-formed: sectional NPS less than or equal to 12, sectional or curved segmented for NPS greater than or equal to 12.

.3 Multi-layered: staggered butt joint construction.

.4 Vertical pipe > NPS 3: insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate on 4.5 m centres.

.5 Expansion joints in insulation: terminate single layer and each layer of multiple layers in straight cut at intervals recommended by Manufacturer. Leave void of 25 mm between terminations. Pack void lightly with flexible mineral insulation.

.6 Seal and finish exposed ends and other terminations with insulating cement.

.7 Expansion joints in piping: provide removable blanket to accommodate for adequate movement of expansion joint.

.8 With pre-formed PVC fittings use a vapour retarder mastic compatible with the PVC, applied around the edges of the adjoining pipe insulation and on the fitting cover throat overlap seam. Apply fitting cover, secure with pressure sensitive tape along the circumferential edges with a minimum of 50 mm overlap.

.9 Orifice plate mounting flanges, flanges and unions at equipment, check valves, strainers, other components requiring regular maintenance: a removable enclosure is to be provided to allow for future access to studs and nuts to permit use of tools without damage to insulation, install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finishes.

.10 Insulation is not required for (excluding chilled water piping, and exterior or unheated areas):

- .1 Unions, and flanges on low temperature systems from 50-95°C.

- .2 Vent, relief, and drain piping under 25 mm, if normally empty.

3.4 Fastenings

.1 Secure pipe insulation by tape at each end and centre of each section, but not greater than 900 mm on centres.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for product selection, installation and testing of packaged indoor air handling units.

1.2 Standards

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

.1 AMCA 99, Standard Handbook.

.2 AMCA 210, Laboratory Methods of Testing Fans for Rating Purposes.

.3 AMCA 300, Reverberant Room Methods for Sound Testing of Fans.

.4 AMCA 301, Method of Calculating Fan Sound Ratings from Laboratory Test Data.

.5 AMCA 99-2408: Operating Limits for Centrifugal Fans.

.2 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

.1 AHRI 260, Sound Rating of Ducted Air Moving and Conditioning Equipment.

.2 AHRI 270, Sound Performance Rating of Outdoor Unitary Equipment.

.3 AHRI 410, Standard for Forced Circulation Air-Cooling and Air-Heating Coils.

.4 AHRI 430, Performance Rating of Central Station Air-Handling Units.

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

.1 ASHRAE 33, Methods of Testing Forced-Circulation Air-Cooling and Air-Heating Coils.

.2 ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.

.4 ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.5 ASHRAE 111, Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

.4 CSA C746 Standard for Rating Large Air Conditioners and Heat Pumps.

.5 National Fire Protection Association (NFPA):

.1 NFPA 70, National Electrical Code.

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

.3 NFPA 90B, Standard for Installation of Warm Air Heating and Air Conditioning Systems.

.6 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG 1, Motors and Generators.

.7 Underwriters Laboratories of Canada (ULC):

.1 UL 181, Standard for Safety Factory-Made Air Ducts and Connectors.

.2 UL 508, Industrial Control Equipment.

.3 UL 705, Power Ventilators.

.4 UL 1995, Standard for Safety Heating and Cooling Equipment.

.8 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

.9 ARI Certification: Provide ARI certified and listed units.

.10 AMCA Compliance: Products are to comply with performance requirements and are to be licensed to use the AMCA-Certified ratings seal.

.11 Manitoba Workplace Safety and Health Act and Regulation.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Certified fan performance curves with system operating conditions indicated per equipment schedules. Select fans at maximum efficiency for specified duty.

.3 Certified sound power levels for make-up air unit inlet and outlet and casing radiation at rated capacity in accordance with AMCA. List for individual octave bands in dB referenced to A rating.

.4 Dampers, including housings, linkages, and operators.

.5 Air Filters: Media, efficiency rating, velocity, pressure drop charts and capacities. Indicate mounting method and arrangement.

.6 Water coil(s) are submitted under Section 15750. Include coil submittal number(s) as reference.

.7 Materials of construction and Electrical Classification: Indicate material and gauge of all construction components and area classification.

.8 Mass distribution drawings: show point loads and recommended method of unit installation.

.9 Detailed composite wiring diagrams and schematics showing factory installed wiring, including wiring of control components.

.10 Control descriptions for internal equipment control and interface with PCS.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Engineered Air.

.2 Mammoth.

.3 Hunt Air.

.4 Haakon.

.5 Scott Springfield.

.6 Or approved equivalent.

2.2 Performance Criteria

.1 Select materials based on the Corrosion Study as specified in Schedule 18 Technical Requirements.

.2 The Manufacturer shall provide a complete factory assembled air handling unit. The unit shall include all specified components installed at the factory. Field fabrication of the units or their components is not acceptable.

.3 Horizontal and Vertical type, as required, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, damper section heating coil.

.4 Protective Coatings in Classified or Category 1 or 2 Areas:

.1 Coat entire assembly with corrosion-resistant factory applied coatings (Acceptable Products: Heresite, Hi-Pro Polyester, or approved equivalent), or epoxy applied in strict conformance with the paint Manufacturer's instructions.

.5 Units located in electrically classified areas will be constructed with Class 1 rated components with Zone (Division) requirements dictated by the area's electrical hazard rating.

.6 All electrical circuits to undergo a dielectric strength test, and to be factory tested and checked as to proper function.

.7 Air handling units are to include, at a minimum, the following components:

.1 Supply fans.

.2 Return fans.

.3 Heating coil.

.4 Prefilter.

.5 Final Filter.

.6 Motorized return air, outdoor air and exhaust air section.

.7 Access sections.

.8 All specified components and internal accessories factory installed and tested and prepared for single-point power connection.

.8 Heating method, hydronic, natural gas or electric, is to be determined following the City of Winnipeg, Winnipeg Sewage Treatment Program – Building Mechanical Design Guideline. Preference is to be given to hydronic.

2.3 Construction

.1 Cabinet:

.1 Exterior Panels:

.1 Minimum 1.6 mm satin coat galvanized steel. Surfaces to be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Exterior panels to be cleaned with degreasing solvent to remove oil and metal oxides and primed with two-part acid based etching prime. Finish coat to be two (2) component epoxy with polyurethane top coat.

.2 Interior surfaces and unit underside to be coated in a two-part 0.1524 mm epoxy finish according to Section 09900.

.3 Other special paint requirements include epoxy coat belt guards, fan casings and steel fan wheels.

.1 Belt guards to comply with the Manitoba Workplace Safety and Health Act and Regulation.

.4 All unprotected metal and welds are to be factory coated.

.5 Air leakage not to exceed 0.034 liters per second / sq. meter of wall area at a pressure differential of 0.96 kPa.

.6 No uncontrolled water penetration through panel joints when tested at 0.96 kPa.

.2 Walls, Ceilings, and Base:

.1 Interlocking formed construction with at least two (2) breaks at each interlocking joint. Wall and ceiling joints are to be broken outward. All panel joints are to be caulked with water resistant sealant.

.2 The casing depth is to match the specified insulation thickness.

.3 Inside surfaces are to be clean and flush, free of exposed flanges.

.4 Floor structure is to be constructed from hot rolled per ASTM A36/44W structural steel channel iron around perimeter with intermediate channel and angle iron supports. Floor plate to be as indicated below:

Location	**Floor plate**
Floor and fan section	2.0 mm welded black iron checker plate floor with epoxy coating
All other areas	2.0 mm satin coat galvanized steel

.5 Provide floor bracing channels at maximum 300 mm on centre.

.3 Insulation and Liner:

.1 Insulate all exterior walls and roof with 50 mm thick rigid fibrous glass acoustic insulation, 48 kg/m³ density. Line interior of all panels with 0.71 mm galvanized steel liner.

.2 Insulate underside of unit floor with 50 mm thick rigid fibrous glass insulation 48 kg/m³ density. Hold in place insulation with welded pins 400 mm on centre.

.3 Wash down liner to be screwed and caulked to allow for power washing without risk of wetting the internal insulation. Solid liner 0.64 mm to be broken over 51 mm drain pan upturn to allow water to shear into pan (see floor as drain pan).

.4 Continuous high pressure sealant to be provided between all panels.

.2 Access Doors:

.1 Provide hinged person sized access doors. Door construction to be the same as casing each complete with 250 mm diameter round, or equivalent area square, wired glass viewing window. Provide minimum two latches per door openable from both sides. Doors to be sealed with neoprene gasketting (foam gasketting not acceptable). Door hinge to be continuous stainless steel piano hinge. Door sizes to be 750 mm x 1800 mm or as limited by height of unit. Provide access doors for the following sections.

.1 Fan motor section.

.2 Heating coil section.

.3 Filter sections.

.4 Access sections.

.5 Damper sections.

.6 Electrical control panel.

.2 Access doors on sections under positive pressure are to be restrained. Apply warning labels to all doors under positive pressure.

.3 Marine Lights:

.1 Provide marine type lights with Lexan bulb covers in all sections having an access door on all units. Lights to be factory installed and wired to a single lighted switch located outside the service corridor access door or where no service corridor is provided on the exterior of the unit.

.2 Install compact fluorescent lamps to each light fitting with an equivalence of 100 W per lamp.

.3 All lights within the units, service corridor and inlet plenum are to be switched from a single switch located outside and adjacent to the service corridor personnel door. Light to be fed from a separate source so that the lights are operative even when the unit is off.

.4 Lights will be Class 1 rated with Zone (Division) requirements dictated by the area’s electrical hazard rating.

.4 Fan:

.1 Fan to consist of a belt driven, backward inclined blower. Assembly to be mounted on heavy gauge galvanized rails and further mounted on seismically rated vibration isolators. Fan assembly to be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.2 Fan to be manufactured according to the Corrosion Study specified in Schedule 18 Technical Requirement and from material suitable for the airstream in which it is located.

.3 For applications in classified areas, fans are to be AMCA A Spark-proof construction.

.4 Fan total static pressure will be based on a filter dirty condition of 250 Pa.

.5 Mount fans on common steel shaft, on L50 - 200,000 hours self-aligning, single row, deep groove ball bearings in a pillow block cast iron housing. Provide extended lube lines to outside of casing.

.6 Provide variable sheaves for motors 11 kW and under and fixed sheaves for motors 15 kW and over.

.7 Motor to be Manufacturer’s premium efficiency for inverter duty.

.8 Entire fan assembly including fan scroll, wheel and motor to be integrally mounted on a unitary fan and motor base and to be separated from unit casing with flexible connections and spring isolators.

.9 A belt guard shall be included to completely cover the sheaves and belt assembly.

.1 Belt guards to comply with the Manitoba Workplace Safety and Health Act and Regulation.

.10 Optional direct dive, unhoused, backward inclined, plenum supply fans with factory mounted and wired VFD or ECM with speed control.

.5 Motors:

.1 Motors to be heavy-duty permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.

.2 Motors to be premium efficiency, totally enclosed, fan cooled (TEFC), inverter duty rated unless otherwise noted.

.3 Drives to be sized for a minimum of 150 percent of driven horsepower and pulleys to be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts.

.4 Motors located in classified areas or handling classified air are to be Class 1 rated with Zone (Division) requirements dictated by the area or air’s electrical hazard rating.

.6 Coils:

.1 Hot water/glycol coils to be in accordance with Section 15750.

.7 Indirect Gas Fired Heat Exchanger:

.1 General:

.1 Heating units to be indirect natural gas fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories to be approved by an independent testing authority, and carry the approval label of that authority as a complete operating package.

.2 All units to exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire.

.3 Operating natural gas pressure at unit(s) manifold to be 1.75 to 3.50 kPa.

.4 Gas manifolds to be provided to FM standards.

.5 Gas fired units to be approved for operation in minus 20°C spaces.

.2 Heat Exchanger:

.1 Heat exchanger to be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane tubulators and to be of a floating stress relieved design. Heat exchanger to be provided with condensate drain connection. The heat exchanger casing is to have 25 mm of insulation between the outer cabinet and inner liner. Blower assemblies close coupled to duct furnace type heat exchangers are not permitted.

.2 Heat exchangers to be tested and certified to CSA standards to provide a minimum ETL certified 90 percent efficiency throughout the entire operating range.

.3 Burner:

.1 The burner assembly to be a blow through positive pressure type with an intermittent pilot ignition system to provide a high seasonal efficiency. Flame surveillance to be with a solid state programmed flame relay complete with flame rod. The burner and gas train to be located inside a cabinet enclosure. Insulation in the burner section to be covered by a heat reflective galvanized steel liner. Atmospheric burners or burners requiring power assisted venting are not permitted.

.2 Provide discharge air temperature control with 15:1 turndown capability for all input capacities in range from 29.3 kW to 410 kW. The high turndown burner minimum input to be capable of controlling at 6.7 percent of its rated input without on-off cycling and include built in electronic linearization of fuel and combustion air. Efficiency is to increase from high to low fire.

.4 Venting:

.1 Installation and venting provisions to be in accordance with CGA Standard B149.1, ANSI Z223.1-NFPA54, and local authorities have jurisdiction. Type A, L, and/or PS venting is required.

.5 Burner Controls:

.1 The gas fired heating controller to be a fuel/combustion air local controller. The controller is to incorporate a solid state analyzer complete with proportional and integral control and with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions.

.2 Combustion efficiency of high efficiency heat exchangers is to increase 4 to 5 percent from high fire to low fire. Heat exchangers are to provide a minimum of 90 percent efficiency throughout the entire operating range.

.3 As an alternative to variable speed combustion air blower, the burner control may include a modulating gas valve and a combustion air damper with a linear linkage connected to an actuator which has a minimum of 100 steps of control.

.6 Burner controls are to include the following standard features:

.1 Linear gas and combustion air flow obtained via a built-in solid state linear algorithm.

.2 Minimum operating ambient temperature: minus 40°C.

.3 Four (4) air change pre-purge on units with over 117 kW input.

.4 Post purge.

.5 Interrupted pilot.

.6 Self-check on start-up to make sure air proving and discharge air sensors are operating within design tolerances.

.7 Low fire start.

.8 Controlled burner start-up and shut down.

.9 Diagnostic lights for ease of set-up and service.

.10 Blower contactor that starts fan after burner pre-purge.

.11 Damper contact that allows fan to start after damper opens, damper to close after fan stops and damper to close on flame failure.

.12 Non-recycling auto by-pass low limit that has built-in sensor checking.

.7 Burner controller to modulate heating output to maintain supply air temperature setpoint. Refer to Sections 15910 and 15920 for control system requirements.

.8 Condensate Neutralization Tank:

.1 Condensate neutralization tank to include of a 20 L tank made from one-piece seamless polyethylene construction with 125 mm media fill/access opening, 40 mm FIP inlets on the top and the side, 40 FIP side outlet, and 40 mm FIP top vent.

.2 Acceptable Product:

.1 Axiom Industries Ltd. - Model NT20.

.2 Or approved equivalent.

.3 Supply complete with initial charge of neutralizing media.

.9 Condensate Pump:

.1 Provide a fully automatic condensate removal pump rated for the removal of acidic condensate with 1.9 L capacity tank manufactured from acrylonitrile butadiene styrene (ABS), a vertical-type pump with stainless steel motor shaft, high-impact ABS volute and motor cover, 3 drain holes, removable 10 mm O.D. barbed check valve. The motor to be thermally protected and cUL and CSA listed. Provide an overflow safety switch for connection to the PCS.

.2 Acceptable Product:

.1 Little Giant VCMA-20 Series.

.2 Or approved equivalent.

.8 Electric-Resistance Heating Coils:

.1 Casing Assembly: Galvanized-steel frame.

.2 Removable for replacement or service without further disassembly of the air handler.

.3 Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.

.4 Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.

.5 Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

.6 Control Panel: Unit mounted with disconnecting means and overcurrent protection.

.1 Full modulation capacity controlled by SCR.

.2 0-10 VDC heating control signal.

.3 Airflow proving switch.

.7 Fans:

.1 Propeller type with single piece spun Venturi outlets and zinc plated guards.

.2 High efficiency electrically commutated motor

.3 Factory installed head pressure control module:

.4 Modulate fan speed based on head pressure.

.5 Cooling operation allowed down to 2 degrees C outdoor air temperature with adjustable compressor lockout.

.8 Condenser coil:

.1 Tubes: Copper.

.2 Fins: Aluminum mechanically bonded to tubes.

.3 Designed for a minimum of 5.5 degrees C of refrigerant sub-cooling.

.4 Hydrogen or helium leak tested.

.5 Flexible, epoxy polymer e-coat over complete coil:

.1 Humidity and water immersion resistance to a minimum of 1,000 hours per ASTM D2247-92 and ASTM D870-92.

.2 Corrosion durability confirmed through testing with coating capable of withstanding at least 10,000 hours of salt spray per ASTM B117-90.

.3 UV resistant polyurethane topcoat.

.4 5 Year warranty on coatings.

.5 Factory piped and charged refrigerant piping with sight glass, filter and valves.

.9 Evaporator coil:

.1 Rated to ARI Standard 210-75.

.2 Tubes: Copper.

.3 Fins: Aluminum mechanically bonded to tubes.

.4 Designed for a minimum of 10 degrees F of refrigerant sub-cooling.

.5 Hydrogen or helium leak tested.

.6 Flexible, epoxy polymer e-coat over complete coil:

.1 Humidity and water immersion resistance to a minimum of 1,000 hours per ASTM D2247-92 and ASTM D870-92.

.2 Corrosion durability confirmed through testing with coating capable of withstanding at least 10,000 hours of salt spray per ASTM B117-90.

.3 UV resistant polyurethane topcoat.

.4 5 Year warranty on coatings

.5 Alternate row circuiting for multi-compressor system, with each compressor on a totally independent refrigeration circuit complete with independent expansion valve.

.9 Drain Pans:

.1 Drain pans to be fabricated of stainless steel and are an integral part of the floor paneling, a minimum of 51 mm deep, with welded corners. Drain pans to extend a minimum of 152 mm downstream of coil face and be provided with a 38 mm stainless steel MPT drain connection. Drain pans to have a fast pan and be sloped and pitched such that there is no standing water. Intermediate fast pans to be provided between cooling coils where required for effective moisture removal.

.2 On units with stacked coils, provide a separate drain pan under each coil. On all units, provide a secondary drain pan extending under the entire access section downstream of the cooling coil and the humidifier section. Provide a drain pan to drain the fresh air intake or mixing plenum. Pipe all drains to the exterior side of unit.

.10 Mixing Section:

.1 Configure to ensure complete mix of air. Arrange dampers to direct the air flow from set of blades into the other.

.2 Utilize damper sections which extend across unit width plane with maximum width not exceeding 1200 mm per section.

.11 Dampers:

.1 Extruded aluminum (6063T5) damper frame not to be less than 2.03 mm in thickness. Damper frame to be minimum of 100 mm deep and is to be insulated with polystyrofoam on four sides. Entire frame is to be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.

.2 Blades to be extruded aluminum (6063T5) profiles, internally insulated with expanded polyurethane foam and are to be thermally broken. Complete blade is to have an insulating factor of R-2.29 and a temperature index of 55. Blade and frame seals to be of extruded silicone and to be secured in an integral slot within the aluminum extrusions.

.3 Bearings to be composed of a Celcon inner bearing fixed to 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact. Linkage hardware to be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.4 Dampers to be designed for operation in temperatures ranging between minus 40°C (minus 40°F) and 85°C (185°F). Dampers to be available with either opposed blade action or parallel blade action.

.5 Each end switch to be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure to permit setting the position of the trip lever that actuates the switch. The trip lever to be aligned with the damper blade.

.6 Damper leakage is to be certified under the AMCA certified rating program and is to carry AMCA seal:

.1 Low Leakage: 8.6 $L/s/m^2$ at 250 Pa pressure difference for a 1220 mm x 1220 mm damper.

.7 Install blade linkage hardware in frame out of air stream. Use cadmium plated steel hardware. Extend damper shaft through casing sufficiently to allow installation of the damper operator in the service corridor.

.8 Arrange linkage and provide an adequate number of damper operators to ensure that the interconnected damper sections operate in unison without binding.

.9 The outdoor air damper to be integral part of the air handling units and is to be supplied and installed by the air handling unit Manufacturer at the factory.

.10 Electronic Non-Modulating Damper Operators:

.1 Spring return, 24 VAC operating voltage, on-off operation, seventy (70) seconds maximum running time for 90 degree opening and thirty (30) seconds maximum closing time.

.2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

.11 Electronic Modulating Damper Operators:

.1 Spring return, 24 VAC operating voltage, 0-10 VDC input signal, 0-10 VDC position output signal, seventy (70) seconds maximum running time for 90 degree opening and thirty (30) seconds maximum closing time.

.2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

.12 Acceptable Manufacturers:

.1 Tamco.

.2 Ruskin.

.3 Or approved equivalent.

.12 Filters:

.1 Filters to be in accordance with Section 15855.

.2 Winter and summer positions.

.3 Filters located in the outdoor air intake to be accessible from the exterior of the unit.

.4 Filters containing asbestos, and urea formaldehyde are not acceptable.

.5 Mounting racks to be galvanised to suit specified filter type.

.6 Limit filter velocity based on face area to less than 2.5 m/s (500 fpm).

.7 Units to be designed with a filter dirty pressure of 250 Pa.

.8 Provide one (1) magnehelic filter gauge for each bank of filters, including for each position of prefilter. Flush mount gauge on the exterior of the unit. Gauge is to be suitable for outdoor operation.

.1 Acceptable Product:

.1 Dwyer 2000.

.2 Or approved equivalent.

.9 Provide one (1) pressure transducer for each bank of filters, including for each position of prefilter to provide continuous monitoring of filter pressure drop at the PCS.

.1 As per Appendix 18E – Standardized Goods.

.2 Or approved equivalent only when the conditions in Appendix 18E – Standardized Goods do not apply.

.10 Control Panels:

.1 Provide control panel of unitised cabinet type construction. Mount relays, switches and control point adjustment in cabinet and pressure gauges, pilot lights, push buttons, switches and VFD’s flush on cabinet panel face.

.2 Fabricate panels from 2.5 mm (12 ga) rolled sheet metal sheet flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. Each panel to have identical key and lock sets. CSA approved for line voltage applications.

.3 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.4 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 VAC supply.

.5 Make all power and control wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.6 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.7 Provide terminal blocks, tabular clamp, 300 VAC, complete with track. Each terminal is to be clearly indelibly marked with the wire number connection to it. Each field connecting conductor is to be served by one terminal. Provide 20 percent spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as Manufacturer jumpers and marking tape.

.8 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position.

.9 Step down transformers to be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, are to have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformers to be sized so that the connected load is 80 percent of the rated capacity or less. Transformers to conform to UL 508.

.10 Control wiring for digital functions to be 18 AWG minimum with 300 VAC insulation.

.11 Control wiring for analog functions to be 18 AWG minimum with 300 VAC insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.12 Sensor wiring is to be 18 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.13 Transformer current wiring is to be 16 AWG minimum.

.13 Instrumentation: Provide all instrumentation required for complete control and monitoring of the units in accordance with Sections 15920, Division 17 and Appendix 18E – Standardized Goods. Instrumentation to be provided with each unit including but not limited to the following:

.1 DPDT air differential pressure switch for fan status.

.2 Filter differential pressure indicating transmitter.

.3 Outdoor air temperature indicating transmitter.

.4 Supply air temperature indicating transmitter.

2.4 Controls

.1 Control will be provided through the Plant Control System (PCS).

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Examination

.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

.2 Examine casing insulation materials and filter media before unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

.4 Verify equipment sectioning and module sizing allows for placement and removal with access hatches indicated on drawings.

3.3 Installation

.1 Equipment Mounting:

  .1 Install packaged, indoor, energy-recovery units on 100 mm cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03300.

  .2 Comply with requirements for vibration-isolation devices specified in Section 15241.

  .3 The installation is to meet the seismic restraint requirements as stated in section 15241.

.2 Install units with clearances for service and maintenance.

.3 The removal from the building of any unit will not require the temporary or permanent decommissioning of other systems.

  .1 Do not use the units for temporary heating or cooling unless expressly approved by the City.

  .2 Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

.4 Ductwork connections:

  .1 Comply with requirements for ductwork according to Section 15890.

  .2 Connect duct to units with flexible connections. Comply with requirements in Section 15890.

.5 Piping connections:

  .1 Comply with requirements for piping specified in Section 15792. Drawings indicate general arrangement of piping, fittings, and specialties.

  .2 Provide a balancing valve in the return piping connection and an isolating valve in the supply piping connection to each unit.

.3 Where installing piping adjacent to unit, allow for service and maintenance.

.4 Connect piping to units mounted on vibration isolators with flexible connectors.

.5 Condensate Drain Piping: Pipe drains from drain pans to nearest floor drain, same size as condensate drain connection.

.1 Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

.6 General: No exposed copper or copper alloy is allowed. Provide a baked on Heresite phenolic coating suitable for three thousand (3000) hours salt spray per ASTM B117 for all copper components.

.6 Electrical connections:

.1 Install electrical devices furnished with units but not factory mounted.

.2 Connect wiring according to Section 16.

.3 Ground equipment according to Section 16.

.4 Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

.1 Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 12 mm high.

.7 Control connections:

.1 Install control and electrical power wiring to field-mounted control devices.

.8 Field quality control:

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

.2 Tests and Inspections:

.1 Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.3 Prepare test and inspection reports.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for product selection, installation and testing of outdoor air handlers.

1.2 Standards

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

.1 AMCA 99, Standard Handbook.

.2 AMCA 210, Laboratory Methods of Testing Fans for Rating Purposes.

.3 AMCA 300, Reverberant Room Methods for Sound Testing of Fans.

.4 AMCA 301, Method of Calculating Fan Sound Ratings from Laboratory Test Data.

.5 AMCA 99-2408: Operating Limits for Centrifugal Fans.

.2 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

.1 AHRI 260, Sound Rating of Ducted Air Moving and Conditioning Equipment.

.2 AHRI 270, Sound Performance Rating of Outdoor Unitary Equipment.

.3 AHRI 410, Standard for Forced Circulation Air-Cooling and Air-Heating Coils.

.4 AHRI 430, Performance Rating of Central Station Air-Handling Units.

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

.1 ASHRAE 33, Methods of Testing Forced-Circulation Air-Cooling and Air-Heating Coils.

.2 ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.

.4 ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.5 ASHRAE 111, Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

.4 American Society for Testing and Materials (ASTM):

.1 ASTM A36, Standard Specification for Carbon Structural Steel.

.2 ASTM A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A568, Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.

.4 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM B88, Standard Specification for Seamless Copper Water Tube.

.6 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

.7 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.8 ASTM C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.9 ASTM D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

.10 ASTM D3359, Standard Test Methods for Rating Adhesion by Tape Test.

.11 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 National Fire Protection Association (NFPA):

.1 NFPA 70, National Electrical Code.

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

.3 NFPA 90B, Standard for Installation of Warm Air Heating and Air Conditioning Systems.

.6 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG 1, Motors and Generators.

.7 Underwriters Laboratories of Canada (ULC):

.1 UL 181, Standard for Safety Factory-Made Air Ducts and Connectors.

.2 UL 705, Power Ventilators.

.3 UL 1995, Standard for Safety Heating and Cooling Equipment.

.8 Manitoba Workplace Safety and Health Act and Regulation.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

.2 Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

.3 Include unit dimensions and weight.

.4 Include cabinet material, metal thickness, finishes, insulation, and accessories.

.5 Fans:

.1 Include certified fan-performance curves with system operating conditions indicated.

.2 Include certified fan-sound power ratings.

.3 Include fan construction and accessories.

.4 Include motor ratings, electrical characteristics, and motor accessories.

.6 Include certified coil-performance ratings with system operating conditions indicated.

.7 Include filters with performance characteristics.

.8 Include dampers, including housings, linkages, and operators.

.9 Submit certified sound power levels for unit inlet and outlet and casing radiation at rated capacity in accordance with AMCA.

.10 Control descriptions for internal equipment control and interface with PCS.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Engineered Air.

.2 Mammoth.

.3 Hunt Air.

.4 Haakon.

.5 Or approved equivalent.

2.2 Performance Criteria

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

.3 ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

.4 ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

.5 Structural Performance: Casing panels shall be self-supporting and capable of withstanding positive/negative 2,500 Pascals of internal static pressure, without exceeding a midpoint deflection of 0.0042 mm/mm of panel span.

.6 Casing Leakage Performance: ASHRAE 111, Class 6 leakage or better at +/- 2,000 Pascals.

.7 Manufacturer shall provide a complete factory assembled air handling unit. The unit shall include all specified components installed at the factory. Field fabrication of the units or their components is not acceptable.

.8 Horizontal type having airtight modular components, consisting of casing, fan section with motor and drive, filter section, damper section heating coil.

.9 Protective Coatings in electrically Classified or Category 1 or 2 wet or corrosive areas:

    .1 Coat entire assembly with corrosion-resistant factory applied coatings (Acceptable Products: Heresite, Hi-Pro Polyester, or approved equivalent), or epoxy applied in strict conformance with the paint Manufacturer's instructions.

.10 Units serving or located in electrically classified areas will be constructed with Class 1 rated components with Zone (Division) requirements dictated by the area’s electrical hazard rating.

.11 All electrical circuits to undergo a dielectric strength test, and to be factory tested and checked as to proper function.

.12 Air handling units are to include, at a minimum, the following components:

    .1 Supply fans.

    .2 Return fans.

    .3 Heating coil.

    .4 DX cooling

    .5 Prefilter.

.6 Final Filter.

.7 Motorized return air, outdoor air and exhaust air section.

.8 Access sections.

.9 All specified components and internal accessories factory installed and tested and prepared for single-point power connection.

.13 Heating method, hydronic, natural gas or electric, is to be determined following the City of Winnipeg, Winnipeg Sewage Treatment Program – Building Mechanical Design Guideline. Preference is to be given to hydronic.

2.3 Construction

.1 Cabinet:

.1 Frame:

.1 Modular and providing overall structural integrity without reliance on casing panels for structural support.

.2 Walls, Ceilings, and Base:

.1 Double-wall construction.

.2 Outside Casing Wall:

.1 Standard Material, Galvanized Steel: Minimum 18 gauge thick.

.2 Alternate Material, Aluminum: Minimum 16 gauge thick when required.

.3 Alternate Material, Stainless Steel: Minimum 18 gauge thick when required.

.3 Inside Casing Wall:

.1 Standard Material, Solid galvanized Steel: Minimum 18 gauge thick.

.2 Alternate Material, Solid aluminum: Minimum 16 gauge thick when required.

.3 Alternate Material, Solid stainless Steel: Minimum 18 gauge thick when required.

.4 Interlocking formed construction with at least two breaks at each interlocking joint. Wall and ceiling joints shall be broken outward. All panel joints shall be hermetically sealed at each corner and around entire perimeter.

.5 Roof shall be pitched slightly (minimum 2 percent) to prevent water pooling.

.6 The casing depth shall match the specified insulation thickness.

.7 Inside surfaces shall be clean and flush, free of exposed flanges.

.8 Provide min. 25 mm x 25 mm drip channels over all access doors.

.9 Floor structure shall be constructed from structural galvanized steel channel iron around perimeter with intermediate channel and angle iron supports. Floor plate shall be 2.0 mm satin coat galvanized steel.

.10 Provide floor bracing channels at maximum 300 mm on centre.

.3 Exterior Panels:

.1 Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.

.2 Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow.

.3 Gasket: Neoprene, applied around entire perimeters of panel frames.

.4 Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components.

.5 Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer.

.6 Exterior finish coat shall be electrostatically applied enamel, to all exposed surfaces custom colour finish, Colour to be confirmed.

.7 Interior surfaces and unit underside are to be coated in a two-part 0.1524 mm epoxy finish.

.8 All unprotected metal and welds shall be factory coated.

.4 Doors:

.1 Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing complete with viewing window.

.2 Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.

.3 Gasket: Neoprene, applied around entire perimeters of panel frames.

.4 Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 72 inches.

.5 Locations and Applications:

.1 Fan Section: Doors, with windows.

.2 Coil Section: Panels.

.3 Access Sections Immediately Upstream and Downstream of Coil Sections: Doors, with windows.

.4 Damper Section: Doors, with viewing windows.

.5 Filter Section: Doors large enough to allow periodic removal and installation of filters.

.6 Access Sections Immediately Upstream and Downstream of Filter Sections: Doors, with windows.

.7 Mixing Section: Doors, with windows.

.5 Windows:

.1 Construction: Fabricate windows in access panels and doors of double-glazed, safety glass with an airspace between panes and sealed with interior and exterior rubber seals.

.2 Size: Minimum 8 inches, square or round.

.6 Service Lights: 100 Watt equivalent LED vaporproof luminaire with individual switched junction box located outside, adjacent to each access door and panel.

.1 Locations: Each section accessed with door or panel.

.7 Convenience Outlets: One 20-A duplex GFCI receptacle per location with junction box located on outside casing wall.

.8 Condensate Drain Pans:

.1 Single-wall, dual sloped, stainless-steel sheet.

.2 Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

.3 Slope: Slope is to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends and to direct water toward drain connection.

.4 Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.

.5 Width: Entire width of water producing device.

.6 Depth: A minimum of 2 inches deep.

.7 Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

.9 Insulation and Liner:

.1 Insulate all exterior walls and roof with 100 mm thick injected polyurethane foam insulation. Line interior of all panels with 0.71 mm galvanized steel liner.

.2 Insulate underside of unit floor with 100 mm thick injected polyurethane foam insulation.

.3 Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

.10 Outdoor Air Hood:

.1 Hood to be furnished from the same material as the exterior walls of the unit. Finish to match unit. Provide 25 mm x 25 mm galvanized mesh over unit opening.

.2 Fan:

.1 Fan to consist of a belt driven, backward inclined blower. Assembly to be mounted on heavy gauge galvanized rails and further mounted on seismically rated vibration isolators. Fan assembly to be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.2 Fan to be manufactured from material suitable for the airstream in which it is located.

.3 For applications in classified areas, fans are to be AMCA A Spark-proof construction.

.4 Fan total static pressure will be based on a filter dirty condition of 250 Pa.

.5 Mount fans on common steel shaft, on L50 - 200,000 hours self-aligning, single row, deep groove ball bearings in a pillow block cast iron housing. Provide extended lube lines to outside of casing.

.6 Provide variable sheaves for motors 11 kW and under and fixed sheaves for motors 15 kW and over.

.7 Entire fan assembly including fan scroll, wheel and motor to be integrally mounted on a unitary fan and motor base and to be separated from unit casing with flexible connections and spring isolators.

.8 A belt guard shall be included to completely cover the sheaves and belt assembly.

.1 Belt guards to comply with the Manitoba Workplace Safety and Health Act and Regulation.

.9 Optional direct dive, unhoused, backward inclined, plenum supply fans with factory mounted and wired VFD or ECM with speed control.

.3 Motor:

.1 Motor to be Premium Efficient motors as defined in NEMA MG 1 for inverter duty.

.2 Enclosure Type: Totally enclosed, fan cooled.

.3 Provide full voltage non-reversing motor starters.

.4 Mount unit-mounted disconnect switches on exterior of unit.

.4 Heating Coil:

.1 Reference Section 15750 for requirements.

.5 Indirect Gas Fired Heat Exchanger:

.1 General:

.1 Heating units to be indirect natural gas fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories to be approved by an independent testing authority, and carry the approval label of that authority as a complete operating package.

.2 All units to exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire.

.3 Operating natural gas pressure at unit(s) manifold to be 1.75 to 3.50 kPa.

.4 Gas manifolds to be provided to FM standards.

.5 Gas fired units to be approved for operation in minus 20°C spaces.

.2 Heat Exchanger:

.1 Heat exchanger to be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane tubulators and to be of a floating stress relieved design. Heat exchanger to be provided with condensate drain connection. The heat exchanger casing is to have 25 mm of insulation between the outer cabinet and inner liner. Blower assemblies close coupled to duct furnace type heat exchangers are not permitted.

.2 Heat exchangers to be tested and certified to CSA standards to provide a minimum ETL certified 90 percent efficiency throughout the entire operating range.

.3 Burner:

.1 The burner assembly to be a blow through positive pressure type with an intermittent pilot ignition system to provide a high seasonal efficiency. Flame surveillance to be with a solid state programmed flame relay complete with flame rod. The burner and gas train to be located inside a cabinet enclosure. Insulation in the burner section to be covered by a heat reflective galvanized steel liner. Atmospheric burners or burners requiring power assisted venting are not permitted.

.2 Provide discharge air temperature control with 15:1 turndown capability for all input capacities in range from 29.3 kW to 410 kW. The high turndown burner minimum input to be capable of controlling at 6.7 percent of its rated input without on-off cycling and include built in electronic linearization of fuel and combustion air. Efficiency is to increase from high to low fire.

.4 Venting:

.1 Installation and venting provisions to be in accordance with CGA Standard B149.1, ANSI Z223.1-NFPA54, and local authorities have jurisdiction. Type A, L, and/or PS venting is required.

.5 Burner Controls:

.1 The gas fired heating controller to be a fuel/combustion air local controller. The controller is to incorporate a solid state analyzer complete with proportional and integral control and with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions.

.2 Combustion efficiency of high efficiency heat exchangers is to increase 4 to 5 percent from high fire to low fire. Heat exchangers are to provide a minimum of 90 percent efficiency throughout the entire operating range.

.3 As an alternative to variable speed combustion air blower, the burner control may include a modulating gas valve and a combustion air damper with a linear linkage connected to an actuator which has a minimum of 100 steps of control.

.6 Burner controls are to include the following standard features:

.1 Linear gas and combustion air flow obtained via a built-in solid state linear algorithm.

.2 Minimum operating ambient temperature: minus 40°C.

.3 Four (4) air change pre-purge on units with over 117 kW input.

.4 Post purge.

.5 Interrupted pilot.

.6 Self-check on start-up to make sure air proving and discharge air sensors are operating within design tolerances.

.7 Low fire start.

.8 Controlled burner start-up and shut down.

.9 Diagnostic lights for ease of set-up and service.

.10 Blower contactor that starts fan after burner pre-purge.

.11 Damper contact that allows fan to start after damper opens, damper to close after fan stops and damper to close on flame failure.

.12 Non-recycling auto by-pass low limit that has built-in sensor checking.

.7 Burner controller to modulate heating output to maintain supply air temperature setpoint. Refer to Sections 15910 and 15920 for control system requirements.

.8 Condensate Neutralization Tank:

.1 Condensate neutralization tank to include of a 20 L tank made from one-piece seamless polyethylene construction with 125 mm media fill/access opening, 40 mm FIP inlets on the top and the side, 40 FIP side outlet, and 40 mm FIP top vent.

.2 Acceptable Product:

.1 Axiom Industries Ltd. - Model NT20.

.2 Or approved equivalent.

.3 Supply complete with initial charge of neutralizing media.

.9 Condensate Pump:

.1 Provide a fully automatic condensate removal pump rated for the removal of acidic condensate with 1.9 L capacity tank manufactured from acrylonitrile butadiene styrene (ABS), a vertical-type pump with stainless steel motor shaft, high-impact ABS volute and motor cover, 3 drain holes, removable 10 mm O.D. barbed check valve. The motor to be thermally protected and cUL and CSA listed. Provide an overflow safety switch for connection to the PCS.

.2 Acceptable Product:

.1 Little Giant VCMA-20 Series.

.2 Or approved equivalent.

.6 Electric-Resistance Heating Coils:

.1 Casing Assembly: Galvanized-steel frame.

.2 Removable for replacement or service without further disassembly of the air handler.

.3 Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.

.4 Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.

.5 Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

.6 Control Panel: Unit mounted with disconnecting means and overcurrent protection.

.1 Full modulation capacity controlled by SCR.

.2 0-10 VDC heating control signal.

.3 Airflow proving switch.

.7 DX Cooling:

.1 Conform to CSA B52-M1977 and UL 465-1978 requirements.

.2 Condensing section:

.1 Compressor: Hermetic, variable speed scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, and internal pressure relief.

.2 Installation: Lockable isolated service compartment to allow access without affecting unit operation.

.3 Refrigeration Specialties:

.1 Refrigerant: R-410A

.2 Expansion valve with replaceable thermostatic element.

.3 Refrigerant filter/dryer.

.4 Manual-reset high-pressure safety switch.

.5 Automatic-reset low-pressure safety switch.

.6 Minimum off-time relay.

.7 Automatic-reset compressor motor thermal overload.

.8 Brass service valves installed in compressor suction and liquid lines.

.9 Low-ambient kit high-pressure sensor.

.3 Fans:

.1 Propeller type with single piece spun Venturi outlets and zinc plated guards.

.2 High efficiency electrically commutated motor.

.3 Factory installed head pressure control module:

.4 Modulate fan speed based on head pressure.

.5 Cooling operation allowed down to 2 degrees C outdoor air temperature with adjustable compressor lockout.

.4 Condenser coil:

.1 Tubes: Copper.

.2 Fins: Aluminum mechanically bonded to tubes.

.3 Designed for a minimum of 5.5 degrees C of refrigerant sub-cooling.

.4 Hydrogen or helium leak tested.

.5 Flexible, epoxy polymer e-coat over complete coil:

.1 Humidity and water immersion resistance to a minimum of 1,000 hours per ASTM D2247-92 and ASTM D870-92.

.2 Corrosion durability confirmed through testing with coating capable of withstanding at least 10,000 hours of salt spray per ASTM B117-90.

.3 UV resistant polyurethane topcoat.

.4 5 Year warranty on coatings

.5 Factory piped and charged refrigerant piping with sight glass, filter and valves.

.5 Evaporator coil:

.1 Rated to ARI Standard 210-75.

.2 Tubes: Copper.

.3 Fins: Aluminum mechanically bonded to tubes.

.4 Designed for a minimum of 10 degrees F of refrigerant sub-cooling.

.5 Hydrogen or helium leak tested.

.6 Flexible, epoxy polymer e-coat over complete coil:

.1 Humidity and water immersion resistance to a minimum of 1,000 hours per ASTM D2247-92 and ASTM D870-92.

.2 Corrosion durability confirmed through testing with coating capable of withstanding at least 10,000 hours of salt spray per ASTM B117-90.

.3 UV resistant polyurethane topcoat.

.4 5 Year warranty on coatings

.5 Alternate row circuiting for multi-compressor system, with each compressor on a totally independent refrigeration circuit complete with independent expansion valve.

.8 Filters:

.1 Replaceable.

.2 Summer and winter positions.

.3 Reference Section 15855 for filter performance and construction criteria.

.4 Provide one (1) Dwyer 2000 magnehelic filter gauge for each bank of filters. Gauge shall in SI units or dual scale. Select gauge so that normal operating pressures are approximately at the scale midpoint. Flush mount gauge on the exterior of the unit. Gauge shall be suitable for outdoor operation.

.5 Provide one (1) pressure transducer for each bank of filters, including for each position of prefilter to provide continuous monitoring of filter pressure drop at the PCS.

.1 As per Appendix 18E – Standardized Goods.

.2 Or approved equivalent only when the conditions in Appendix 18E – Standardized Goods do not apply.

.9 Mixing Section:

.1 Configure to ensure complete mix of air. Arrange dampers to direct the air flow from set of blades into the other.

.2 Utilize damper sections which extend across unit width plane with maximum width not exceeding 1,200 mm per section.

.10 Dampers:

.1 Extruded aluminum (6063T5) damper frame shall not be less than 2.03 mm in thickness.

.2 Damper frame to be 100 mm deep and shall be insulated with polystyrofoam on four sides.

.3 Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.

.4 Blades to be extruded aluminum (6063T5) profiles, internally insulated with expanded polyurethane foam and shall be thermally broken.

.5 Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.

.6 Blade and frame seals shall be of extruded silicone and be secured in an integral slot within the aluminum extrusions.

.7 Bearings are to be composed of a Celcon inner bearing fixed to 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame.

.8 Linkage hardware shall be installed in the frame side.

.9 Dampers are to be designed for operation in temperatures ranging between minus 40°C and 85°C.

.10 Dampers shall be available with either opposed blade action or parallel blade action.

.11 Damper leakage shall be certified under the AMCA certified rating program and shall carry AMCA seal.

.12 The air dampers shall be integral part of the air handling units and shall be supplied and installed by the manufacturer at the factory.

.13 Electronic Non-Modulating Damper Operators:

 .1 Spring return, 24 VAC operating voltage, on-off operation, 70 seconds maximum running time for 90 degree opening and 30 seconds maximum closing time.

 .2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

.14 Electronic Modulating Damper Operators:

 .1 Spring return, 24 VAC operating voltage, 0-10 VDC input signal, 0-10 VDC position output signal, 70 seconds maximum running time for 90 degree opening and 30 seconds maximum closing time.

 .2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

.11 Control Panels and Wiring:

.1 Provide control panel of unitized cabinet type construction. Mount relays, switches and control point adjustment in cabinet and pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

.2 Fabricate panels from 2.5 mm rolled sheet metal sheet with baked enamel finish, flush fitting, gasketed doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications. Panels located outdoors shall have a NEMA 4X rating.

.3 Panels located outdoor shall be manufactured as above but shall be manufactured from Type 316 stainless steel with a #2b finish. Outdoor panels shall have a NEMA 4X rated.

.4 Mount panels on vibration free wall or free standing angle iron supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.6 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 VAC supply.

.7 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.8 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.9 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20 percent spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape.

.10 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are still functioning in “Hand” mode.

.11 Control wiring for digital functions shall be 18 AWG minimum with 300 V insulation.

.12 Control wiring for analog functions shall be 18 AWG minimum with 300 V insulation, twisted and shielded, two (2) or three (3) wire to match analog function hardware.

.13 Sensor wiring shall be 18 AWG minimum twisted and shielded, two (2) or three (3) wire to match analog function hardware or 16 AWG as required by code.

.14 Transformer current wiring shall be 16 AWG minimum.

.12 Instrumentation: Provide all instrumentation required for complete control and monitoring of the units in accordance with Sections 15920, Division 17 and Appendix 18E – Standardized Goods. Instrumentation to be provided with each unit includes but is not limited to the following:

.1 DPDT air differential pressure switch for fan status.

.2 Filter differential pressure indicating transmitter.

.3 Outdoor air temperature indicating transmitter.

.4 Supply air temperature indicating transmitter.

2.4 Materials

.1 Steel:

.1 ASTM A36 for carbon structural steel.

.2 ASTM A568 for steel sheet.

.2 Stainless Steel:

.1 Manufacturer's standard grade for casing.

.2 Manufacturer's standard type, ASTM A240 for bare steel exposed to airstream or moisture.

.3 Galvanized Steel: ASTM A653.

.4 Aluminum: ASTM B209.

.5 Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.

.1 Standards:

.1 ASTM B117 for salt spray.

.2 ASTM D2794 for minimum impact resistance of 100 in-lb (11.3 N-m).

.3 ASTM D3359 for cross hatch adhesion of 5B.

.2 Application: Immersion.

.3 Thickness: 1 mil.

.4 Gloss: Minimum gloss of 60 on a 60-degree meter.

2.5 Controls

.1 Control will be provided through the Plant Control System (PCS).

2.6 Source Quality Control

.1 AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.

.2 Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

.3 Water Coils: Factory tested to 2068 kPag (300 psig) according to AHRI 410 and ASHRAE 33.

.4 Refrigerant Coils: Factory tested to minimum 3101 kPag (450 psig) internal pressure and to minimum 2068 kPag (300 psig) internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Examination

.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

.2 Examine casing insulation materials and filter media before unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

.4 Verify equipment sectioning and module sizing allows for placement and removal with access hatches indicated on drawings.

3.3 Installation

.1 Equipment Mounting:

.1 Install packaged, indoor, energy-recovery units on 100 mm cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03300.

.1 Comply with requirements for vibration-isolation devices specified in Section 15241.

.2 The installation is to meet the seismic restraint requirements as stated in section 15241.

.2 Install units with clearances for service and maintenance.

.3 The removal from the building of any unit will not require the temporary or permanent decommissioning of other systems.

.4 Do not use the units for temporary heating or cooling unless expressly approved by the City.

.5 Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

.2 Ductwork Connections:

.1 Comply with requirements for ductwork according to Section 15890.

.2 Connect duct to units with flexible connections. Comply with requirements in Section 15890.

.3 Piping Connections:

.1 Comply with requirements for piping specified in Section 15792. Drawings indicate general arrangement of piping, fittings, and specialties.

.2 Provide a balancing valve in the return piping connection and an isolating valve in the supply piping connection to each unit.

.3 Where installing piping adjacent to unit, allow for service and maintenance.

.4 Connect piping to units mounted on vibration isolators with flexible connectors.

.5 Condensate Drain Piping: Pipe drains from drain pans to nearest floor drain, same size as condensate drain connection.

.1 Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

.6 General: No exposed copper or copper alloy is allowed. Provide a baked on Heresite phenolic coating suitable for three thousand (3000) hours salt spray per ASTM B117 for all copper components.

.4 Electrical Connections:

.1 Install electrical devices furnished with units but not factory mounted.

.2 Connect wiring according to Section 16.

.3 Ground equipment according to Section 16.

.4 Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

.1 Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 12 mm high.

.5 Control Connections:

.1 Install control and electrical power wiring to field-mounted control devices.

.6 Field Quality Control:

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

.2 Tests and Inspections:

.1 Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.3 Prepare test and inspection reports.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section specifies the requirements for product selection, installation and testing of heat recovery ventilators.

1.2 Standards

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

  .1 ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.

  .2 ASHRAE 84, Method of Testing Air-to-Air Heat Exchangers (ANSI approved).

  .3 ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Health Canada/WHMIS:

  .1 MSDS.

.3 National Fire Protection Association (NFPA):

  .1 NFPA 70, National Electrical Code.

  .2 NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment.

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

  .4 NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

.4 Manitoba Workplace Safety and Health Act and Regulation.

.5 Underwriters Laboratories of Canada (ULC):

  .1 CAN/ULC S102, Test for Surface Burning Characteristics of Building Materials and Assemblies.

.6 Canadian Standards Association (CSA).

.7 American Society for Testing and Materials (ASTM):

  .1 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

  .2 ASTM C1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facing.

.3 ASTM C1104, Standard Test Method for Determining the water Vapor Sorption of Unfaced Mineral Fiber Insulation.

.8 Air Movement and Control Association (AMCA).

.9 National Electrical Manufacturers Association (NEMA).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Certified fan sound-power ratings.

.2 Energy recovery performance at specified operating conditions including efficiencies.

.3 Heating and cooling coil performance at specified operating conditions.

.4 Roof curbs and accessories.

.5 Certificates: submit certificates signed by Manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.4 Spare Parts

.1 Provide spare parts that are identical to and interchangeable with similar parts installed and in accordance with Schedule 18 Technical Requirements and the following:

.1 Two (2) sets of each type of filter specified.

.2 One (1) set of belts for each belt-driven fan in energy recovery units.

2. PRODUCTS

2.1 Performance Criteria

.1 General Requirements: Section 11000.

.2 In addition, meet the following:

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

.3 ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

.4 ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

.3 Units serving areas to reduce electrical hazard classifications per NFPA 820 requirements or over 1000 liters per second capacity will be Dual Core Reverse Flow type.

2.2 Dual Core Reverse Flow Energy Recovery Ventilator

.1 Performance Requirements

.1 NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

.2 ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

.3 System must utilize a regeneration reversing fresh air / exhaust air recovery methodology with a minimum 70 second cycle time.

.4 Winter: 90% plus or minus 5% sensible and 70% plus or minus 5% latent at equal airflow.

.5 Summer: 80% plus or minus 5% sensible and 70% plus or minus 5% latent at equal airflow.

.6 The maximum allowable cross contamination in a balance flow system is 4% return air.

.7 No defrost. Unit requires no frost protection in applications down to -40 ºC.

.8 Maximum allowable face velocity across heat exchangers: 2.3 m/s.

.2 Construction:

.1 General:

.1 Unit is to be of modular construction to facilitate splitting into sections to allow for installation and removal without modification to the building structure. Coordinate size requirements with the installing contractor.

.2 Unit is to be capable of running at 50% of the scheduled airflow with no loss of energy recovery efficiency.

.2 Housing:

.1 Minimum 18 gauge satin coat galvanized sheet metal.

.2 Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer.

.3 Finish coat shall be an electrostatically applied enamel, to all exposed surfaces.

.4 All unprotected metal and welds shall be factory coated.

.5 Unit to come with double wall construction and have two-part epoxy coated steel on both interior and exterior of the unit.

.6 All high pressure 1250Pa to 2250Pa fan sections shall be constructed of 14 gauge (2.0mm) metal. Continuous high-pressure sealant shall be provided between all panels.

.7 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units, roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water-resistant sealant.

.8 All units shall be internally insulated with 50mm thick lb./cu.ft. (24 kg./cu.m.) density insulation.

.9 The unit shall include an integral base with lifting points.

.3 Insulation:

.1 The insulation shall have a flame spread and smoke development index of 0, when tested according to ASTM E84, and ULC S102.

.2 The insulation shall be chemically inert, water resistant, and shall not rot or sustain vermin.

.3 The insulation shall not promote the growth of fungi or mildew, when tested according to ASTM C1338.

.4 The insulation shall display low moisture sorption when tested according to ASTM C1104.

.5 The insulation shall have a VOC content of 0 and shall be non-off-gassing.

.4 Panels and Access Doors:

.1 Access doors shall be large enough for easy access.

.2 RSI: 1.14 m^2 ºC/W per 25 mm of wall thickness.

.3 Inner and outer sections of panel constructed of epoxy coated steel.

.4 Module to module assembly shall be accomplished with self-adhering foam gaskets.

.5 Provide test data demonstrating less than 5 mm deflection for an unsupported 1220 mm x 1220 mm panel under 7.5 kPa pressure.

.6 Access Doors flush mounted to cabinetry, minimum of two (2) hinges, locking latch, full size handle assembly.

.7 All access doors shall be sealed with permanently applied bulb-type gasket.

.8 Access doors to allow full access to motor, drive, and bearings, filters, dampers, damper operators and coils.

.9 Access doors to include locking latches on control section.

.10 Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.

.5 Drain Pan:

.1 The units shall be supplied with cleanable, positive draining, drain pan(s).

.2 The drain pan(s) shall be marine grade aluminum.

.3 The drain pan(s) shall be designed as necessary to prevent carryover of water droplets beyond the drain pan to 1.40 mL/m2 (0.0044 oz/ft2) of face area per hour under peak sensible and peak dew-point conditions, accounting for both latent load and a coil face velocity 20 percent above the design velocity.

.6 Hardware:

.1 All hardware, hinges, handles and fasteners shall be non-corrosive.

.2 All external hardware, handles and fasteners, shall be non-corrosive 300 series stainless steel.

.3 All internal fasteners used on insulated panels shall be non-corrosive aluminum or 300 Series stainless steel.

.3 Energy Recovery Cores:

.1 General:

.1 The cores shall be removable for cleaning without disconnecting the ductwork or disassembly of other component sections.

.2 Materials:

.1 Corrugated high grade aluminum.

.2 Stainless steel heat exchanger frames.

.3 Stainless steel drain pans complete with 38 mm NPT connections.

.3 Damper Section:

.1 Low leakage insulated dampers operated by fast acting electric or pneumatic actuators. Actuators shall be suitably rated for the electrical hazard exposure.

.2 Dampers capable of orienting to close off outside air to the building without needing external shut off dampers.

.3 Dampers capable of orienting to allow 100% recirculation of air without using heat recovery device for off peak or unoccupied heating modes.

.4 Recovery cycles controlled by internal programmed thermostats measuring both supply and exhaust air, optimizing performance of both heat recovery and free cooling modes.

.5 Dampers blades galvanized steel or extruded aluminum.

.6 Damper Manufacturer must provide the following:

.1 Written documentation that the dampers are capable of a minimum duty cycle of 500,000 cycles annually.

.4 Fans:

.1 Supply and return fans shall be backward inclined airfoil direct-drive plenum fans or belt-drive blowers.

.2 Belt-drive blowers shall have a dual belt arrangement.

.3 Fan assemblies including fan and motor dynamically balanced by the Manufacturer on all three planes and at all bearing supports.

.4 Size fans to ensure maximum fan RPM is below first critical speed.

.5 Bearings and Shafts (belt-drive):

.1 Self-aligning, grease lubricated, ball or roller bearings with extended stainless steel lubrication lines to access side of unit.

.2 Heavy duty, greaseable, pillow block flange bearings. Bronze or plastic bearings are not acceptable.

.3 Bearing minimum diameter: 20 mm (¾”).

.4 20 mm (¾”) chromium shafts, maximum of 4 shafts per unit.

.5 Grease fittings attached to the fan base assembly near access door: either factory or field installed.

.6 Extended stainless steel lubrication lines to access side of unit.

.6 Fan and motor mounted internally on galvanized, steel base. Fan and motor assembly shall be mounted on rubber-in-shear vibration type isolators inside cabinetry.

.7 Fan motors will be totally enclosed fan cooled.

.5 Controls:

.1 Provide all sensors for standalone operation.

.2 Unit Control Panel:

.1 NEMA rated to installation area electrical hazard Zone rating and moisture / corrosive category rating.

.2 Contains unit PLC, electrical contacts, electro-pneumatic valves, and all accessories to operate ERV in the following modes:

.1 Heat Recovery.

.2 Free Cooling.

.3 Recirculation.

.3 Inputs from Plant Control System (PCS):

.1 Start/Stop.

.4 Outputs to PCS:

.1 Damper Actuator Failure.

.2 Dirty Filter.

.3 General Alarm.

.3 Variable Frequency Drives (VFD’s):

.1 Integral to unit.

.2 Inputs from PCS:

.1 Start/Stop.

.2 Speed.

.3 Outputs to PCS:

.1 Status.

.2 Alarm.

.3 Speed.

.4 Pneumatic Compressor:

.1 If a pneumatic actuator is used on the flow diverting damper(s) the unit shall be provided with a dedicated and integral air compressor, controls, filters, gauges and drainage.

.2 Provide a factory installed connection and isolation valves for an external compressor for use on failure of integral compressor.

.3 Provide factory installed pressure switch to alarm compressor failure to PCS.

.4 If the ERV is to be installed in an electrically classified area the compressor assembly will have to be remote mounted in a non-classified area and piped to the actuator.

.6 Electrical:

.1 Bears CSA or ULc listing label for entire assembly. Units with only components bearing third party safety listing are unacceptable.

.2 Control panels supplied loose and to be remotely field mounted in unclassified area as required.

.3 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. All wires shall be number tagged and cross-referenced to the wiring diagram for ease of troubleshooting.

.4 Provide motors, accessories, and wiring for classified applications that are rated for Class 1 applications with Zone (Division) designation defined by area / space electrical hazard rating.

.5 Electrical components not rated for classified areas that are exposed to classified atmospheres will be in an enclosure meeting the requirements of NFPA 496.

.6 Provide a single point power connection with any required transformers.

.7 Hydronic Coils:

.1 Integral or remote heating coils required for tempering supply air.

.2 Access to coils from both sides of unit for service and cleaning.

.3 Enclose coil headers and return bends fully within unit casing.

.4 Coil connections to extend a minimum of 125 mm beyond unit casing for ease of installation.

.5 Drain and vent connections provided exterior to unit casing.

.6 Coil connections factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly.

.7 Coils removable through side and top panels of unit without the need to remove and disassemble the entire section from the unit.

.8 Reference Section 15750 for requirements.

.8 Filters:

.1 Filter section with filter racks and guides with hinged and latching access doors on either, or both sides, for side loading and removal of filters.

.2 Filter section with front loading frames and clips.

.3 Reference Section 15855 for filter performance and construction criteria.

.4 Provide one (1) Dwyer 2000 magnehelic (or approved equivalent) filter gauge for each bank of filters. Gauge shall in SI units or dual scale. Select gauge so that normal operating pressures are approximately at the scale midpoint. Flush mount gauge on the exterior of the unit. Gauge shall be suitable for outdoor operation.

.5 Provide one (1) pressure transducer for each bank of filters, including for each position of prefilter to provide continuous monitoring of filter pressure drop at the PCS.

.1 As per Appendix 18E – Standardized Goods.

.2 Or approved equivalent only when the conditions in Appendix 18E – Standardized Goods do not apply.

2.3 Fixed Plate Heat Recovery Ventilator

.1 Cabinet:

.1 Minimum 20 gauge galvanized steel

.2 Internally insulated casing

.3 Painted finish.

.2 Drain connections.

.3 Energy Recovery Cores:

.1 Counter airflow corrugated aluminum.

.2 Minimum Sensible Heat Recovery Efficiency (SRE) rating of 75% at 0°C (32°F).

.3 Minimum Apparent Sensible Heat Effectiveness rating of 80% at 0°C (32°F).

.4 Airstream cross leakage rate less than 10%.

.4 Multispeed motor.

.5 Centrifugal fans for exhaust and supply.

.6 Hydronic Coils:

.1 Integral or remote heating coils required for tempering supply air.

.2 Access to coils from both sides of unit for service and cleaning.

.3 Enclose coil headers and return bends fully within unit casing.

.4 Coil connections to extend a minimum of 125 mm beyond unit casing for ease of installation.

.5 Drain and vent connections provided exterior to unit casing.

.6 Coil connections factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly.

.7 Coils removable through side and top panels of unit without the need to remove and disassemble the entire section from the unit.

.8 Reference Section 15750 for requirements.

.7 Electric Heating Coils:

.1 Electric resistance heaters shall be provided in the capacities, voltage, and steps of control as noted in the Schedules and shall bear a listing or certification mark from an authorized agency.

.2 Heater elements shall be installed a minimum of 305 mm (12 inch) downstream from air filters. Insulation in heating sections shall be fiber-reinforced foil faced. Should discharge air exceed 40°C (105°F), employ motors in air stream with Class F insulation. Over 65°C (150°F) discharge air temperature, mount motors out of the heated air stream.

.3 Heater element wiring shall terminate in a full height enclosure at one end of the heater. All internal wiring shall terminate on clearly identified terminal blocks. A wiring diagram shall be provided on the enclosure cover.

.4 Heaters shall be equipped with an automatic reset disc type thermal cut-out. Heaters rated at 30 kW and less shall be equipped with an additional manual reset disc type thermal cut-out.

.5 Heater elements shall Sheathed coils shall be a maximum of 13 kw/ft^2. Coil terminal pins shall be mechanically secured and insulated from the frame by means of non-rotating ceramic bushings.

.6 Heating coil casings shall be corrosion resistant and made of galvanized steel of suitable gauge as required by approval agency.

.7 Heaters to be supplied with protective screens on inlet and outlet sides.

.8 Discharge air control with Silicon Controlled Rectifier (SCR) performing time based sine wave phase control. The SCR shall be controlled by a factory installed solid-state proportional integral controller.

.8 Filters:

.1 Filter section with filter racks and guides with hinged and latching access doors on either, or both sides, for side loading and removal of filters.

.2 Filter section with front loading frames and clips.

.3 Reference Section 15855 for filter performance and construction criteria.

.4 Provide one (1) Dwyer 2000 magnehelic (or approved equivalent) filter gauge for each bank of filters. Gauge shall in SI units or dual scale. Select gauge so that normal operating pressures are approximately at the scale midpoint. Flush mount gauge on the exterior of the unit. Gauge shall be suitable for outdoor operation.

.5 Provide one (1) pressure transducer for each bank of filters, including for each position of prefilter to provide continuous monitoring of filter pressure drop at the PCS.

.1 As per Appendix 18E – Standardized Goods.

.2 Or approved equivalent only when the conditions in Appendix 18E – Standardized Goods do not apply.

.9 Automatic defrost cycling:

.1 From -3°C to -19°C: shall not exceed 11% of operating time.

.2 From -20°C to -38°C: shall not exceed 20% of operating time.

.3 From -39°C and colder: shall not exceed 33% of operating time.

.10 Unit Control Panel:

.1 NEMA rated to installation area electrical hazard Zone rating and moisture / corrosive category rating.

.2 Contains unit PLC, electrical contacts and all accessories to operate HRV in the following modes:

.1 Heat Recovery.

.2 Free Cooling.

.3 Recirculation.

.3 Inputs from Plant Control System (PCS):

.1 Start/Stop.

.4 Outputs to PCS:

.1 Dirty Filter.

.2 General Alarm.

.11 Electrical:

.1 Bears CSA or ULc listing label for entire assembly. Units with only components bearing third party safety listing are unacceptable.

.2 Control panels supplied loose and to be remotely field mounted in unclassified area as required.

.3 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. All wires shall be number tagged and cross-referenced to the wiring diagram for ease of troubleshooting.

.4 Provide explosion-proof motors and wiring for classified applications.

.5 Electrical components not rated for classified areas that are exposed to classified atmospheres will be in an enclosure meeting the requirements of NFPA 496.

.6 Provide a single point power connection with any required transformers.

2.4 Heat Pipe Heat Recovery Ventilator

.1 Casing:

.1 Exterior units shall be weatherproofed and equipped for installation outdoors as indicated. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 25 mm galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 51 mm with three break interlocking design; outer wall panels extend a minimum of 6 mm below the floor panel; drain trap(s) connections for field supply and installation of drain traps.

.2 Provide 25 mm flanged test ports in each plenum section. Provide screw cap on exterior. Interior flanged to cover the casing penetration and on exterior for air seal.

.3 Unit casing shall be of minimum 1.6 mm satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be electrostatically applied enamel, to all exterior surfaces. All unprotected metal and welds shall be factory coated.

.4 Interior surfaces and unit underside are to be coated in two-part 0.1524 mm epoxy finish.

.5 All high pressure 1250Pa to 2250Pa fan sections shall be constructed of 2.0 mm metal. Continuous high-pressure sealant shall be provided between all panels.

.6 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor unit's roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water-resistant sealant.

.7 Provide 22 gauge (0.85 mm) solid galvanized metal liner over insulation including unit underside.

.8 The exhaust section drain pans shall be an integral part of the floor paneling, a minimum of 51 mm deep, with welded corners. Drain pans shall extend over the full exhaust fan plenum and be connected with a 38 mm M.P.T. drain connection.

.9 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, electrical control panels, heat recovery section. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.10 Units shall be provided with hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units. Hinges shall be continuous stainless steel piano hinge type. Doors for outside units shall include tie back clips. Hinged access doors open outwards on all sections for outdoors units. Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed. Whenever possible, hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label and safety chain must be affixed. Access doors shall incorporate double pane hermetically sealed safety glass viewing windows (30 cm x 30 cm). Lift out access panels either bolted or secured with two or more camlock fasteners must be provided in locations where non-regular access would be beneficial.

.11 Provide marine lights with Lexan bulb covers in each section provided with an access door. Lights shall be wired in EMT conduit to a NEMA 4 switch with pilot light. 120 V power supply by others. Bulbs to be LED w/ 80w equivalent IP65 rated.

.12 All units shall be internally insulated with 51 mm thick nominal 48 kg./cu.m. density acoustic insulation.

.13 48 kg/cu.m. insulation is secured with steel angles. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

.14 Unit casing floors in walk in sections shall be fabricated with 2.0 mm galvanized checker plate steel. Smaller units that do not accommodate walk in due to cabinet height shall be fabricated with 2.0 mm Satin Coat. Provide reinforcing channels under floor to minimize deflection.

.2 Heat Recovery Section:

.1 The heat recovery device shall be an air-to-air heat pipe heat exchanger.

.2 The heat exchanger core shall be of seamless aluminum tubing permanently expanded into aluminum fins. Each tube shall be an individually sealed heat pipe filled with a working fluid conforming to Group 1 in the American National Standard Safety Code for Mechanical Refrigeration. Serpentine coils or headered tubes will not be considered equal and shall be bid as an alternate.

.3 The secondary surface shall be continuous plate aluminum fins of corrugated design to produce maximum heat transfer efficiency and reduce the frost threshold of the unit.

.4 Tube Construction:

.1 Heat pipe tubes are wicked. The capillary wick of each heat pipe shall be an integral part of the inner wall of the tube to provide a completely wetted surface for maximum heat pipe capacity with minimum heat transfer resistance. Non-wicked heat pipes will not be considered as an equal, unless they have additional rows, and increased face area as required to provide a pressure drop equal to or less than that specified for the QDT heat pipes.

.5 Air Stream Partition:

.1 A partition shall be provided to isolate the exhaust and supply air streams from each other to prevent cross-contamination.

.2 The partition shall be a single piece sheet metal divider. Tubes are expanded into this divider to form a positive seal against air leakage.

.6 Face & Bypass Control:

.1 The supply air side of the heat pipe shall be equipped with opposed blade face and bypass dampers with accompanying linkage and operating controls which will act to bypass cold air around the supply side of the coil in order to provide temperature and frost control for single season recovery.

.3 Finishes:

.1 The heat pipe and divider panel shall be coated with Heresite P-413C or approved equivalent.

.4 Fans:

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan Manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.2 Single low pressure forward curved fans of 457 mm (18 inch) or less diameter, shall be equipped with permanently lubricated cartridge ball bearings, supported by a 3 point "spider" bearing bracket in the fan inlets. All other forward curved fan assemblies shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame.

.3 Fans to be Epoxy coated.

.4 Fan bearings to be pillow block with concentric locking collars (set screw type not permitted). Bearings shall be selected for a basic rating fatigue life (L10) of 50,000 hours at maximum operating speed.

.5 Bearings shall have Zerk fittings to allow for lubrication with extended grease lines extended outside the unit casing.

.6 Drives shall be adjustable on fans with motors 7 1/2 HP (5.6 kW) or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure. Minimum drive service factor 1.2.

.7 Provide full section return air fan(s) as scheduled. The use of power exhaust propeller or centrifugal fan arrangements will not be considered.

.8 Variable air volume fan control for units:

.9 Provide terminal lugs to and from VFDs by others. VFDS by Division 16 to be remote mounted.

.10 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.

.11 Provide belt guards on all units. Guards to be painted in Epoxy Yellow.

.1 Belt guards to comply with the Manitoba Workplace Safety and Health Act and Regulation.

.12 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be neoprene-in-shear type for single 230 mm (9 inch) to 380 mm (15 inch) diameters forward curve fans. All other fans shall incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 25 mm (1 inch) static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

.13 Provide extended greases to the outside of Unit Casing.

.14 Fan motors shall be TEFC (totally enclosed fan cooled) Super E high efficiency type.

.5 Filters:

.1 Filter section with filter racks and guides with hinged and latching access doors on either, or both sides, for side loading and removal of filters.

.2 Filter section with front loading frames and clips.

.3 Reference Section 15855 for filter performance and construction criteria.

.4 Provide one (1) Dwyer 2000 magnehelic (or approved equivalent) filter gauge for each bank of filters. Gauge shall in SI units or dual scale. Select gauge so that normal operating pressures are approximately at the scale midpoint. Flush mount gauge on the exterior of the unit. Gauge shall be suitable for outdoor operation.

.5 Provide one (1) pressure transducer for each bank of filters, including for each position of prefilter to provide continuous monitoring of filter pressure drop at the PCS.

.1 As per Appendix 18E – Standardized Goods.

.2 Or approved equivalent only when the conditions in Appendix 18E – Standardized Goods do not apply.

.6 Hydronic Coils:

.1 Integral or remote heating coils required for tempering supply air.

.2 Access to coils from both sides of unit for service and cleaning.

.3 Enclose coil headers and return bends fully within unit casing.

.4 Coil connections to extend a minimum of 125 mm beyond unit casing for ease of installation.

.5 Drain and vent connections provided exterior to unit casing.

.6 Coil connections factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly.

.7 Coils removable through side and top panels of unit without the need to remove and disassemble the entire section from the unit.

.8 Reference Section 15750 for requirements.

.7 Electric Heating Coils:

.1 Electric resistance heaters shall be provided in the capacities, voltage, and steps of control as noted in the Schedules and shall bear a listing or certification mark from an authorized agency.

.2 Heater elements shall be installed a minimum of 305 mm (12 inch) downstream from air filters. Insulation in heating sections shall be fiber-reinforced foil faced. Should discharge air exceed 40°C (105°F), employ motors in air stream with Class F insulation. Over 65°C (150°F) discharge air temperature, mount motors out of the heated air stream.

.3 Heater element wiring shall terminate in a full height enclosure at one end of the heater. All internal wiring shall terminate on clearly identified terminal blocks. A wiring diagram shall be provided on the enclosure cover.

.4 Heaters shall be equipped with an automatic reset disc type thermal cut-out. Heaters rated at 30 kW and less shall be equipped with an additional manual reset disc type thermal cut-out.

.5 Heater elements shall Sheathed coils shall be a maximum of 13 kw/ft^2. Coil terminal pins shall be mechanically secured and insulated from the frame by means of non-rotating ceramic bushings.

.6 Heating coil casings shall be corrosion resistant and made of galvanized steel of suitable gauge as required by approval agency.

.7 Heaters to be supplied with protective screens on inlet and outlet sides.

.8 Discharge air control with Silicon Controlled Rectifier (SCR) performing time based sine wave phase control. The SCR shall be controlled by a factory installed solid-state proportional integral controller.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Examination

.1 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

.2 Examine casing insulation materials and filter media before unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

.4 Verify equipment sectioning and module sizing allows for placement and removal with access hatches indicated on drawings.

3.3 Installation

.1 Equipment Mounting:

.1 Install packaged, indoor, energy-recovery units on 100 mm cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03300.

.2 Comply with requirements for vibration-isolation devices specified in Section 15241.

.1 The installation is to meet the seismic restraint requirements as stated in Section 15241.

.3 Install units with clearances for service and maintenance.

.4 The removal from the building of any unit will not require the temporary or permanent decommissioning of other systems.

.5 Do not use the units for temporary heating or cooling unless expressly approved by the City.

.6 Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

.2 Ductwork Connections:

.1 Comply with requirements for ductwork according to Section 15890.

.2 Connect duct to units with flexible connections. Comply with requirements in Section 15890.

.3 Piping Connections:

.1 Comply with requirements for piping specified in Section 15792. Drawings indicate general arrangement of piping, fittings, and specialties.

.2 Provide a balancing valve in the return piping connection and an isolating valve in the supply piping connection to each unit.

.3 Where installing piping adjacent to unit, allow for service and maintenance.

.4 Connect piping to units mounted on vibration isolators with flexible connectors.

.5 Condensate Drain Piping: Pipe drains from drain pans to nearest floor drain, same size as condensate drain connection.

.1 Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

.6 General: No exposed copper or copper alloy is allowed. Provide a baked on Heresite phenolic coating suitable for three thousand (3000) hours salt spray per ASTM B117 for all copper components.

.4 Electrical Connections:

.1 Install electrical devices furnished with units but not factory mounted.

.2 Connect wiring according to Section 16.

.3 Ground equipment according to Section 16.

.4 Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

.1 Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 12 mm high.

.5 Control Connections:

.1 Install control and electrical power wiring to field-mounted control devices.

.6 Field Quality Control:

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

.2 Tests and Inspections:

.1 Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

.2 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.3 Prepare test and inspection reports.

END OF SECTION

DUCT SILENCERS

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of duct silencers.

.2 This Section is not for use with foul air duct silencers.

1.2 Standards

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

.1 ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

.3 ASTM E477 – Standard Test Method for Laboratory Measurements of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

.2 National Voluntary Laboratory Accreditation Program (NVLAP).

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

.1 ASHRAE 62.1 – Standard – “Ventilation for Acceptable Indoor Air Quality”.

.4 National Fire Protection Association (NFPA).

.1 NFPA 90A, "Installation of Air Conditioning and Ventilating Systems"

.2 NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

.5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.6 Underwriters Laboratories (UL):

.1 UL 723, Standard for Test for Surface Burning Characteristics of Building Materials.

.2 CAN/ULC S102, Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Laboratory acoustic and aerodynamic performance obtained according to ASTM E477 and so certified when submitted for approval.

.2 Silencer pressure drop measurements to be made in accordance with the ASTM E477 test standard. Conduct test and report on the identical units for which acoustical data is presented.

.3 Supply submittals specific to the silencer installed conditions. Include the overall silencer dimensions and module quantity and sizes, a drawing detailing baffle location and quantities, dynamic insertion loss (DIL) and generated noise levels, silencer pressure loss and construction. The DIL values to account for the differences between unlined and lined fill.

1.4 Quality Assurance

.1 Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

.2 Silencer performance to have been substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477.The test facility to provide for airflow in both directions through the test silencer. The test set-up, procedure and facility to eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption. The aero-acoustic laboratory to be currently NVLAP accredited for the ASTM E477 test standard. A copy of the accreditation certificate to be included with the submittals.

.3 Silencer Manufacturer to provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84 or UL 723.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

  .1 Silencers:

    .1 Price.

    .2 Vibro-Acoustics.

    .3 Kinetics Noise Control.

    .4 VAW.

    .5 Or approved equivalent.

2.2 Performance Criteria

.1 Silencers to be of the size, configuration, capacity and acoustic performance as required to meet space sound requirements specified in the Technical Requirements.

.2 Factory fabricate all silencers and supply all silencers by the same Manufacturer.

.3 Silencer inlet and outlet connection dimensions to be equal to the duct sizes specified in the Final Design. Duct transitions at silencers are not permitted.

.4 Construct silencers in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Increase material gauges as required for the system pressure and velocity classification. The silencers not to fail structurally when subjected to a differential air pressure of 2.0 kPa.

.5 All casing seams and joints to be lock-formed and sealed or stitch welded and sealed to provide leakage-resistant construction.

.6 All perforated steel to be adequately stiffened to insure flatness and form. Paint all spot welds.

.7 Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill, film liner, sealants, and acoustical spacer, to have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84 or UL 723.

.8 Airstream Surfaces: Surfaces in contact with the airstream to comply with requirements in ASHRAE 62.1.

2.3 Materials and Construction

.1 Rectangular Silencers outer casing to be ASTM A 653/A 653M and to be made of a minimum 0.864 mm thick material lock form quality, perforated galvanized steel, Type G90, 316/304 stainless steel or aluminum to match associated ductwork.

.2 Rectangular elbow silencers outer casing to be ASTM A 653/A 653M, G90 galvanized sheet steel, a minimum 1.321 mm thick. All acoustical splitters to have internal radii and aerodynamically designed for efficient turning of the air. Provide half and full splitters to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 1,200 mm to have at least two half splitters and one full splitter.

.3 Circular silencers outer casing to be ASTM A 653/A 653M, G90 galvanized sheet steel as listed below:

  .1 Minimum sheet metal thickness for units up to 450 mm in diameter: 0.864 mm.

  .2 Minimum sheet metal thickness for units 450 through 750 mm in diameter: 1.02 mm.

  .3 Minimum sheet metal thickness for units 750 through 1,350 mm in diameter: 1.321 mm.

  .4 Minimum sheet metal thickness for units over 1,350 mm in diameter: 1.626 mm.

.4 Interior baffles and bullet for standard rectangular straight, rectangular elbow and circular silencers to be made of a minimum 0.889 mm thick material lock form quality, perforated galvanized steel, Type G90, 316/304 stainless steel or aluminum to match associated ductwork, properly stiffened to ensure structural integrity.

.5 Interior baffles for rectangular reactive straight silencers to be made of a minimum 0.711 mm thick and properly stiffened to ensure structural integrity; lock form quality, micro-perforated, Type G90 galvanized steel, 316/304 stainless steel or aluminum to match associated ductwork.

.6 Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel minimum thickness.

   .1 Rectangular Silencers: 0.559 mm.

   .2 Rectangular Elbow Silencers: 0.864 mm.

   .3 Circular Silencers:

      .1 Connection diameter up to 450 mm: 0.559 mm.

      .2 Connection diameter greater than 450 mm: 0.864 mm.

.7 Acoustically absorptive fill except for reactive (packless) silencers to be inorganic glass fiber of a proper density to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material to be inert, vermin and moisture proof and impart no odour to the airstream.

.8 Combustion ratings for the standard silencers with acoustic fill to be equal to or lower than the following when tested to ASTM E84, NFPA Standard 255, UL 723, or ULC S102:

   .1 Flame spread classification: 20.

   .2 Smoke development rating: 20.

.9 Filmed lined or bagged silencers to use Tedlar®, or approved equivalent (Mylar or polyethylene are not permitted), and spacer and acoustical fill equal to or lower than the following when tested to ASTM E84, NFPA Standard 255, UL 723, or ULC S102:

   .1 Flame spread Classification: 25.

   .2 Smoke Development Rating: 50.

.10 Acoustic spacer to be flame and erosion resistant.

.11 Principal Sound-Absorbing Mechanism:

   .1 No-Media silencers:

      .1 Units not to contain absorptive media of any kind. Attenuation to be achieved with controlled impedance membranes and broadly tuned resonators.

   .2 Dissipative and Film Lined Silencers:

      .1 Media to be of acoustic quality, glass fiber packed with a minimum of 15 percent compression during silencer assembly. Media to be resilient such that it does not crumble or break and conform to irregular surfaces. Media not to cause or accelerate corrosion of aluminum or steel. Mineral wool is not permitted as a substitute for glass fibre.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

END OF SECTION

HVAC FANS

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for product selection, installation and testing of HVAC fans including:

.1 Centrifugal Roof Exhaust Fans – Down Blast.

.2 Centrifugal Exhaust Fans – Up Blast Roof Mount and Sidewall.

.3 Tubular In-Line Centrifugal Fans.

.4 Tubular In-Line Axial Fans.

.5 Sidewall Propeller Fans.

.6 Centrifugal Fans.

.7 FRP Centrifugal Fans.

.8 Fan Arrays.

.9 Industrial Air Curtains.

.2 For Centrifugal Foul Air Fan requirements, see Section 15854.

1.2 Standards

.1 Air Movement and Control Association (AMCA)/ American National Standards Institute (ANSI):

.1 ANSI/AMCA 99A - Standard Handbook.

.2 ANSI/AMCA 204 - Standard Balance Quality and Vibration Levels for Fans.

.3 ANSI/AMCA 205 - Energy Efficiency Classification for Fans.

.4 ANSI/AMCA 210 – ANSI/ASHRAE 51 - Laboratory Methods of Testing Fans for Rating Purposes.

.5 AMCA Publication 211, “Certified Ratings Program – Product Rating Manual for Fan Air Performance”.

.6 AMCA Publication 311, “Certified Ratings Program – Product Rating Manual for Fan Sound Performance”.

.7 AMCA 300 – Test code for Sound Rating Air Moving Devices.

.8 AMCA 301 – Method of Calculating Fan sound Ratings from Laboratory Test Data.

.2 National Electrical Manufacturer Association (NEMA):

  .1 NEMA MG-1 – Motors and Generators.

.3 Canadian Standards Association (CSA):

  .1 CSA C22.1 – Canadian Electrical Code.

  .2 CSA S832-14 - Seismic Risk reduction of Operational and Functional Components (OFCs) of Buildings.

.4 cUL 705 - Power Ventilators.

.5 The Occupational Health & Safety (OHS) Regulation of Canada, Part 13 – Tools and Machinery.

.6 ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures.

.7 ICC-ES AC 156 - Seismic Certification by Shake-table Testing of Nonstructural Components.

.8 ASA/ANSI S2.19 - Mechanical Vibration - Balance Quality Requirements Of Rigid Rotors - Part 1: Determination Of Possible Unbalance, Including Marine Applications.

.9 National Fire Protection Association (NFPA):

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

  .2 NFPA 70 – National Electric Code.

.10 National Roofing Contractors Association (NRCA).

.11 Manitoba Workplace Safety and Health Act (WSHA).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

  .2 Certified fan performance curves with system operating conditions indicated.

  .3 Certified fan sound-power ratings.

  .4 Roof curbs and accessories.

  .5 Detailed installation drawings showing equipment layout, and the size and location of all piping, electrical, instrumentation and structural connections.

2. PRODUCTS

2.1 Performance Criteria

.1 Operating Requirements:

.1 Fans to be capable of accommodating static pressure variations of plus or minus 15 percent with no impairment of operating performance.

.2 External static pressure means external to the fan cabinet and all accessories such as backdraft dampers, mixing boxes, filters and coils. Accessories supplied as part of the unit to be considered as internal losses for fan.

.3 Performance ratings: Conform to ANSI/AMCA Standards 210 and 300. Fans to be tested in accordance with AMCA Publications 211 and 311 in an AMCA accredited laboratory and certified for air performance. Fans to be licensed to bear the AMCA ratings seal for air performance (AMCA 210).

.4 Units located in electrically classified areas or handling air from a classified area will be constructed with Class 1 rated components including but not limited to motors, wiring and switches with Zone (Division) requirements dictated by the area's electrical hazard rating.

.5 All fans serving classified areas are to have AMCA Spark A or B construction.

2.2 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Centrifugal Roof Exhaust Fans – Down Blast:

.1 Greenheck.

.2 Loren Cook.

.3 Penn Barry.

.4 Or approved equivalent.

.2 Centrifugal Exhaust Fans – Up Blast Roof Mount and Sidewall:

.1 Greenheck.

.2 Loren Cook.

.3 Penn Barry.

.4 Or approved equivalent.

.3 Tubular In-Line Centrifugal Fans:

.1 Greenheck.

.2 Loren Cook.

.3 Penn Barry.

.4 Or approved equivalent.

.4 Tubular In-Line Axial Fans:

.1 Greenheck.

.2 Loren Cook.

.3 Penn Barry.

.4 Or approved equivalent.

.5 Sidewall Propeller Fans:

.1 Greenheck.

.2 Loren Cook.

.3 Penn Barry.

.4 Or approved equivalent.

.6 Centrifugal Fans:

.1 Greenheck.

.2 Northern Blower.

.3 Twin City.

.4 New York Blower.

.5 Hartzell.

.6 Or approved equivalent.

.7 FRP Centrifugal Fans:

.1 Greenheck.

.2 Universal.

.3 M. K. Plastics.

.4 New York Blower.

.5 Hartzell.

.6 Or approved equivalent.

.8 Fan Arrays:

.1 Huntair.

.2 Greenheck.

.3 Trane.

.4 Or approved equivalent.

.9 Industrial Air Curtains:

.1 Berner.

.2 Swank.

.3 Mars.

.4 Or approved equivalent.

2.3 Materials

.1 Centrifugal Roof Exhaust Fans – Down Blast:

Component	**Material**
Hood	Aluminum
Fan Wheel	Aluminum
Fan Wheel Shaft	Steel
Fan Housing	Aluminum
Fasteners	Type 316, Stainless Steel
Bird Screen	Stainless Steel

.2 Centrifugal Exhaust Fans – Up Blast Roof Mount and Sidewall:

Component	**Material**
Hood	Aluminum
Fan Wheel	Aluminum
Fan Wheel Shaft	Steel
Fan Housing	Aluminum
Fasteners	Type 316, Stainless Steel
Bird Screen	Stainless Steel

.3 Tubular In-Line Centrifugal Fans:

Component	**Material**
Fan Wheel	Aluminum
Fan Wheel Shaft	Steel
Fan Housing	Aluminum
Fasteners	Type 316, Stainless Steel

.4 Tubular In-Line Axial Fans:

Component	Material
Fan Wheel	Aluminum
Fan Wheel Shaft	Steel
Fan Housing	Aluminum
Fasteners	Type 316, Stainless Steel

.5 Sidewall Propeller Fans:

Component	Material
Propeller	Aluminum / Steel
Venturi	Galvanized Steel
Wall Panel	Galvanized Steel
Fan Propeller Shaft	Galvanized Steel
Fasteners	Type 316, Stainless Steel

.6 Centrifugal Fans:

Component	Material
Fan Wheel	Aluminum
Fan Wheel Shaft	Steel
Fan Housing	Aluminum
Fasteners	Type 316, Stainless Steel

.7 FRP Centrifugal Fans:

Component	Material
Fan Wheel	FRP
Fan Wheel Shaft	Type 316, Stainless Steel
Fan Housing	FRP
Fasteners	Type 316, Stainless Steel

.8 Fan Array:

Component	Material
Fan Wheel	Aluminum
Fan Housing	Aluminum
Backflow Damper	Aluminum
Fasteners	Type 316, Stainless Steel

.9 Industrial Air Curtains:

Component	Material
Fan Wheel	Aluminum
Cabinet	Stainless Steel
Base Frame	Stainless Steel
Directional Vanes	Aluminum
Fasteners	Type 316, Stainless Steel

2.4 Configuration, Components and Features

.1 General:

.1 Fan to bear the AMCA seal.

.2 Each fan to bear a permanently affixed Manufacture's engraved metal nameplate containing the model number and individual serial number.

.3 Statically and dynamically balance fans so no vibration or noise is transmitted to occupied areas of the building.

.4 Non-ducted fans to be provided with inlet and/or outlet guards.

.5 When located in or servicing an electrically classified space the fan to be rated for operation in this classified space (explosion-proof motor) and be of spark-proof construction. Classification for spark resistant construction is to conform to Type A ANSI/AMCA Standard 99.

.6 All ventilation equipment included in Essential Services is to be seismically certified through seismic analysis and shake table testing in accordance with ASCE/SEI 7 and ICC-ES AC 156.

.2 Centrifugal Roof Exhaust Fans – Down Blast:

.1 Roof exhaust fans to be factory fabricated assemblies having fan, fan-motor, fan housing, hood, and bird screen.

.2 Housing:

.1 Motor cover, shroud, curb cap, and lower windband to be constructed of heavy gauge aluminum.

.2 Shroud to have an integral rolled bead for extra strength.

.3 Shroud to be drawn from a disk and direct air downward.

.4 Lower windband to have a formed edge for added strength.

.5 Motor cover to be drawn from a disk.

.6 Curb cap to have pre-punched mounting holes to ensure correct attachment.

.7 Rigid internal support structure.

.8 Birdscreen protection at discharge.

.9 Leak proof.

.3 Fan Wheel:

  .1 Aluminum, non-overloading, backward inclined centrifugal type, statically and dynamically balanced in accordance with AMCA 204.

.4 Drive Assembly:

  .1 Fan shaft to be ground and polished solid steel with anti-corrosive coating.

  .2 Permanently sealed bearings or pillow block ball bearings.

  .3 Fan Shaft first critical speed to be at least 25 percent over maximum operating speed.

  .4 Belts: Static free and oil resistant.

  .5 Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

  .6 The motor pulley to be adjustable for final system balancing.

  .7 Readily accessible for maintenance.

.5 Motors:

  .1 Refer to Division 16 for requirements.

  .2 Motors to be suitable for the electrical hazard classification of the location or the space served.

  .3 Motors to be mounted out of the airsteam.

  .4 Motors intended for VFD applications to be rated for this service.

.6 Finishes:

  .1 Standard duty: None.

  .2 Corrosive ambient environment or exhaust air: Heresite.

.7 Roof Curb:

  .1 Each fan to be provided with a 360 mm tall, prefabricated mounting curb.

  .2 The outer shell of the curb to be formed with an integral cant strip and mounting flange. The corners to be mitered and welded continuously to form a one-piece leak proof shell. The bottom of the curb to have a baseplate which encloses the lower edge of the roof insulation.

  .3 A damper holding tray to be provided.

.4 Wooden nailing strips to be bolted to the top of the curb shell to provide means for easily attaching the flashing material to the curb.

.5 Provide 40 mm thick, rigid, fibreglass insulation adhered to inside walls.

.6 Provide curb for flat, pitched, or ridged roof as indicated.

.7 Standard duty: None.

.8 Corrosive ambient environment or exhaust air: Heresite.

.3 Centrifugal Exhaust Fans – Up Blast Roof Mount and Sidewall

.1 Roof exhaust fans to be factory fabricated assemblies having fan, fan-motor, fan housing, hood, and bird screen.

.2 Housing:

.1 Constructed of heavy gauge aluminum includes exterior housing, curb cap, windband, and motor compartment housing. Galvanized material is not permitted.

.2 Housing is to have a rigid internal support structure.

.3 Windband to be one piece uniquely spun aluminum construction and maintain original material thickness throughout the housing.

.4 Windband to include an integral rolled bead for strength.

.5 Curb cap base to be fully welded to windband to ensure a leak proof construction. Tack welding, bolting, and caulking are not acceptable.

.6 Curb cap to have integral deep spun inlet venturi and pre-punched mounting holes to ensure correct attachment to curb.

.7 Drive frame assemblies to be constructed of heavy gauge steel and mounted on vibration isolators.

.8 Breather tube to be 10 square inches in size for fresh air motor cooling and designed to allow wiring to be run through it.

.9 Leak proof.

.3 Fan Wheel:

.1 Aluminum, non-overloading, backward inclined centrifugal type, statically and dynamically balanced in accordance with AMCA 204.

.4 Drive Assembly:

.1 Fan shaft to be ground and polished solid steel with anti-corrosive coating.

.2 Permanently sealed bearings or pillow block ball bearings.

.3 Fan shaft first critical speed is to be at least 25 percent above maximum operating speed.

.4 Belts: Static free and oil resistant.

.5 Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

.6 The motor pulley to be adjustable for final system balancing.

.7 Readily accessible for maintenance.

.5 Motors:

.1 Refer to Division 16 for requirements.

.2 Motors to be suitable for the electrical hazard classification of the location or the space served.

.3 Motors to be mounted out of the airsteam.

.4 Motors intended for VFD applications to be rated as such service.

.6 Finishes:

.1 Standard duty: None.

.2 Corrosive ambient environment or exhaust air: Heresite.

.7 Roof Curb:

.1 Each fan to be provided with a 360 mm tall, prefabricated mounting curb.

.2 The outer shell of the curb to be formed with an integral cant strip and mounting flange. The corners to be mitered and welded continuously to form a one-piece leak proof shell. The bottom of the curb is to have a baseplate which encloses the lower edge of the roof insulation.

.3 A damper holding tray to be provided.

.4 Wooden nailing strips to be bolted to the top of the curb shell to provide means for easily attaching the flashing material to the curb.

.5 Provide 40 mm thick, rigid, fibreglass insulation adhered to inside walls.

.6 Provide curb for flat, pitched, or ridged roof as indicated.

.7 Corrosion-resistant, factory applied coatings to be Heresite or Hi-Pro Polyester applied in strict conformance with the paint Manufacturer’s instructions.

.4 Tubular In-Line Centrifugal Fans:

.1 Inline centrifugal fans to be aluminum, factory fabricated assemblies having fan, fan motor, drive cover, and fan housing.

.2 Housing:

.1 Fan housing to be constructed of rolled aluminum with a continuous seam weld and punched inlet and outlet flanges for ductwork connection.

.2 Fans to be equipped with lifting lugs.

.3 Built-in access panel to allow internal cleaning and service without disturbing the ductwork.

.4 Either an WSHA compliant weatherhood, or an WSHA compliant belt guard to be included to completely cover the motor pulley and belt(s).

.3 Fan Wheel:

.1 Fan wheel to be non-overloading, fully welded, backward inclined centrifugal type, statically and dynamically balanced in accordance with AMCA 205.

.4 Drive Assembly:

.1 Fan to be belt driven with motor out of airstream.

.2 Belts, bearings and drives to be protected from the airstream by heavy gauge belt tubes and bolted bearing covers with shaft seals.

.3 Fan shaft to be ground and polished solid steel with anti-corrosive coating.

.4 Fan shaft bearings to be Air Handling Quality, bearings to be heavy-duty grease lubricated, self-aligning or roller pillow block type.

.5 Motors:

.1 Refer to Division 16 for requirements.

.2 Motors to be suitable for the electrical hazard classification of the location or the space served.

.3 Motors to be mounted out of the airsteam.

.4 Motors intended for VFD applications to be rated as such.

.6 Finishes:

.1 Standard duty: Polyester Urethane.

.2 Corrosive ambient environment or exhaust air: Heresite.

.5 Tubular In-Line Axial Fans:

.1 Inline axial fans to be aluminum, factory fabricated assemblies having fan, fan motor, drive cover, and fan housing.

.2 Housing:

.1 Fan housing to be constructed of continuously welded aluminum and include an integral punched inlet and outlet flange for duct connection.

.2 Built-in access panel to allow internal cleaning and service without disturbing the ductwork.

.3 Fans are to incorporate universal a mounting system to allow for field transitions from horizontal base mount, horizontal ceiling hung, vertical base mount or vertical ceiling hung configurations.

.4 Either an WSHA compliant weatherhood, or an WSHA compliant belt guard to be included to completely cover the motor pulley and belt(s).

.3 Fan Wheel:

.1 The fan propeller to be heavy duty, cast aluminum with high performance, tapered airfoil blades designed to meet varied capacity and pressure requirements.

.2 A standard square key or tapered bushing is to lock the propeller to the fan shaft. Hubs to be two (2) piece aluminum castings that securely lock the blades in place.

.3 Wheels to be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.

.4 Drive Assembly:

.1 Fan to be belt driven with motor out of airstream.

.2 Belts, bearings and drives to be protected from the airstream by heavy gauge belt tubes and bolted bearing covers with shaft seals.

.3 Fan shaft to be ground and polished solid steel with anti-corrosive coating.

.4 Fan shaft bearings to be air handling quality, bearings to be heavy-duty grease lubricated, self-aligning or roller pillow block type.

.5 Motors:

.1 Refer to Division 16 for requirements.

.2 Motors to be suitable for the electrical hazard classification of the location or the space served.

.3 Motors to be mounted out of or isolated from the airsteam.

.4 Motors intended for VFD applications to be rated for such service.

.6 Finishes:

.1 Standard duty: Polyester Urethane.

.2 Corrosive ambient environment or exhaust air: Heresite.

.6 Sidewall Propeller Fans:

.1 Wall supply and exhaust fans to be factory fabricated assemblies having fan, motor, drive guard(s), mounting frame, and special features and accessories as noted.

.2 Drive Frame/Wall Panel:

.1 Drive frame assemblies to be galvanized steel, and bolted construction.

.2 Drive frame is to have formed channels.

.3 Fan panels are to have pre-punched mounting holes, formed flanges and a deep formed one piece inlet venture.

.3 Drives (Belt Driven Fan):

.1 Fan Shaft to be ground and polished solid steel with an anti-corrosive coating.

.2 Bearings to be cast iron pillow block with grease fittings.

.3 Fan Shaft first critical speed is at least 25 percent over maximum operating speed.

.4 Belt: Static free and oil resistant.

.5 Fully machined cast iron pulley, keyed and securely attached to the wheel and motor shafts.

.6 The motor pulley to be adjustable for final system balancing.

.7 Readily accessible for maintenance.

.4 Fan wheel:

.1 Material type: Steel blades and hubs. Cast aluminum for spark-proof construction.

.2 Securely attached to fan shaft by welding or with standard square key and set screw.

.3 Statically and dynamically balanced in accordance with AMCA Standard 204.

.5 Guards and Wall Collars:

.1 Where either front, rear, or both front and rear sides of fan assembly are exposed to personnel, provide protective guards.

.2 Guard type: WSHA Guard.

.3 Protective guard completely enclose the motor and drive side of the fan.

.4 Wall collar to be constructed of galvanized steel with heavy gauge mounting flanges and pre- punched mounting holes.

.6 Motors:

.1 Refer to Division 16 for requirements.

.2 Motors to be suitable for the electrical hazard classification of the location or the space served.

.3 Motors to be mounted out of the airsteam.

.4 Motors intended for VFD applications to be rated for such service.

.7 Finishes:

.1 Standard duty: Polyester Urethane.

.2 Corrosive ambient environment or exhaust air: Heresite.

.7 Centrifugal Fans:

.1 Centrifugal (blower) supply and exhaust fans to be factory fabricated assemblies having fan, motor, drive guard(s), mounting frame, and special features and accessories.

.2 Fan Housing and Outlet:

.1 Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.

.2 Fan to be of continuously welded heavy gauge aluminum construction with the scroll panel material formed and embedded into the side panels.

.3 Housing and bearing support to be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.

.4 Bolted access door for cleaning and inspection.

.5 25mm threaded drain and plug.

.3 Fan Wheel:

.1 Non-overloading single width airfoil type.

.2 Wheels to be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.

.3 Fan wheel to be manufactured with continuously welded aluminum blades.

.4 Drives:

.1 Fan to be belt driven in AMCA Arrangement 9 with shaft guard to cover bearings and shaft.

.2 Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25 percent above the maximum operating speed for each pressure class.

.3 Fan shaft bearings to be air handling quality. Bearings to be heavy-duty grease lubricated, self-aligning or roller pillow block type.

.4 Bearings to be 100 percent tested for noise and vibration by the Manufacturer. Bearings to be 100 percent tested to ensure the inner race diameter is within tolerance to prevent vibration.

.5 Bearings to be fixed to the fan shaft using concentric mounting locking collars. Bearings that use set screws are not permitted.

.5 Motors:

.1 Refer to Division 16 for requirements.

.2 Motors to be suitable for the electrical hazard classification of the location or the space served.

.3 Motors to be mounted out of the airsteam.

.4 Motors intended for VFD applications to be rated for such service.

.6 Interior and Exterior Finishes:

.1 Standard duty: polyester urethane.

.2 Corrosive ambient environment or exhaust air: Heresite.

.8 FRP Centrifugal Fans:

.1 Centrifugal (blower) supply and exhaust fans to be factory fabricated assemblies having fan, motor, drive guard(s), mounting frame, and special features and accessories as noted.

.2 In explosion-proof applications surfaces in the airstream to be graphite-impregnated and a grounding lug provided to eliminate static buildup.

.3 Fan Housing and Outlet:

.1 Fan to be of solid FRP composite one-piece construction with corrosion grade resins.

.2 Fasteners to be Type 316 stainless steel and fully FRP encapsulated in the airstream.

.3 The fan exterior is to have a UFBL grey gel coat finish with UV inhibitor.

.4 Bolted access door for cleaning and inspection.

.5 25 mm threaded drain and plug.

.6 Support structure to be steel construction with a minimum of two coat epoxy finish with a minimum dry film thickness of 152-203 microns (6-8 mils).

.4 Fan Wheel:

.1 Fan wheel to be of the non-overloading single backward inclined type.

.2 Wheels to be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.

.3 Fan wheel to be manufactured of solid FRP.

.5 Drives:

.1 Fan to be belt driven in AMCA Arrangement 9 with shaft guard to cover bearings and shaft.

.2 Fan shaft to be turned and polished stainless steel that is sized so the first critical speed is at least 35 percent over the maximum operating speed for each pressure class.

.3 The shaft seal to be Teflon, encased in a FRP seal box.

.4 Fan shaft bearings to be air handling quality. Bearings to be heavy-duty grease lubricated pillow block type.

.5 Bearings to be 100 percent tested for noise and vibration by the Manufacturer. Bearings to be 100 percent tested to ensure the inner race diameter is within tolerance to prevent vibration.

.6 Motors:

.1 Refer to Division 16 for requirements.

.2 Motors to be suitable for the electrical hazard classification of the location or the space served.

.3 Motors to be mounted out of the airsteam.

.4 Motors intended for VFD applications to be rated for such service.

.7 Interior and Exterior Finishes:

.1 UFBL grey gel coat with UV inhibitor.

.9 Fan Arrays:

.1 The fan array is to consist of multiple housed direct drive fans or “cells”, spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air tunnel cross section and components therein.

.2 Each fan and motor assembly to be removable through a 600mm wide, free area, access door located on the discharge side of the fan wall array without removing the fan wheel from the motor.

.3 All fans in multiple fan arrays to be AMCA certified for performance per AMCA arrangement “A” testing configuration. The submitted fan performance to be inclusive of system effects attributed to the fan mounting arrangement, fan enclosures, back draft dampers, and other fan appurtenances not considered when AMCA certified performance per AMCA arr. “A” is determined.

.4 Fans to have non-invasive, zero pressure drop flow a/o pressure sensing taps installed in the fan inlet cone for airflow monitoring capability as specified.

.5 Each fan applied in multiple fan applications to be provided with an integral back flow prevention device that prohibits recirculation of air in the event a fan, or multiple fans, become disabled. The system effect for the submitted back flow prevention device to be included in the calculation to determine the fan TSP for fan selection purposes, and to be indicated as a separate line item SP loss in the submitted fan selection data.

.6 Fans are to have non-invasive, zero pressure drop flow a/o pressure sensing taps installed in the fan inlet cone for airflow monitoring capability.

.7 Fan Wheel:

.1 Aluminum airfoil, Class III.

.2 Each fan/motor assembly to be dynamically balanced to meet AMCA standard 204, for fan application class BV-5.

.8 Cell Housing:

.1 Fan housing or “cell” to be constructed of aluminum or stainless steel with perforated inner liner, melamine insulation, with either solid or perforated outer panels as required by applications.

.2 Fan/motor to be mounted within the housing on an adjustable slide rail base. Fan/motor assembly to be capable of either horizontal or vertical application.

.9 Motors:

.1 Refer to Division 16 for requirements.

.2 Motors to be suitable for the electrical hazard classification of the location or the space served.

.3 Motors intended for VFD applications to be rated for such service.

.4 All motors to be standard foot mounted type.

.10 Industrial Air Curtains:

.1 General:

.1 Provide factory-assembled units of sufficient structural strength to be supported from ends without intermediate support. Ship units completely assembled. Units shall have split cabinet with removable lower section for access to internal components.

.2 Housing:

.1 Welded 316 Stainless steel.

.3 Adjustable Discharge Nozzle:

.1 Integral part of the housing, containing adjustable air-directional vanes with 20-degree deflection either side of centerline.

.2 Constructed of airfoil-shaped aluminum extrusions.

.3 Includes air volume control damper constructed of same material as cabinet.

.4 Mounting Brackets:

.1 Powder coat epoxy steel.

.2 Confirm wall or ceiling mounting based on overhead door configuration.

.5 Air-Intake Grilles:

.1 Integral part of and same material as the housing.

.2 Expanded metal with welded frame.

.6 Air Inlet Filter:

.1 Flat-faced type MERV 8, disposable with hinged inlet screen.

.7 Fans:

.1 Direct drive.

.2 Balanced forward curved centrifugal type, double inlet, double width design with welded hubs, mounted in matched fan housings with aerodynamically formed air inlet venturis.

.3 Aluminum wheels.

.4 Epoxy powder coated galvanized housing.

.5 Drive blower wheels through flexible couplings.

.8 Motors:

.1 Single speed.

.2 Resiliently mounted.

.3 Continuous duty.

.4 Totally enclosed, air over.

.5 Integral thermal-overload protection.

.6 Bearings: Permanently sealed, lifetime, pre-lubricated, ball bearings.

.7 Disconnect switch.

.9 Controls:

.1 Automatic Door Switch: Installed in door area to activate air curtain when door opens and to deactivate air curtain when door closes.

.2 Start-Stop, Push-Button Switch: Manually activates and deactivates air curtain.

.10 Electrical Components, Devices, and Accessories:

.11 Listed and labeled as defined in NFPA 70 and marked for intended location and use.

2.5 Equipment and System Controls

.1 Sections 15910 and 15920 specify control system requirements.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Install equipment mounted outdoors at grade level on a group C equipment mounting system per the equipment mounting schedule specified in Section 11002.

.4 Interface with Other Work:

.1 Install in accordance with Manufacturer's instructions.

.2 Roof curbs to be mounted level on roof in accordance with NRCA manuals and details. Secure to structure per engineered/sealed seismic installation details.

.3 Provide flexible connection for electrical power.

.4 Seal openings between curb, roof opening, ducts, electrical conduits, piping, and building interior.

.5 Protect the roof from damage during installation. Secure factory touch-up paint to repair scratches and minor damage to equipment prior to start-up.

.6 Install units with clearances for service and maintenance. Install ducts and piping adjacent to units to allow service and maintenance.

.7 Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors per Section 15890.

.8 Provide fixed sheaves required for final air balance.

.9 Provide safety screen where inlet and/or outlet is exposed.

.10 Pipe scroll drains to nearest floor drain.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for product selection, installation and testing of packaged make-up air units.

1.2 Standards

.1 Air Movement and Control Association (AMCA):

.1 AMCA 99, Standard Handbook.

.2 AMCA 210, Laboratory Methods of Testing Fans for Rating Purposes.

.3 AMCA 300, Reverberant Room Methods for Sound Testing of Fans.

.4 AMCA 301, Method of Calculating Fan Sound Ratings from Laboratory Test Data.

.5 AMCA 99-2408: Operating Limits for Centrifugal Fans.

.2 Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

.1 AHRI 260, Sound Rating of Ducted Air Moving and Conditioning Equipment.

.2 AHRI 270, Sound Performance Rating of Outdoor Unitary Equipment.

.3 AHRI 410, Standard for Forced Circulation Air-Cooling and Air-Heating Coils.

.4 AHRI 430, Performance Rating of Central Station Air-Handling Units.

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

.1 ASHRAE 33, Methods of Testing Forced-Circulation Air-Cooling and Air-Heating Coils.

.2 ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.

.4 ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.5 ASHRAE 111, Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

.4 American Society for Testing and Materials (ASTM):

.1 ASTM A36, Standard Specification for Carbon Structural Steel.

.2 ASTM A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A568, Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.

.4 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM B88, Standard Specification for Seamless Copper Water Tube.

.6 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

.7 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.8 ASTM C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.9 ASTM D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

.10 ASTM D522, Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.

.11 ASTM D3359, Standard Test Methods for Rating Adhesion by Tape Test.

.12 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 Canadian Standards Association (CSA):

.1 CSA B52, Mechanical Refrigeration Code

.2 CSA B149.1, Natural gas and propane installation code.

.6 Electrical Testing Laboratories (ETL).

.7 FM Approvals.

.8 National Fire Protection Association (NFPA):

.1 NFPA54-ANSI Z223.1, National Fuel Gas Code.

.2 NFPA 70, National Electrical Code.

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

.4 NFPA 90B, Standard for Installation of Warm Air Heating and Air Conditioning Systems.

.9 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG 1, Motors and Generators.

.10 Underwriters Laboratories of Canada (ULC):

.1 UL 705, Power Ventilators.

.2 UL 1995, Standard for Safety Heating and Cooling Equipment.

.11 Manitoba Workplace Safety and Health Act and Regulation.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and 11000 the following:

.1 Manufacturer's descriptive literature for materials.

.2 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

.3 Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

.4 Include unit dimensions and weight.

.5 Include cabinet material, metal thickness, finishes, insulation, and accessories.

.6 Fans:

.1 Include certified fan-performance curves with system operating conditions indicated.

.2 Include certified fan-sound power ratings.

.3 Include fan construction and accessories.

.4 Include motor ratings, electrical characteristics, and motor accessories.

.7 Include certified coil-performance ratings with system operating conditions indicated.

.8 Include filters with performance characteristics.

.9 Include dampers, including housings, linkages, and operators.

.10 Submit certified sound power levels for make-up air unit inlet and outlet and casing radiation at rated capacity in accordance with AMCA.

.11 Roof curbs and accessories.

.12 Water coil(s) are submitted under Section 15750. Include coil submittal number(s) as reference.

.13 Control descriptions for internal equipment control and interface with PCS.

2. PRODUCTS

2.1 Performance Criteria

.1 General Requirements: Section 11000.

.2 In addition, meet the following:

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

.3 ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

.4 ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

.5 Structural Performance: Casing panels shall be self-supporting and capable of withstanding positive/negative 10-inch wg of internal static pressure, without exceeding a midpoint deflection of 0.0042 inch/inch of panel span.

.6 Casing Leakage Performance: ASHRAE 111, Class 6 leakage or better at +/- 8 inches wg.

.7 Cabinet Thermal Performance:

.1 Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.

.2 Include effects of metal-to-metal contact and thermal bridges in the calculations.

.8 Cabinet Surface Condensation:

.1 Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.

.2 Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

.9 AHRI Certification:

.1 Provide AHRI certified and listed units.

.10 AMCA Compliance:

.1 Products are to comply with performance requirements and to be licensed to use the AMCA-certified ratings seal.

.11 NEMA Compliance:

.1 Motors and electrical accessories are to comply with NEMA standards.

.3 All fans to bear the AMCA seal.

.4 Makeup air units are to include but not be limited to the following components depending on location and heating energy source:

.1 Supply fan.

.2 Cooling coil.

.3 Pre-filter.

.4 Final filter.

.5 Hydronic Coil.

.6 Electric Heating Coil.

.7 Indirect gas fired heat exchanger.

.8 Access sections.

.9 Service corridor.

.10 Refrigeration compressors.

.11 Condenser coils and fans.

.12 All specified components and internal accessories to be factory installed and tested and prepared for single-point power connection.

2.2 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 Engineered Air.

.2 Mammoth.

.3 Hunt Air.

.4 Haakon.

.5 Or approved equivalent.

2.3 Construction

.1 Cabinet.

.1 Frame:

.1 Modular and providing overall structural integrity without reliance on casing panels for structural support.

.2 Exterior Panels:

.1 Minimum 1.6 mm satin coat galvanized steel.

.2 Surfaces to be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Exterior finish coat to be electrostatically applied enamel, to all exposed surfaces.

.3 Protective Coatings:

.1 In Hazardous Classified (explosive), Category 1 or 2 (wet or corrosive) and exterior applications, coat entire assembly, including roof curb.

.2 Corrosion-resistant, factory applied coatings to be Heresite, Hi-Pro Polyester, or epoxy applied in strict conformance with the paint Manufacturer's instructions.

.4 Interior surfaces and unit underside to be coated in a two-part 0.1524 mm epoxy finish.

.5 Provide epoxy coated belt guards, fan casings and steel fan wheels.

.1 Belt guards to comply with the Manitoba Workplace Safety and Health Act and Regulation.

.6 All unprotected metal and welds to be factory coated.

.3 Walls, Ceilings, and Base:

.1 Double-wall construction.

.2 Outside Casing Wall:

.1 Standard Material, Galvanized Steel: Minimum 18 gauge thick.

.2 Alternate Material, Aluminum: Minimum 16 gauge thick when required.

.3 Alternate Material, Stainless Steel: Minimum 18 gauge thick when required.

.3 Inside Casing Wall:

.1 Standard Material, Solid galvanized Steel: Minimum 18 gauge thick.

.2 Alternate Material, Solid aluminum: Minimum 16 gauge thick when required.

.3 Alternate Material, Solid stainless Steel: Minimum 18 gauge thick when required.

.4 Interlocking formed construction with at least two breaks at each interlocking joint. Wall and ceiling joints shall be broken outward. All panel joints shall be hermetically sealed at each corner and around entire perimeter.

.5 Roof shall be pitched slightly (minimum 2 percent) to prevent water pooling.

.6 Casing depth to match the specified insulation thickness.

.7 Inside surfaces to be clean and flush, free of exposed flanges.

.8 Provide minimum 25 mm x 25 mm drip channels over all access doors.

.9 Floor structure to be constructed from structural steel channel iron around perimeter with intermediate channel and angle iron supports. Floor plate to be as set out below:

Location	Floor plate
Service corridor floor and fan section	2.0 mm galvanized steel checker plate
All other areas	1.6 mm satin coat galvanized steel

.10 Provide floor bracing channels at maximum 300 mm on centre.

.4 Exterior Access Panels:

.1 Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.

.2 Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow.

.3 Gasket: Neoprene, applied around entire perimeters of panel frames.

.4 Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components.

.5 Surfaces to be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Exterior finish coat to be electrostatically applied enamel, to all exposed surfaces.

.6 Protective Coatings:

.1 In classified, Category 1 or 2 and exterior applications, coat entire assembly, including roof curb.

.2 Corrosion-resistant, factory applied coatings to be Heresite, Hi-Pro Polyester, or epoxy applied in strict conformance with the paint Manufacturer's instructions.

.7 Interior surfaces and unit underside to be coated in a two-part 0.1524 mm epoxy finish.

.8 Provide epoxy coated belt guards, fan casings and steel fan wheels.

.1 Belt guards to comply with the Manitoba Workplace Safety and Health Act and Regulation.

.9 All unprotected metal and welds to be factory coated.

.5 Doors:

.1 Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing complete with viewing window.

.2 Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.

.3 Gasket: Neoprene, applied around entire perimeters of panel frames.

.4 Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 46 cm (18 inches) wide by full height of unit casing up to a maximum height of 178 cm (72 inches).

.5 Locations and Applications:

.1 Fan Section: Doors, with windows.

.2 Coil Section: Panels.

.3 Access Sections Immediately Upstream and Downstream of Coil Sections: Doors, with windows.

.4 Damper Section: Doors, with viewing windows.

.5 Filter Section: Doors large enough to allow periodic removal and installation of filters.

.6 Access Sections Immediately Upstream and Downstream of Filter Sections: Doors, with windows.

.6 Windows:

.1 Construction: Fabricate windows in access panels and doors of double-glazed, safety glass with an airspace between panes and sealed with interior and exterior rubber seals.

.2 Size: Minimum 20 cm (8 inches), square or round.

.7 Service Lights: 100 Watt equivalent LED vaporproof luminaire with individual switched junction box located outside, adjacent to each access door and panel.

.1 Locations: Each section accessed with door or panel.

.2 Design according to electrical classifications.

.8 Convenience Outlets: One 20-A duplex GFCI receptacle per location with junction box located on outside casing wall and designed according to electrical classifications.

.9 Condensate Drain Pans:

.1 Single-wall, dual sloped, stainless-steel sheet.

.2 Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

.3 Slope: Slope is to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends and to direct water toward drain connection.

.4 Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.

.5 Width: Entire width of water producing device.

.6 Depth: A minimum of 5 cm (2 inches) deep.

.7 Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

.8 On units without stacked coils, provide a single fabricated 16 gauge galvanized steel drain pan under cooling coils. Prime coat pan inside and out with zinc chromate, iron oxide, phenolic resin paint and two (2) coats of bitumastic paint.

.9 On units with stacked coils, provide a separate drain pan under each coil. On all units, provide a secondary drain pan extending under the entire access section downstream of the cooling coil and the humidifier section. Provide a drain pan to drain the fresh air intake or mixing plenum. Pipe all drains to the exterior side of unit.

.10 Insulation and Liner:

.1 Insulate all exterior walls and roof with 100 mm thick injected polyurethane foam insulation. Line interior of all panels with 0.71 mm galvanized steel liner.

.2 Insulate underside of unit floor with 100 mm thick injected polyurethane foam insulation.

.3 Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

.2 Access Doors:

.1 Provide hinged person sized access doors. Door construction to be the same as casing each complete with 250 mm diameter round, or equivalent area square, wired glass viewing window. Provide minimum two (2) latches per door openable from both sides. Doors to be sealed with neoprene gasketting (foam gasketting not acceptable). Door hinge to be continuous stainless steel piano hinge. Door sizes to be 750 mm x 1800 mm or as limited by height of unit. Provide access doors for the following sections.

.1 Fan motor section.

.2 Cooling coil section.

.3 Heating section.

.4 Final filter section.

.5 Pre-filter section.

.6 Access sections.

.7 Damper sections.

.2 Access doors on sections under positive pressure to be restrained. Apply warning labels to all doors under positive pressure.

.3 Marine Lights:

.1 Provide marine type lights with Lexan bulb covers in all sections having an access door on all units. Lights to be factory installed and wired to a single lighted switch located outside the service corridor access door or where no service corridor is provided on the exterior of the unit.

.2 Design according to electrical classifications.

.3 Install LED lamps to each light fitting with an equivalence of 100 W per lamp.

.4 All lights within the units, service corridor and inlet plenum to be switched from a single switch located outside and adjacent to the service corridor personnel door. Light to be fed from a separate source so that the lights are operative even when the unit is off.

.4 Fan:

.1 Fan to consist of a belt driven, backward inclined blower with adjustable pullies for constant volume speed adjustment. Optional direct drive with factory supplied, mounted and wired speed control assembly in constant volume applications for air balancing. Mount on heavy gauge galvanized rails and further mounted on minimum 28 mm thick neoprene vibration isolators. Fan assembly to be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.2 Fan to be manufactured from material suitable for the airstream in which it is located.

.3 Fan to be constructed to AMCA A or B spark-proof standard in electrically classified areas.

.5 Motors:

.1 Motors to be in accordance with Division 16.

.2 Motors to be heavy-duty permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Motors to be totally enclosed, fan cooled (TEFC). Drives to be sized for a minimum of 150 percent of driven horsepower and pulleys to be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts.

.3 Motor to be Premium Efficient motors as defined in NEMA MG 1 for inverter duty.

.4 Motors to be explosion-proof for classified spaces.

.5 The entire fan assembly to be seismically restrained.

.6 Motors to be integrally mounted, 1,800 RPM maximum, with pre-lubricated sealed ball bearings.

.7 Motors for units with variable speed fans to be inverter duty type.

.8 Mount unit-mounted disconnect switches on exterior of unit.

.9 Provide full voltage non-reversing motor starter on constant speed units.

.6 Coils:

.1 Hydronic heating coils to be in accordance with Section 15750.

.2 Heat recovery coils to be in accordance with Section 15750.

.3 Evaporator coils to be in accordance with Section 15752.

.4 Electric Heating Coil:

.1 Electric heating coils to be factory-supplied.

.2 Electric heat assembly to have single-point power wiring from the unit’s main power connection.

.3 Heater assembly to include contactors with 24 V coils, power wiring, 24 V control wiring terminal blocks, and a hinged access panel.

.4 Elements to be sheathed.

.5 Output SCR or multi-stage with SCR controlled.

.6 Provide explosion-proof construction for electrically classified areas.

.7 Indirect Gas Fired Heat Exchanger:

.1 General:

.1 Heating units to be indirect natural gas fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories to be approved by an independent testing authority, and carry the approval label of that authority as a complete operating package.

.2 All units to meet the ASHRAE 90.1 requirement of steady state efficiency at low fire.

.3 Operating natural gas pressure at unit(s) manifold to be 1.75 to 3.50 kPa.

.4 Gas manifolds to be provided to FM standards.

.5 Gas fired units to be approved for operation in minus 20°C spaces.

.2 Heat Exchanger:

.1 Heat exchanger to be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane tubulators and to be of a floating stress relieved design. Heat exchanger to be provided with condensate drain connection. The heat exchanger casing is to have 25 mm of insulation between the outer cabinet and inner liner. Blower assemblies close coupled to duct furnace type heat exchangers are not permitted.

.2 Heat exchangers to be tested and certified to CSA standards to provide a minimum ETL certified 90 percent efficiency throughout the entire operating range.

.3 Burner:

.1 The burner assembly to be a blow through positive pressure type with an intermittent pilot ignition system to provide a high seasonal efficiency. Flame surveillance to be with a solid state programmed flame relay complete with flame rod. The burner and gas train to be located inside a cabinet enclosure. Insulation in the burner section to be covered by a heat reflective galvanized steel liner. Atmospheric burners or burners requiring power assisted venting are not permitted.

.2 Provide discharge air temperature control with 15:1 turndown capability for all input capacities in range from 29.3 kW to 410 kW. The high turndown burner minimum input to be capable of controlling at 6.7 percent of its rated input without on-off cycling and include built in electronic linearization of fuel and combustion air. Efficiency is to increase from high to low fire.

.4 Venting:

.1 Installation and venting provisions to be in accordance with CGA Standard B149.1, ANSI Z223.1-NFPA54, and local authorities have jurisdiction. Type A, L, and/or PS venting is required.

.5 Burner Controls:

.1 The gas fired heating controller to be a fuel/combustion air local controller. The controller is to incorporate a solid state analyzer complete with proportional and integral control and with a discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions.

.2 Combustion efficiency of high efficiency heat exchangers is to increase 4 to 5 percent from high fire to low fire. Heat exchangers are to provide a minimum of 90 percent efficiency throughout the entire operating range.

.3 As an alternative to variable speed combustion air blower, the burner control may include a modulating gas valve and a combustion air damper with a linear linkage connected to an actuator which has a minimum of 100 steps of control.

.6 Burner controls are to include the following standard features:

.1 Linear gas and combustion air flow obtained via a built in solid state linear algorithm.

.2 Minimum operating ambient temperature: minus 40°C.

.3 Four (4) air change pre-purge on units with over 117 kW input.

.4 Post purge.

.5 Interrupted pilot.

.6 Self-check on start-up to make sure air proving and discharge air sensors are operating within design tolerances.

.7 Low fire start.

.8 Controlled burner start-up and shut down.

.9 Diagnostic lights for ease of set-up and service.

.10 Blower contactor that starts fan after burner pre-purge.

.11 Damper contact that allows fan to start after damper opens, damper to close after fan stops and damper to close on flame failure.

.12 Non-recycling auto by-pass low limit that has built-in sensor checking.

.7 Burner controller to modulate heating output to maintain supply air temperature setpoint. Refer to Sections 15910 and 15920 for control system requirements.

.8 Condensate Neutralization Tank:

.1 Condensate neutralization tank to include of a 20 L tank made from one-piece seamless polyethylene construction with 125 mm media fill/access opening, 40 mm FIP inlets on the top and the side, 40 FIP side outlet, and 40 mm FIP top vent.

.2 Acceptable Product:

.1 Axiom Industries Ltd. - Model NT20.

.2 Or approved equivalent.

.3 Supply complete with initial charge of neutralizing media.

.9 Condensate Pump:

.1 Provide a fully automatic condensate removal pump rated for the removal of acidic condensate with 1.9 L capacity tank manufactured from acrylonitrile butadiene styrene (ABS), a vertical-type pump with stainless steel motor shaft, high-impact ABS volute and motor cover, 3 drain holes, removable 10 mm O.D. barbed check valve. The motor to be thermally protected and cUL and CSA listed. Provide an overflow safety switch for connection to the PCS.

.2 Acceptable Product:

.1 Little Giant VCMA-20 Series.

.2 Or approved equivalent.

.8 Dampers:

.1 Extruded aluminum (6063T5) damper frame is not to be less than 2.03 mm in thickness. Damper frame to be 100 mm deep and to be insulated with polystyrofoam on four sides. Entire frame to be thermally broken by means of polyurethane resin pockets, complete with thermal cuts. Blades to be extruded aluminum (6063T5) profiles, internally insulated with expanded polyurethane foam and to be thermally broken. Complete blade is to have an insulating factor of R-2.29 and a temperature index of 55. Blade and frame seals to be of extruded silicone and to be secured in an integral slot within the aluminum extrusions. Bearings to be composed of a Celcon inner bearing fixed to 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact. Linkage hardware to be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip. Dampers to be designed for operation in temperatures ranging between minus 20°C and 40°C. Dampers to be available with either opposed blade action or parallel blade action.

.2 Each end switch to be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure is to permit setting the position of the trip lever that actuates the switch. The trip lever to be aligned with the damper blade.

.3 Damper leakage to be certified under the AMCA certified rating program and is to carry AMCA seal:

  .1 Low Leakage: 8.6 L/s/m^2 at 250 Pa pressure difference for a 1220 mm x 1220 mm damper.

.4 Install blade linkage hardware in frame out of air stream. Use cadmium plated steel hardware. Extend damper shaft through casing sufficiently to allow installation of the damper operator in the service corridor.

.5 Arrange linkage and provide an adequate number of damper operators to ensure that the interconnected damper sections operate in unison without binding.

.6 The outdoor air damper to be integral part of the air handling units and to be supplied and installed by the air handling unit Manufacturer at the factory.

.7 Electronic Non-Modulating Damper Operators:

  .1 Spring return, 24 VAC operating voltage, on-off operation, seventy (70) seconds maximum running time for 90 degree opening and thirty (30) seconds maximum closing time.

  .2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

  .3 Actuators to be explosion proof in electrically classified areas.

.8 Electronic Modulating Damper Operators:

  .1 Spring return, 24 VAC operating voltage, 0-10 VDC input signal, 0-10 VDC position output signal, 70 seconds maximum running time for 90 degree opening and 30 seconds maximum closing time.

.2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one (1) damper operator per damper section.

.3 Actuators to be explosion proof in electrically classified areas.

.9 Filters:

.1 Replaceable.

.2 Summer and winter positions.

.3 Reference Section 15855 for filter performance and construction criteria.

.4 Provide one (1) Dwyer 2000 magnehelic (or approved equivalent) filter gauge for each bank of filters. Gauge shall in SI units or dual scale. Select gauge so that normal operating pressures are approximately at the scale midpoint. Flush mount gauge on the exterior of the unit. Gauge shall be suitable for outdoor operation.

.10 Service Corridors:

.1 Provide common service corridor for each pair of makeup air units.

.2 Structural base frame of the service corridor to be an extension of the MAU base frame.

.3 Materials of construction:

.1 The wall, floor, roof and doors to be same at the MAU. The wall and roof to be lined with a 0.71 mm satin coat galvanized steel liner.

.4 Provide a 2.0 mm thick galvanized steel checker plate floor sloped to low point complete with floor drain. Piping from all coil drains to be routed to this floor drain.

.5 Provide floor bracing channels at maximum 300 mm on centre.

.6 Provide one (1) marine light every 1800 mm, with a minimum of two (2) marine lights designed per electrical classifications. Wire lights to a single weatherproof lighted switch located outside the access door. Lights to be fed from a separate source so that the lights are operative even when the unit is off. Provide two (2) grounded convenience outlets (120 VAC/1 Phase). Lights and convenience circuit to be fed from the same electrical feed.

.7 Provide electric unit heater(s), complete with a local disconnect switch and wall mounted electric thermostat, sufficiently sized to ensure a minimum internal temperature of 5ºC at a maximum external temperature of minus 20ºC.

.8 Service corridor interior height is not to be less than 2400 mm.

.9 Service corridor interior width is not to be less than 1800 mm, or wider if required for removal of coils from the MUA.

.10 Exterior access door entering into the service corridor to be 900 mm wide x 2100 mm high. Door to be neoprene gasketted, have thermal window (400 mm wide x 600 mm minimum height) and swing open to outside. Provide tie-back for door.

.11 Provide inlet and outlet motorized dampers and fan to ventilate the service corridor at minimum six (6) ACH or the minimum air flow required to maintain an internal temperature of 36ºC when the external ambient is 31ºC when MUA is in operation. All control and electrical wiring for motorized dampers and fans to be factory installed.

.12 Make provisions for adequate ducted combustion air supply to gas burner section with all servicing of burner from inside of the service corridor.

.13 Make provisions for venting gas regulators through roof of service corridor.

.14 Provide aluminum or stainless steel wedge vent through side of casing. Extend a minimum of 300 mm from casing.

.15 Provide openings in wall/roof for all electrical services, gas, condensate and glycol piping.

.11 VFDs:

.1 Refer to Division 16.

.12 Refrigeration/Electrical:

.1 Conform to CSA B52 requirements.

.2 Condensing section:

.1 Hermetic compressors, vibration isolated with flexible suction and discharge connections, oil sight glass.

.2 Fans: Propeller type with single piece, spun venturi outlets, and zinc plated guards.

.3 Condenser: Staggered copper tube aluminum fin coil assembly.

.4 Factory piped and charged refrigerant piping with sight glass, filter and valves.

.3 Electrical/controls:

.1 Design according to electrical classifications.

.2 Electrical system is to have operating controls, oil and refrigerant pressure protection and motor overload protection. Wiring to be weather proofed: Mount all controls, transformers, disconnects, starters in a NEMA 4X cabinet.

.3 Provide motor starters for all compressors and fans.

.4 Provide terminal strip suitable for wiring to the dry control contactors of the automation system.

.5 Provide ambient control to prevent condenser operation below 13°C.

.6 Provide anti-cycle timers between each stage of cooling.

.7 Provide a temperature controller to control mix air temperature at 13°C by modulating mix dampers.

.8 Control unit supply temperature from space thermostat by sequentially modulating the preheat coil valve, reheat coil valve and cycling the various stages of refrigerant cooling. Provide a discharge air limit controller that is to ensure that the supply air temperature is maintained between the present minimum and maximum limits.

.9 Provide a minimum of four (4) stages of DX cooling.

.13 Control Panels:

.1 Provide control panel of unitized cabinet type construction. Mount relays, switches and control point adjustment in cabinet and pressure gauges, pilot lights, push buttons, switches and VFD’s flush on cabinet panel face.

.2 Fabricate panels from 2.5 mm (12 ga) rolled sheet metal sheet with baked enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. Each panel to have identical key and lock sets. CSA approved for line voltage applications. Panels located outdoors to be manufactured from Type 316 stainless steel sheet metal with a #2b brushed finish. Outdoor panels to be NEMA 4X rated.

.3 Mount panels on vibration free wall or free standing angle iron supports in the location identified on the accompanying drawings. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.4 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.5 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 VAC supply.

.6 Make all power and control wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.7 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.8 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal to be clearly indelibly marked with the wire number connection to it. Each field connecting conductor to be served by one terminal. Provide 20 percent spare unit terminals with a minimum of two (2) spare terminals. Provide all necessary terminal block accessories such as Manufacturer jumpers and marking tape.

.9 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position.

.10 Step down transformers to be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, are to have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformers to be sized so that the connected load is 80 percent of the rated capacity or less. Transformers are to conform to UL 508 and NEMA ST 1.

.11 Control wiring for digital functions to be 18 AWG minimum with 300 VAC insulation.

.12 Control wiring for analog functions to be 18 AWG minimum with 300 VAC insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.13 Sensor wiring to be 18 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.14 Transformer current wiring to be 16 AWG minimum.

.14 Instrumentation: Provide all instrumentation required for complete control and monitoring of the units in accordance with Sections 15920 and Division 16. Instrumentation to be provided with the unit includes but is not limited to the following:

.1 DPDT air differential pressure switch for fan status.

.2 Filter differential pressure transmitter.

.3 Outdoor air temperature indicating transmitter.

.4 Supply air temperature indicating transmitter.

.15 Roof Curbs:

.1 Construct from 12 gauge galvanized steel with 50 mm x 100 mm nailing strip around the entire perimeter.

.2 Insulate interior of the curb with 50 mm thick, 24 kg/m³ neoprene coated fibreglass insulation.

.3 Provide a 25 mm x 19 mm closed cell neoprene sealing gasket to seal the perimeter joint between roof curb and air processing unit.

.4 Roof curb to be seismic rated with attachment points to both the unit and the structure.

.5 Coordinate the roof attachment with Professional of Record.

2.4 Materials

.1 Steel:

.1 ASTM A36 for carbon structural steel.

.2 ASTM A568 for steel sheet

.2 Stainless Steel:

.1 Manufacturer's standard grade for casing.

.2 Manufacturer's standard type, ASTM A240 for bare steel exposed to airstream or moisture.

.3 Galvanized Steel: ASTM A653.

.4 Aluminum: ASTM B209.

.5 Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 6000-hour salt-spray test according to ASTM B117.

.1 Standards:

.1 ASTM B117 for salt spray.

.2 ASTM D522 Bend test > 0.6 cm (0.25 inches).

.3 ASTM B3359 for cross hatch adhesion of 5B.

.4 Thermal Efficiency Impact: < 1 percent.

2.5 Controls

.1 Control will be provided through the Plant Control System (PCS).

2.6 Source quality control

.1 AHRI 430 Certification: Air-handling units and their components shall be factory tested according to AHRI 430 and shall be listed and labeled by AHRI.

.2 Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

.3 Water Coils: Factory tested to 2068 kPag (300 psig) according to AHRI 410 and ASHRAE 33.

.4 Refrigerant Coils: Factory tested to minimum 3101 kPag (450 psig) internal pressure and to minimum 2068 kPag (300 psig) internal pressure while underwater, according to AHRI 410 and ASHRAE 33.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Provide flexible connection for electrical power and hot water piping.

.4 Seal openings between curb, roof opening, ducts, electrical conduits, piping, and building interior.

.5 Secure factory touch-up paint to repair scratches and minor damage to equipment prior to start-up.

.6 Install units with clearances for service and maintenance. Install ducts and piping adjacent to units to allow service and maintenance.

.7 Hot Water Piping: Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

.8 Install filters upstream of heating coils prior to fan operation.

END OF SECTION

AIR OUTLETS AND INLETS

1. GENERAL

1.1 Summary

.1 This Section specifies provisions for the materials, installation and testing of air outlets and inlets, including:

.1 Grilles, registers, diffusers.

.2 Wall mounted louvers.

.3 Gravity intake and relief hoods.

1.2 Standards

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 ANSI/ASHRAE 70 – Method of Testing the Performance of Air Outlets and Air Inlets.

.2 ASHRAE 62.1 – Ventilation for Acceptable indoor Air Quality.

.2 Air Movement and Control Association (AMCA):

.1 AMCA 511 – Certified Ratings for Water Penetration and Air Performance.

.2 AMCA Standard 500 – Test methods for Louvers, Dampers, and Shutters.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.2 ASTM B308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.

.3 Performance Data: Include testing standards, throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.

.4 Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.

2. PRODUCTS

2.1 Diffusers, Grilles and Registers

.1 General Requirements:

.1 Provide Manufacturer’s standard diffusers, grilles, and registers constructed of materials and components required for complete installation.

.2 Performance: Furnished diffusers, grilles and registers are to each have, as minimum, air pattern and pressure drop performance and noise criteria ratings evidenced by listing in Manufacturer’s current data.

.3 All performance testing to be done in accordance with ANSI / ASHRAE Standard 70.

.4 Compatibility: Border styles to be compatible with adjacent wall, ceiling or duct systems, specifically manufactured to fit into ceiling module, wall or duct construction with accurate fit and adequate support.

.5 All grilles, registers and diffusers to be made of the same material as the ductwork in which they are installed.

.6 Provide 1-, 2-, 3-, or 4-way deflection as required for proper air distribution.

.7 In occupied areas, outlet type and location to be selected to maximize the zone air distribution effectiveness as defined by ASHRAE Standard 62.1.

.8 Dampers: Registers and diffusers to be furnished with opposed blade volume control dampers and gasket seals. Dampers to be adjustable through face of the diffuser or factory assembled side operator providing external duct operation. Construct of the same material as the grille. Manufacturer to be the same as grilles/diffuser.

.9 Registers, grilles and diffusers in non-process finished areas are to receive a white powder coat finish.

.2 Ceiling Supply Diffusers (CSD): For hung tile ceilings, frames to be lay-in type. For hard ceilings, frames to be flush mounting type. Where lights are surface mounted, diffusers to be of dropped face design.

.1 CSD-1: Office application rectangular square cone diffusers to be adjustable type.

.1 Acceptable Products:

.1 Titus Model TMSA (steel), TMSA-AA (aluminum).

.2 Price Model SCDA (steel)/ASCDA (aluminum).

.3 Or approved equivalent.

.2 CSD-2: Office application rectangular modular core type diffusers. Provide rectangular to round adapter for connecting to round ductwork.

.1 Acceptable Products:

.1 Titus Model MCD (steel), MCD-AA (Aluminum).

.2 Price Model SMCD (steel), AMCD (aluminum).

.3 Or approved equivalent.

.3 CSD-3: Round diffusers (for exposed duct in finished non-process areas) to be adjustable type.

.1 Acceptable Products:

.1 Titus Model TMRA (steel)/TMRA-AA (aluminum).

.2 Price Model RCDA (steel)/ARCDA (aluminum).

.3 Or approved equivalent.

.3 Wall or Duct-Mounted Supply Grilles (WSG): Wall supply grilles and registers to be adjustable louver or double deflection type. Supply grilles installed in wall openings are to have an overlap margin to cover wall opening.

.1 WSG-1: Adjustable diffusers for rectangular ductwork to be adjustable type.

.1 Acceptable Products:

.1 Titus Model 250 (steel), 250-AA (aluminum).

.2 Price Model SCVD, CVD (aluminum).

.3 Or approved equivalent.

.2 WSG-2: Non-process area double-deflection louvered type with individually adjustable bars that allow 45° adjustment spread. Bars to be on 19 mm centres, with horizontal face bars and vertical rear bars.

.1 Acceptable Products:

.1 Titus Model 300RL (steel), 300 FL (aluminum), 300 RL-SS (stainless steel).

.2 Price Model 520 (steel), 620 (aluminum), 720 (stainless steel).

.3 Or approved equivalent.

.3 WSG-3: Process area heavy duty double-deflection louvered type with individually adjustable bars that allow 45° adjustment spread. Bars to be on 38 mm centres, with horizontal face bars and vertical rear bars. Aluminum blades and frame and damper.

.1 Acceptable Products:

.1 Price Model 152D (aluminum).

.2 Titus Model 112R (aluminum).

.3 Or approved equivalent.

.4 WSG-4: Process area heavy duty, high performance drum louver type. The outlets are to consist of individually adjustable spread control vanes housed within a rotatable drum. Drum, frame and vanes to be aluminum construction. The drum pivot mechanism is to incorporate a positive positioning detent device to hold field adjusted drum angles of up to 30° off centre. Adjustable vanes are to pivot and maintain blade setting. A pole operator bracket to be provided for locations more than 5 m AFF.

.1 Acceptable Products:

.1 Titus DL.

.2 Price Model AHCD.

.3 Or approved equivalent.

.4 Ceiling Exhaust and Return Registers (CER) and Grilles (CEG)

.1 CER-1: Grilles to be eggcrate type, with a grid of 13 mm x 13 mm x 13 mm. Ceiling grilles are to have a factory applied prime coat and baked white enamel finish. For hung tile ceilings, frames to be lay-in type. For hard ceilings, frame to be flush mounted type. Grilles in plaster, drywall and concealed spline ceilings are to have an overlap margin to cover the ceiling opening. Ceiling grilles are to have an integral duct collar and concealed mounting frame. Duct at grille inlet/outlet to be internally painted flat black.

.1 Acceptable Products:

.1 Titus Model 50R (steel), 50F (aluminum).

.2 Price Model 80 (aluminum).

.3 Or approved equivalent.

.2 CEG-1: Linear bar grille to be extruded aluminum bar and frames that have a factory prime coat suitable for field paint. Provide plaster frames of the same materials as diffuser. Frames to be prime coated and suitable for field painting. The linear diffuser plenum to be internally painted flat black.

.1 Acceptable Products:

.1 Titus Model CT-580, CT-540 or CT-581.

.2 Price model LBP 15B, LBP 25B or LBP 16B Type C concealed fastener.

.3 Or approved equivalent.

.5 Wall- or Duct-Mounted Exhaust or Return Air Grilles (WEG): Grille blades to be set horizontally, 19 mm on centre and 35-45 degrees.

.1 WEG-1: Louvered return grilles for rectangular ductwork.

.1 Acceptable Products:

.1 Titus Model 350RL (steel), 350FL (aluminum), 355RL (stainless steel).

.2 Price Model 530 (steel), 630 (aluminum), 730 (stainless steel).

.3 Or approved equivalent.

2.2 Gravity Intake and Relief Hoods

.1 Intake and relief hoods to be constructed of heavy gauge aluminum and of precision formed, arched panels with interlocking seams. Unit to be equipped with a 13 mm aluminum birdscreen mounted across the discharge area of the hood, gravity backdraft damper tray and roof curb. Hoods to be coated with Heresite if handling corrosive exhaust.

.1 Rectangular intake and relief hoods:

.1 Acceptable Products:

.1 Greenheck Model FGI/FGR.

.2 Loren Cook Model GI/GR.

.3 Or approved equivalent.

.2 Round intake and relief hoods:

.1 Acceptable Products:

.1 Greenheck Model GRSI/GRSR.

.2 Loren Cook Model PR or TR.

.3 Or approved equivalent.

2.3 Louvers

Component	**Material**
Blades	ASTM B221, 6063-T52 extruded aluminum alloy
Frame	ASTM B221, 6063-T52 extruded aluminum alloy
Fasteners	Stainless steel or aluminum
Bird Screen	ASTM B308, Aluminum

2.4 Configuration, Components and Features

.1 Stationary Wall Mounted Exterior Louvers:

.1 Intake and relief louvers will be constructed of 2.1 mm thick aluminum extrusions.

.2 Frames and louver blade connections to frames will be welded. Screws or rivets will not be acceptable.

.3 Louvers will be 150 mm deep with blades 100 mm on centre and a 35 degree blade angle.

.4 Louvers will be of a drainable blade configuration with vertical jamb gutters and horizontal blade gutters.

.5 Blades will be continuous in appearance with rear mounted, invisible, jambs at adjoining sections.

.6 Unit will be equipped with a removable 13 mm square aluminum birdscreen with extruded aluminum frame mounted across the interior side of the louver.

.7 Louvers will be certified to be tested in accordance with AMCA 511 to have a beginning point of water penetration at a minimum of 5.5 m per second.

.8 Louvers shall be finished to match architectural requirements.

.9 Louvers handling corrosive exhaust will be finished a Duranar fluoropolymer coating.

.10 Acceptable Products:

  .1 Greenheck ESD-635.

  .2 Price DE635.

  .3 Or approved equivalent.

.2 Stationary Wall Mounted Exterior Acoustic Louvers:

  .1 Acoustic intake and relief louver blades and frames will be constructed of 2.0 mm thick formed aluminum.

  .2 Frames and louver blade connections to frames will be welded. Screws or rivets will not be acceptable.

  .3 Louvers will be 150 mm deep with 45 degree blade angle.

  .4 Louver blades will incorporate fibreglass insulation and 2.0 mm perforated aluminum insulation retaining screen.

  .5 Blades will be continuous in appearance with rear mounted, invisible, jambs at adjoining sections.

  .6 Unit will be equipped with a removable 13 mm square aluminum birdscreen with extruded aluminum frame mounted across the interior side of the louver.

.7 Louver will be certified to be tested in accordance with AMCA 511 to have a beginning point of water penetration at a minimum of 4.5 meters per second.

.8 Acoustical performance will be certified to be derived in accordance and comply with the requirements of AMCA 511 at a minimum.

.9 Louvers are to be finished to match architectural requirements.

.10 Louvers handling corrosive exhaust are to be finished a Duranar fluoropolymer coating.

.11 Acceptable Products:

.1 Greenheck AFJ-601.

.2 Price QA645.

.3 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Coordinate installation of framing. Provide complete coverage of rough openings by integral device flanges or auxiliary frames. Where above ceiling location is unconditioned space, caulk rough openings; repair and re-paint locations where dust entrainment streaks develop due to unsealed openings.

.4 Damp locations, such as lockers, restrooms, showers, and process areas to have aluminum construction with mounting hardware to be stainless steel.

.5 Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Coordinate with architectural reflected ceiling plan(s).

.6 Install diffusers to ductwork with airtight connection. 450 mm straight duct section or acoustic plenum at connection. Provide square to round adapters where required for connection to round ducts.

.7 Provide integral balancing dampers for diffusers, and grilles and registers where duct manual balancing dampers are not used.

.8 Adjust throws of air outlets to eliminate drafts and to distribute air during heating and cooling operation.

.9 Paint ductwork visible behind air outlets and inlets matte black.

.10 Louvers are to be aligned, connected, and installed as specified and in accordance with the Manufacturer's recommendations. A bituminous coating is to be applied to all aluminum surfaces in contact with concrete or masonry.

.11 Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.

.12 The supporting structure is to be designed to accommodate the point loads transferred by the louvers when subject to the design wind loads.

.13 Acoustic louvers are to be used as a component in systems designed to satisfy sound criteria as defined in the Final Design.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing of fibreglass reinforced plastic fans and blowers complete with motors, drives, inertia bases, flexible connectors, and accessories.

1.2 Standards

.1 Air Movement and Control Association (AMCA):

.1 ANSI/AMCA 99-0401 – Classification for Spark Resistant Construction.

.2 ANSI/AMCA 210 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.

.3 ANSI/AMCA 300 – Reverberant Room Method for Sound Testing of Fans.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A36 – Standard Specification for Carbon Structural Steel.

.2 ASTM C582 – Standard Specification for Contact Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.

.3 ASTM D4167 – Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.

.4 ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Fan performance curves illustrating speed, capacity, pressure, and power for the specified operating conditions.

.3 Description of FRP materials and construction methods.

.4 Fan and motor bearing ratings, with supporting calculations, at the specified operating conditions.

.5 Bearing calculations.

.6 Equipment weights and bearing point weights with vibration isolation design data.

.7 Documentation that fans are AMCA certified for sound and air performance.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 New York Blower FE-MP or FE-HP.

.2 Verantis Club or CMH.

.3 Hartzell Series 41.

.4 Or approved equivalent.

2.2 Performance Criteria

.1 Service Conditions:

	Description	
(1)	Area Exposure	Per Section 01450.
(2)	Air Type	Saturated air containing corrosive vapours and gases including methane, hydrogen sulphide, dimethyl sulphide and other organic sulphur compounds, ammonia, amines, and dilute sulphuric acid.
(3)	Air Temperature	0°C to 40°C

.2 Design Requirements:

.1 AMCA certified for sound and air performance.

.2 Select the fans to achieve the indicated operating capacity at no greater than 85 percent of maximum recommended RPM.

.3 Non-overloading along entire curve; capacity per ANSI/AMCA 210.

.4 Speed differential allows increases in volume and/or pressure.

.5 Spark resistant construction per ANSI/AMCA 99-0401.

2.3 Materials

Component	**Material**
Housing and Wheel	FRP, ASTM C582 and ASTM D4167, Derakane 510 A or Hetron FR992 resin
Shaft	Type 316 Stainless Steel
Shaft Seal	PTFE
Shaft Seal Rings and Springs	Type 316 Stainless Steel
Shaft Hub and Bushings	Type 316 Stainless Steel, FRP encapsulated
Base	Steel
Drain	FRP

Component	Material
Flexible Connectors	Neoprene
Door gasket	Neoprene
Fasteners and Hardware (e.g., bolts, nuts, band clamps, anchor bolts, backing bars, backing flange)	Type 316 Stainless Steel

2.4 Configuration, Components and Features

.1 Fan:

  .1 Construction per ASTM D4167.

  .2 Centrifugal, non-overloading air foil design.

  .3 Static and dynamically balanced wheel.

  .4 AMCA arrangement 9 or 10.

  .5 Overhung type wheel with double row, self-aligning, precision anti-friction, grease lubricated ball or spherical roller bearings in split pillow block.

  .6 Provide a sleeve extending from the back plate of the fan wheel through the fan housing that protects the fan shaft.

  .7 Provide labyrinth seals rings and springs to prevent air leakage.

  .8 Provide 25 mm drain at the lowest point of the scroll housing.

  .9 Provide factory drilled inlet and outlet flanges.

  .10 Provide braced, fabricated base equipped with lifting eyes.

.2 Motor and Drive Unit:

  .1 Mount V-belt drives and motor on a common base. Provide adjustable mounting base to allow belt tension adjustments.

  .2 Provide motors and wiring in accordance with Division 16 including installation area’s electrical classification.

.3 Inertia Base:

  .1 Frame constructed of powder coated or galvanized welded structural steel shapes, plates, and/or bars complying with ASTM A36.

  .2 Minimum Depth: 200 mm or 0.08 times the longest base dimension, whichever is greater.

.3 Minimum weight of frame plus concrete fill equals operating weight of supported equipment. Minimum concrete density: 2400 kg/m^3.

.4 Concrete reinforcing steel (13 mm minimum diameter) at 150 mm centres in each direction.

.5 Provide anchor bolts as required. Fix into position and house in bolt sleeves (75 mm) to allow minor bolt adjustments.

.6 Weld 16-gauge sheet metal bottom panel to frame.

.7 Provide welded support brackets for anchoring inertia base to spring isolators.

.8 Minimum clearance between inertia base and equipment pad: 63 mm.

.9 Acceptable Manufacturer:

  .1 Mason Industries Type K concrete welded base.

  .2 Or approved equivalent.

.10 Spring Mounts:

  .1 Vibration isolation spring between top and bottom loading plates with pad type isolator bonded to loading plate bottom.

  .2 Leveling bolt with lock nuts and washers, centred in top plate.

  .3 Holes in bottom plate for bolting to floor.

  .4 Spring diameter no less than 0.8 of compressed spring height (at rated load).

  .5 Additional travel to solid equal to 50 percent of rated deflection.

  .6 Provide minimum 20 mm clearance around springs to assure no contact with any part of the mounted assembly.

  .7 Acceptable Manufacturer:

    .1 Mason Industries.

    .2 Kinetics Noise Control.

    .3 Vibro-acoustics.

.11 Flexible Connectors:

  .1 For each fan, provide flexible connections at fan inlet and discharge.

  .2 Match fan inlet dimensions or fan outlet dimensions.

.3 Bellows type with flanged end connections and backing flanges.

.4 Corrosion resistant construction with PTFE flex membrane, stainless steel frame and hardware.

.5 Acceptable Manufacturers:

.1 New York Blower.

.2 dB Noise Reduction.

.3 U.S. Bellows.

.4 Or approved equivalent.

.12 Accessories:

.1 Inspection and cleanout door: Provide inspection door at 2 o'clock or 10 o'clock positions when viewing from the drive side.

.2 Provide a combination FRP drive guard and protection cover for the belt drive and motor, bolted to the fan frame, and separately removable.

2.5 Fabrication

.1 Housing:

.1 Flame spread rating ≤ 25 per ASTM E84.

.2 C-glass veil for corrosion resistance and chopped strand or woven fibreglass for structural core strength.

.3 Outer layers of 100 percent resin gel coat.

.4 Inner layer of C-glass corrosion resistant veil followed by another resin rich gel coat layer and another C-glass veil.

.5 Structural core layer from resin and chopped strands or woven fibreglass.

.6 Total glass content: 30 to 40 percent.

.7 Graphite-impregnated, grounded to prevent static electricity build-up.

.2 Fan Wheel:

.1 Flame spread rating of 25 or less per ASTM E84.

.2 The first layer of the wheel laminate is 100 percent resin gel followed by a C-glass corrosion resistant veil followed by another resin rich gel coat and another C-glass veil.

.3 The structural core consists of chopped strand or woven fibreglass and resin followed by a C-glass veil, a resin rich gel coat, another C-glass veil and a final 100 percent gel coat.

.4 Total glass content: 30 to 40 percent.

.5 Graphite impregnated, grounded to prevent static electricity build-up.

.3 Conduct Factory Acceptance Tests on each fan using the motor that will be used on the equipment at the Facility.

.1 Vibration Test:

.1 Conducted by a factory-trained technician.

.2 Measure every bearing housing using IRD or General Radio calibrated electronic analyzer.

.3 Prepare record log, including location identification and peak-to-peak displacement in a direction parallel to the shaft in a horizontal position and in a direction perpendicular to the shaft in both horizontal and vertical planes.

.4 Test at specified capacity and pressure as well as at 70 percent and 85 percent of specified capacity.

.5 Balancing methods per ASTM D4167.

.6 Balance the equipment and retest if peak-to-peak amplitude exceeds the following limits.

Rotation Speed (rpm)	**Vibration Amplitude (microns)**
300 – 600	65
600 – 900	50
900 – 1,200	40
1,200 – 1,800	25
1,800 – 3,000	15

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Pipe scroll drain connection through a ball valve and a minimum 50 mm deep P-trap to nearby floor drains. Slope drain lines at a minimum 1 percent.

.4 Install vibration isolation base and vibration isolators such that fan is installed level. Provide level bearing surface for fan base at housekeeping pad.

.5 Adjust fan assemblies such that drive unit and fan are plumb, level, and properly aligned.

.6 Install lube lines to accessible service locations.

.7 Connect inlet and discharge ductwork without imposing strain on fan flanges.

.8 Install, connect, and initiate operation of each fan and all components and in accordance with Manufacturer's written instructions.

.9 Conduct vibration test to factory test standards of the final installation running at design conditions.

    .1 Test, adjust, and balance the foul air systems per Section 15990.

END OF SECTION

FILTERS AND FILTER GAUGES

1. GENERAL

1.1 Summary

.1 This Section specifies the supply, installation and testing requirements for the following equipment:

  .1 Filter Frames.

  .2 Magnahelic Air Filter Gauges.

  .3 Pleated Filters.

  .4 Chemical Filters.

  .5 Filter Housing Units.

1.2 Standards

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

  .1 ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.2 City of Winnipeg:

  .1 Winnipeg Sewage Treatment Program (WSTP) Building Mechanical Design Guideline.

.3 Underwriters Laboratories (UL):

  .1 UL 900 - Test performance of air filter units.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

  .2 Filter housing catalog information showing dimensions.

2. PRODUCTS

2.1 General

.1 Filters containing asbestos, urea formaldehyde or fibreglass are not permitted.

.2 Provide filters to meet the requirements of Section 3.7.2 Outdoor Air Filtration Criteria of the WSTP Building Mechanical Design Guideline.

.3 Approved Manufacturers and models are listed below. The Manufacturer's standard product may require modification to conform to specified requirements.

.1 Filter Gauges:

.1 Dwyer.

.2 Or approved equivalent.

.2 Pressure Transmitters:

.1 As per Appendix 18E – Standardized Goods.

.2 Or approved equivalent only when the conditions in Appendix 18E – Standardized Goods do not apply.

.3 Filters (Standard):

.1 American Air Filter (AAF).

.2 Camfil.

.3 Or approved equivalent.

.4 Filters (Chemical):

.1 Circul-Aire.

.2 Unisorb.

.3 Or approved equivalent.

.5 Filter Housing Units:

.1 Circul-Aire,

.2 Or approved equivalent.

2.2 Frames

.1 Fabricate filter frames and supporting structures with necessary gasketing between frames and walls.

.2 Frames and supporting structures constructed of extruded aluminum.

.3 Providing holding frames 1.6 mm, "T" section construction.

.4 Provide standard size frames to provide interchangeability of filter media of other Manufacturers.

.5 High Efficiency Extended Area Filters Holding Frames: Include sealing grooves and gaskets, locking clips and provision for removal of filter media.

.6 High Efficiency Deep Pleated Filters Holding Frames: Make rigid enclosure for the filter is affected. Bond the filter pack to the periphery of the frame to eliminate air bypass.

2.3 Air Filter Gauges

.1 Provide Magnahelic air filter gauge to measure differential pressure across each filter bank.

2.4 Pressure Transmitters

.1 Provide one (1) differential pressure transmitter for each bank of filters, including for each position of prefilter to provide continuous monitoring of filter pressure drop at the PCS.

.2 When installed in an electrically classified area, the transmitter to be suitable for installation in the classified area and designed as explosion proof.

2.5 Pleated Filters

.1 Average capture efficiency of 70 percent in the 3-10 micron particle range. Minimum Efficiency Reporting Value (MERV) 8 at 2.5 m/s per ASHRAE 52.2.

.2 Diamond grid with 98 percent open area to provide support for the media.

.3 Bond the media to media support to ensure pleat stability enclosure the media with a rigid moisture resistant, heavy duty kraft board.

.4 Bond the filter pack to the inside periphery of the frame to eliminate air bypass.

.5 Material: Non-Woven Reinforced Cotton Rayon.

2.6 High Efficiency Extended Area Filters

.1 Average capture efficiency of 70 percent in the 0.3-1.0 micron particle range. Average capture efficiency of 90 percent in the 1.0-3.0 particle range. Average capture efficiency of 90 percent in the 3.0-10.0 micron particle range. MERV 13 at 2.5 m/s per ASHRAE 52.2.

.2 Provide filter consisting of three (3) layers of progressively structured filter media combining synthetic unbreakable micro wires with prefilter media layer.

.3 Packets to be self-supported, leak free welded and an integral part of the header frame.

.4 Construct header frame of corrosion resistant hard polyurethane foam constructed to withstand up to 100 percent relative humidity, high velocity and turbulence.

.5 Provide Class II UL, Listed H.E. Filters.

.6 Acceptable Products:

    .1 Camfil RIGA-Flo.

.2 Or approved equivalent.

2.7 High Efficiency Deep Pleated Filters

.1 High efficiency deep pleated filter: Average capture efficiency of 75-85 percent in the 0.3-1.0 micron particle range. Average capture efficiency of 90 percent in the 1.0-3.0 particle range. Average capture efficiency of 90 percent in the 3.0-10.0 micron particle range. MERV 14 at 2.5 m/s per ASHRAE 52.2.

.2 Form the media support grid with welded wire having an effective open area of not less than 96 percent.

.3 Bond the welded wire grid to the filter media to eliminate the possibility of media oscillation and media pullaway.

.4 Provide Class II, UL listed H.E. Filters.

.5 Acceptable Products:

.1 Camfil RIGA-V PH.

.2 Or approved equivalent.

2.8 3-Stage Chemical Filters

.1 Chemical filters are to meet the following performance requirements when operating under the listed design flow conditions.

Inlet Contaminant	Inlet Concentration	Outlet
Peak hydrogen sulphide	5 ppm	50 ppb
Avg hydrogen sulphide	1 ppm	99% of inlet
Peak organic sulphides	1 ppm	90% of inlet
Avg organic sulphides	0.5 ppm	90% of inlet

.2 Provide multi-mix media within three (3) stages of chemical filtration. Suitable to eliminate sulphides from the air stream with ranges in temperature from minus 20°C to 30°C.

.3 Use media consisting of activated carbon impregnated with potassium hydroxide.

.4 House media modules in aluminum filter tracks.

.5 Provide 100 percent extra media sealed in plastic tubs.

.6 Provide life-long testing (free of charge) to evaluate containment level of media and ensure properly timed replacement of same.

.7 Acceptable Products:

.1 Circul-Aire MM9000.

.2 Or approved equivalent.

2.9 Filter Housing Units

.1 Construct exterior from minimum 1.6 mm satin coated steel.

.2 Double wall, roof and floor construction throughout with 48 kg/m^3 density insulation. Provide aluminum interior liner.

.3 Penta-post frame structure, fully self-supporting mounted on 75 mm high formed channel base.

.4 Seal all joints to prevent high static pressure leakage.

.5 Provide weather-resistant housing suitable for outdoor installation.

.6 Bolt and seal all non-access panels.

.7 Provide gasketed access panels with stainless steel hinges and quick release locking devices.

3. EXECUTION

3.1 General

.1 Review the City of Winnipeg, Winnipeg Sewage Treatment Program – Building Mechanical Design Guideline for outside air filtration criteria.

.2 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.3 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.4 Construct and install filters to prevent bypass of unfiltered air.

.5 Provide gasketing of a material to withstand the hydrogen sulphide environment.

.6 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place.

.7 Replace filters used during construction.

.8 Provide filter banks with removal and access indicated.

END OF SECTION

BREECHING AND CHIMNEYS

1. GENERAL

1.1 Summary

.1 This Section specifies site fabricated breeching, manufactured vents and chimneys for atmospheric gas fired equipment and manufactured chimneys for forced draft natural gas fired equipment.

1.2 Standards

.1 Canadian Standards Association (CSA):

- .1 CAN/CSA-B149.1: Natural gas and propane installation code.
- .2 CAN/CSA-B149.6: Code for digester gas, landfill gas, and biogas generation and utilization.

.2 National Fire Protection Association (NFPA):

- .1 NFPA-37: Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.

.3 Underwriters Laboratories of Canada (ULC):

- .1 CAN/ULC 604: Standard for Factory-Built Type A Chimneys.
- .2 CAN/ULC 629: Standard for 650 °C Factory-Built Chimneys.
- .3 CAN/ULC 605: Standard for Gas Vents.
- .4 CAN/ULC 609: Standard for Low Temperature Vents Type L and PL.

1.3 Definitions

.1 Vent: Enclosed passageway for conveying flue gases from the appliances to outdoors.

.2 Breeching: Portion of vent from the appliance to the chimney.

.3 Chimney: Primary vertical portion of vent.

.4 Draft: Flow of air or combustion products or both, through an appliance and its venting system.

.5 Mechanical Draft: Draft produced by a mechanical device such as a fan, blower, or aspirator which may supplement natural draft.

.6 Forced Draft: A mechanical draft produced by a device upstream of the combustion zone of an appliance.

.7 Induced Draft: A mechanical draft produced by a device downstream from the combustion zone of an appliance.

.8 Natural Draft: A draft other than mechanical draft.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

1.5 Quality Assurance

.1 Vents and Chimneys: Labelled by ULC.

.2 Provide a suitable concrete base and building tie backs as required to account for all relevant moments and loads that result from wind and vortex shedding.

2. PRODUCTS

2.1 Vents

.1 Type A: To CAN/ULC 604.

.1 Application: Gas and liquid fuel fired appliances.

.2 Service Temperature: Maximum flue gas temperature of 540°C.

.2 Type A-2 Vent: To CAN/ULC 629.

.1 Application: Gas, liquid and solid fuel fired appliances.

.2 Service Temperature: Maximum flue gas temperature of 650°C.

.3 Type B Vent: To CAN/ULC 605.

.1 Application: Gas fired appliances certified with draft hoods or diverters.

.2 Service Temperature: Maximum flue gas temperature of 243°C.

.4 Type BW Vent: To CAN/ULC 605.

.1 Application: Gas fired recessed heaters.

.2 Service Temperature: Maximum flue gas temperature of 243°C.

.5 Type L Vent: To CAN/ULC 609.

.1 Application: Fuel burning appliances certified to use with Type L vents.

.2 Service Temperature: Maximum flue gas temperature of 298°C.

.6 For condensing boiler applications:

.1 SAF-T-CI Ventilator stainless steel construction, sealed, suitable and rated for condensing flue gas applications or as recommended by Manufacturer.

2.2 Breeching

.1 Breeching Type 1: For natural draft, gas burning appliances with draft hoods, use one of the following:

.1 Galvanized steel with thicknesses as follows:

Vent Diameter	Min. Thickness
Smaller than 125 mm	0.4 mm (30 ga)
125 mm to 200 mm	0.5 mm (26 ga)
Larger than 200 mm	0.6 mm (24 ga)

.2 Breeching constructed of same vent components as chimney.

.2 Breeching Type 2: For forced, induced, or natural draft with dilution, gas or liquid fuel fired appliances, use one of the following:

.1 Mild steel, all welded construction with thicknesses as follows:

Vent Diameter	Min. Thickness
300 mm and smaller	1.3 mm (18 ga)
325 mm and 600 mm	1.6 mm (16 ga)
625 mm to 900 mm	2.0 mm (14 ga)
925 mm and larger	3.0 mm (11 ga)

.2 Breeching constructed of same vent components as chimney.

2.3 Accessories

.1 Cleanouts: bolted, gasketed type, full size of breeching area.

.2 Barometric Damper: double acting sized to 70 percent of full size of breeching area.

.3 Breeching Damper: Motor operated damper 3.5 mm (10 ga) thick steel, ball bearings on full length shaft, 80 percent maximum closure.

.4 Appurtenances: Raincap, thimbles, support brackets and guys, flashing and counter flashings, fly ash screen, and other materials required to complete the assembly.

.5 Roof thimble:

.1 Insulated roof thimble manufactured to NFPA-37, shell assemblies aluminized steel and finished with black paint complete with a wall plate at outlet, high temperature insulation and exterior face of the thimble incorporates ventilation holes covered with bird screen and rain guard.

.2 Acceptable Products:

.1 Silex Model #AC-RT.

.2 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Vent Installation:

.1 Install vents, complete with accessories and appurtenances, in accordance with latest editions of CAN/CSA-B149.1, CAN/CSA-B149.6, Manufacturer's instructions and as follows:

.1 Type A: To CAN/ULC 604.

.2 Type A-2: To CAN/ULC 629.

.3 Type B: To CAN/ULC 605.

.4 Type BW: To CAN/ULC 605.

.5 Type L: To CAN/ULC 609.

.6 Do not penetrate flue gas chamber of vent with screws or mechanical fasteners.

.7 Install breeching with positive slope upward from appliance, minimum 2 percent.

.8 Suspend breeching using trapeze hangers at 1500 mm centres.

.9 Install cleanout at base of chimney.

.10 Support chimney at bottom, roof and intermediate levels.

.1 Install thimbles where penetrating roof, floor, ceiling, wall and where breeching enters masonry chimney.

.11 Install fly ash screen on all chimneys serving solid fuel fired appliances.

.12 Install raincap on chimney outlet.

.13 Install counterflashing where chimneys pass through roof.

.14 Provide for expansion and contraction of chimney and breeching.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the supply and installation of the following:

.1 Ductwork and plenums.

.2 Fasteners.

.3 Sealants.

1.2 Standards

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE Manuals.

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 ASTM A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat- Resisting Steel Plate, Sheet, and Strip.

.4 ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 American Welding Society (AWS):

.1 AWS D9.1 – Sheet Metal Welding Code.

.4 City of Winnipeg:

.1 Winnipeg Sewage Treatment Program (WSTP) Building Mechanical Design Guideline.

.5 National Air Duct Cleaners Association (NADCA).

.6 National Fire Protection Association (NFPA):

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

.7 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 HVAC Air Duct Leakage Test Manual.

.2 HVAC Duct Construction Standards.

.3 FRP Duct Construction Manual.

.4 Round and Rectangular Industrial Duct Construction Standards.

.8 Underwriters Laboratories of Canada (ULC):

.1 ULC S102: Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 Definitions

.1 Low Pressure: Static pressure in duct less than 500 Pa and velocities less than 10 m/s.

.2 Medium Pressure: Static pressure in duct less than 1500 Pa and velocities greater than 10 m/s.

.3 High Pressure: Static pressure over 1500 Pa and less than 2500 Pa and velocities greater than 10 m/s.

.4 Duct sizes are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Duct fittings including particulars such as gauge sizes, welds and configurations.

.3 Acoustic panels.

.4 Samples of duct fittings including particulars such as gauge sizes, welds and configurations.

.5 Qualifications of cleaning contractor:

.1 Qualification of the HVAC System Cleaning Contractor: The HVAC system cleaning contractor to have a minimum of two (2) Air System Cleaning Specialist (ASCS) certified by the National Air Duct Cleaners Association (NADCA) on a full time basis, or to have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.

.2 Supervisor Qualifications: A person certified as an ASCS by NADCA or maintaining an equivalent certification by a nationally recognized program and organization, to be responsible for the total work herein specified.

.3 Experience: The HVAC system cleaning contractor to submit records of experience in the field of HVAC system cleaning.

1.5 Quality Assurance

.1 Line or roll mark all sheets to clearly differentiate between the Type 304 and 316 stainless materials. Such markings to be such as to be sufficient to eliminate any errors within the fabrication and installation.

.2 Size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

2. PRODUCTS

2.1 Ductwork

.1 General:

.1 Design, construct, support and seal all ductwork in accordance with SMACNA HVAC duct construction standards and pressure classifications, unless otherwise noted. When the ductwork pressure classification of these standards is exceeded, construct ductwork in accordance with SMACNA round and rectangular industrial duct construction standards.

.2 Provide material to meet requirements of the Corrosion Study as specified in Schedule 18 Technical Requirements and Table 3-6: Minimum Material Requirements for Ductwork of the WSTP Building Mechanical Design Guideline.

.2 Galvanized Steel – Rectangular:

.1 Galvanized steel to ASTM A 653/A 653M, Z90 zinc coating, shop or factory fabricated, water-tight, with metal gauges and fabrication in accordance with the SMACNA Rectangular Industrial Duct Construction Standards or HVAC Duct Construction Standards Metal and Flexible to suit the duct location and working pressure classification and galvanized steel support hardware.

.3 Galvanized Steel – Round:

.1 Galvanized steel to ASTM A 653/A 653M, Z90 zinc coating, with gauges in accordance with SMACNA Rectangular Industrial Duct Construction Standards or the SMACNA HVAC Duct Construction Standards - Metal and Flexible to suit the duct location and working pressure classification and use galvanized steel fasteners/support hardware.

.4 Aluminum – Rectangular:

.1 Alloy 3003 Temper H14 aluminum, ASTM B209, shop or factory fabricated, water-tight, with metal gauges and fabrication in accordance with the SMACNA Rectangular Industrial Duct Construction Standards or HVAC Duct Construction Standards Metal and Flexible to suit the duct location and working pressure classification and Type 316 stainless steel support hardware.

.5 Aluminum – Round:

.1 Spirally wound 3003-H14 aluminum strip fabricated in a manner to produce a “RL-1” spiral lock seam conforming to ASTM B209 with gauges in accordance with SMACNA

Rectangular Industrial Duct Construction Standards or the SMACNA HVAC Duct Construction Standards - Metal and Flexible to suit the duct location and working pressure classification and use aluminum fasteners/support hardware. 1.5CLr elbows to 300 mm to be 3003 aluminum 0.906 mm flanged die-stamped & factory assembled with stainless steel rivets and silicone sealant.

.6 Stainless Steel – Rectangular:

.1 300 Series stainless steel, Type 316, ASTM A 167 and ASTM A 480, with a #2B finish, unless otherwise specified. Metal gauges in accordance with SMACNA HVAC Duct Construction Standards Metal and to suit the duct location and working pressure classification. The support hardware to be stainless steel to match the duct material.

.7 Stainless Steel – Round:

.1 Single wall duct fabricated of Type 316 per Final Design, and conforming to ASTM A 240 with metal gauges in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible for 2.5 kPa pressure. Fittings and couplings to be factory made Type 316 stainless steel one metal gauge heavier than the duct with which they are associated. Metal gauges in accordance with SMACNA HVAC Duct Construction Standards Metal and to suit the duct location and working pressure classification. Stainless steel finish to be #2B.

.8 Stainless Steel Welding:

.1 Certify welding procedures, welding equipment and welders in accordance with AWS D9.1 – Sheet Metal Welding Code.

.2 Joints to be continuous inert gas welded.

.3 Provide butt seam continuous welds for all joints. Lap type joints are not permitted.

.4 Grind and polish all welded joints in exposed areas.

.5 Pickling and Neutralization Paste:

.1 Pickling paste:

.1 For cleaning and passivating welding joints and heat affected zone.

.2 Acceptable Products:

.1 Sandvik Formula Green.

.2 Or approved equivalent.

.2 Neutralization Paste:

.1 For use on steel surfaces to neutralize and inhibit pickling paste after use.

.2 Acceptable Products:

.1 Sandvik Neutralization Paste.

.2 Or approved equivalent.

.9 FRP:

.1 Standard resin used in the laminate shall be premium corrosion resistant and fire-retardant AOC K022 brominated biphenol-A vinylester resin. Filament wound (SMACNA Type X) or hand lay-up construction as needed (SMACNA Type II). All fittings such as elbows, laterals, tees, and reducers shall be of the same resin as duct, and equal or superior in strength to the adjacent duct section and shall have the same internal diameter as the adjacent duct. Duct shall meet or exceed all applicable construction requirements of SMACNA FRP Duct Construction Manual.

2.2 Casing and Plenum Material

.1 Casing and plenum material to be the same as the connecting duct material.

.2 Each plenum is to have a hinged access door and each intake plenum is to have a watertight drainage pan and 25 mm drainage port.

2.3 Joints and Reinforcing

.1 Transverse stiffeners and joints to be appropriately spaced to maintain duct cross-section integrity in accordance with the pressure class specified and at the prevailing operating velocities. After joints are crimped, they are to be further secured by bottom punching or riveting. Longitudinal seams to be Pittsburgh lock and to be cross-broken outward. Intake, or exhaust, side ducts to be cross-broken inward. Discharge ducts to be cross-broken outward. All plenums and casings to be similarly cross-broken and further reinforced with 25 mm x 25 mm x 3 mm angles running diagonally between joints, riveted to the casings.

.2 Low pressure ductwork to have slip joints. Medium pressure ductwork to have flanged or welded joints. Joints not to interfere with airflow in the ducts. Exterior ducts to be stiffened, braced, and supported in a manner designed to maintain duct integrity and cross-section under wind and snow loads. Interior ducts to be suitably braced and stiffened at floor and roof penetrations as well as over their unsupported length in a manner designed to maintain duct integrity.

.3 Ducts over 430 mm in largest dimension to be cross-broken or beaded on all four sides. In ducts over 1830 mm at each transverse joint 10 mm stay rods to be installed. Spacing between rods or rods on side of duct is not to exceed 1220 mm.

2.4 Duct Hangers and Supports

.1 Conform to the SMACNA handbooks.

2.5 Duct System Joint Sealant

.1 High velocity duct sealant, ULC listed and labelled, premium grade, water base, non-flammable duct sealer, brush or gun applied, with a maximum flame spread rating of 0 and smoke developed rating of 0.

2.6 Flexible Connection Material

.1 Waterproof indoor-outdoor woven fibreglass fabric coated on both sides with a specially compounded synthetic rubber, off-white in colour, flexible material between the fan discharge and the casing opening, with spring thrust restraints secured to welded brackets on the fan housing and by steel rods though the fan casing with a steel back-up plate.

.2 Acceptable Products:

.1 Duro Dyne Canada Inc. "DUROLON".

.2 Dyn Air Inc. "HYPALON".

.3 Or approved equivalent.

2.7 Acoustic Lining

.1 Provide as required by the Final Design.

.2 Minimum 25 mm thick acoustic lining material meeting NFPA 90A requirements and flame spread and smoke developed fire hazard ratings of CAN/ULC S102, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fibreglass mat coated on the inside (airside) face with a black fire-resistant coating.

.3 Acceptable Manufacturers:

.1 Johns-Manville “Permacote Linacoustic”.

.2 Knauf.

.3 Manson Insulation Inc.

.4 Or approved equivalent.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Ductwork to be installed in accordance with SMACNA and NFPA.

.1 Ductwork and accessories to be installed to provide a system free from buckling, warping, breathing, and vibration. Ductwork installation to permit installation of other required services without piercing, crimping, or reducing duct sizes. Where space conditions permit, full radius turns to be used at offsets. The inside of all ducts visible through grilles and registers to be painted flat black.

.4 Coordinate the location of duct access doors. Refer to Section 15895.

.5 Plenum Doors:

.1 Set plenum doors 150 mm above floor.

.2 Arrange door swings so that the system static pressure holds door in closed position.

.6 Install openings in ductwork where required to accommodate thermometers and controllers.

.7 Install pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage.

.8 Where openings are provided in insulated ductwork, install insulation material inside a metal ring of the same material as the ductwork housing the openings.

.9 Interrupt duct linings at fire, control, balancing, backdraft and smoke dampers so as not to interfere with operation of devices.

.10 Install metal edge protection, of material similar to the ductwork, over linings on both sides of damper device.

.11 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty.

.12 Flexible Connections:

.1 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment.

.2 Do not use the flexible connector to offset or change direction.

.13 Ductwork and Plenum Sealing:

.1 All ductwork to be made airtight. Flanged joints to be sealed with closed-cell neoprene gaskets compressed between mating flanges. All other joints and seams to be sealed with liquid or mastic type sealants. Taped joints are not permitted. All joints to comply with the requirements of SMACNA seal class A.

.2 Where accessible, apply sealer to inside of joints on ducts and plenums under positive pressure.

.3 Apply sealer to outside of joints on ducts and plenums under negative pressure.

.14 Installation of Stainless Steel Ductwork:

.1 Provide Type 316 stainless steel ductwork as per the Final Design.

.2 All joints on stainless steel duct and fittings to be butt joints continuously MIG welded.

.3 All stainless steel welds to be pickled to remove weld oxide. All stainless steel surfaces to be passivated to remove embedded foreign material.

.15 Installation of Aluminum Ductwork:

.1 Provide aluminum ductwork as per the Final Design. Wherever bare aluminum ductwork comes in contact with ferrous metal or copper, paint the ferrous metal or copper surface with a heavy, 100 percent covering coat of zinc chromate paint, asphalt paint or otherwise isolate direct contact with the bare aluminum.

.2 Use "COMMENTARY ON ALUMINUM DUCTS" on pages 1.58, 1.59 and 1.60 of SMACNA HVAC Duct Construction Standards Metal and Flexible, however, do not use drive and S cleats for joining waterproof aluminum ductwork. Use the following SMACNA joining methods:

.1 T-21 - welded flange.

.2 T-22 - companion angle and gasket.

.3 T-24A flanged.

.3 Keep longitudinal joints at the top surface of horizontal runs. Provide proper transverse supports to prevent deflection. Ensure that the duct is rigid.

.4 When mastic is used for sealing such as sealing longitudinal joints, apply the mastic to both surfaces before they are mated. When dry, apply mastic again for a water-tight seal.

.16 Ductwork and Plenum:

.1 Ensure that the inside of all ductwork is cleaned prior to Substantial Completion. This responsibility includes the entire systems, from outdoor air intakes to air terminals and from air terminals to relief outlets. It includes all ductwork, lined and unlined, all plenums and all equipment within or connected to ducts and plenums. The surfaces to be considered clean when all foreign materials capable of becoming particles and visible to the naked eye are removed.

.2 Procedure:

.1 Wipe all ductwork clean prior to installation.

.2 Close all dampers immediately following installation thus checking the operation and retarding movement of contaminants through the system.

.3 Seal all openings at the end of each day and at such other time as site conditions dictate.

.4 Floor openings to be capped with sheet metal or floor grilles plus 0.15 mm thick poly sheet.

.5 Other openings to be covered with 0.15 mm thick poly sheet taped so as to be air tight.

.3 Cleaning Procedure:

.1 On completion of the duct and plenum installation and prior to the installation of air terminals and prior to balancing of the air systems, but not until the areas are substantially clean (floors have been swept and vacuumed) and all "dirty" construction has been completed, employ an acceptable cleaning company to vacuum clean the air handling units, all plenums, all supply and return air ducts and all exhaust air ducts.

.2 All components within each system to be thoroughly cleaned and are to include but not be limited to the following: coils, dampers, fans, and motors.

.3 Cleaning is to generally be by high capacity power vacuum. High-pressure compressed air, wire brushing and/or non-toxic solvent cleaning to be used where dirt or scale cannot be removed otherwise. Coils to be de-scaled.

.4 The cleaning agency to be responsible for removing and replacing filter media. This company is to remove the temporary filters and replace with new after cleaning the systems.

.5 The cleaning agency to mark balancing damper positions before cleaning and return them to their original position when cleaning is completed unless the system is still to be balanced.

.6 Re-install any grilles, registers and diffusers, which may have been removed for cleaning purposes.

.7 After the duct systems have been cleaned they are to be re-sealed if they are not being used. Provide filter media on the return air terminals if the return air fans are run after cleaning has been completed.

.8 The cleaning company to perform a full inspection of the duct interior. Utilizing a fibre optic borescope with dedicated light source, inspect interior ductwork surfaces, and ductwork accessories including terminal units, mixing boxes / air valves, ductwork liners, duct-mounted coils, filters, dampers, humidifiers and all other appurtenances within the ductwork system.

.9 Submit for review a report from the cleaning agency describing their work, photographs of finished work, video and certification that all air systems have been cleaned.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for the supply, installation and testing of the following:

.1 Duct access doors.

.2 Splitter dampers.

.3 Air turning vanes.

.4 Manual balancing (volume) dampers.

.5 Backdraft dampers.

.6 Fire dampers.

.7 Outdoor Air Control Dampers.

.8 General Control Dampers.

.9 Bubble Tight Dampers.

.10 Instrument Test Ports.

.11 Ductwork Drain Points.

1.2 Standards

.1 Air Movement and Control Association (AMCA):

.1 AMCA Standard 500-D: Laboratory Methods of Testing Dampers for Rating.

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE Manuals.

.3 National Fire Protection Association (NFPA):

.1 NFPA 80: Standard for Fire Doors and Other Opening Protectives.

.2 NFPA 90A: Standard for the Installation of Air Conditioning and Ventilating Systems.

.3 NFPA 105: Standard for Smoke Door Assemblies and Other Opening Protectives.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 HVAC Duct Construction Standards Metal and Flexible.

.5 Underwriters Laboratories of Canada (ULC):

.1 S112: Standard Method of Fire Test of Fire Damper Assemblies.

.6 Warnock Hersey.

1.3 Definitions

.1 Low Pressure: Static pressure in duct less than 500 Pa and velocities less than 10 m/s.

.2 Medium Pressure: Static pressure in duct less than 1500 Pa and velocities greater than 10 m/s.

.3 High Pressure: Static pressure over 1500 Pa and less than 2500 Pa and velocities greater than 10 m/s.

.4 Duct sizes shown are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Submit Shop Drawings for each of the following:

.1 Duct access doors.

.2 Splitter dampers.

.3 Air turning vanes.

.4 Manual balancing (volume) dampers.

.5 Backdraft dampers.

.6 Fire dampers.

1.5 Quality Assurance

.1 Obtain written permission from the Professional of Record prior to making variations in duct configuration or sizes.

2. PRODUCTS

2.1 Duct Access Doors

.1 Fabricate rigid and close-fitting doors of same material as the connecting ductwork with sealing gaskets, safety chain and suitable quick fastening locking devices. Duct access panels with screws are not acceptable. Install minimum 25 mm in thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricate with two butt hinges and two sash locks for sizes up to 450 mm, two hinges and two compression latches with outside and inside handles for sizes up to 600 mm x 1200 mm and an additional hinge for larger sizes.

2.2 Splitter Dampers

.1 Minimum 0.95 mm thick (20 gauge) damper blade constructed of the same material as the duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

.2 Acceptable Products:

.1 Dyn Air Inc. #Q-50 "DYN-A-QUAP S-S".

.2 Or approved equivalent.

2.3 Air Turning Vanes

.1 For square elbows multiple-radius turning vanes, interconnected with bars, adequately reinforced to suit the pressure and velocity of the system, constructed of the same material as the duct they are associated with, and in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible.

.1 Acceptable Products:

.1 Ductmate PROrail.

.2 Or approved equivalent.

.2 For short branch ducts at grille and diffuser connections - air extractor type, each equipped with a matching bottom operated 90 degree opposed blade volume control damper, constructed of the same material as the duct it is associated with, and in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.4 Manual Balancing (Volume) Dampers

.1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of the same material as the connecting ductwork, each designed to maintain the internal free area of the connecting duct, and each complete with:

.1 A round shaft extension through the frame.

.2 Stainless steel, linkages, bearings and axles.

.3 Blade stops for single blade dampers, designed to prevent the blade from moving more than 90 degrees.

.4 Linkage for multiple blade dampers.

.5 Locking hand quadrant damper operator with 50 mm standoff mounting.

.2 Rectangular Dampers: Maximum size 1.2 m x 1.2 m for a single damper and equipped with a 1.613 mm thick (16 gauge) flanged type frame with 40 mm bolt hole centres, constructed of the same material as the connecting ductwork, no sill and linkage out of air stream.

.1 For systems greater than 10 m/s and 75 Pa use a 1.613 mm thick (16 gauge) flanged type frame with 40 mm bolt hole centres.

.3 Round Dampers: Full perimeter blade stop, maximum 1.2 m diameter equipped with a minimum 200 mm deep frame, and blade stiffeners where required, constructed of the same material as the connecting ductwork.

.4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of the same material as the damper and designed for tight and secure mounting of the individual dampers.

.5 Acceptable Manufacturers:

.1 Nailor Industries Inc.

.2 Spinnaker Industries Inc.

.3 Ruskin Company.

.4 Greenheck.

.5 Or approved equivalent.

2.5 Backdraft Dampers

.1 Counterbalanced backdraft dampers, 65 mm deep and complete with:

.1 Extruded aluminum frame and blades, minimum 1.52 mm thick, with captive extruded Silicone blade gaskets and side seals in slots integral with the aluminum extrusions.

.2 Each blade manufactured with a mounting hole to receive a front-mounted mechanical weight supplied with the unit.

.3 Linkage system consisting of hard alloy aluminum (6005T5) crankarms fastened to zinc-plated steel pivot rods and doubly secured within channel running along top of blade. Large diameter 8.73 mm hard alloy aluminum (6065T5) linkage rod connects the crankarms by means of a zinc-plated steel trunnion.

.4 Air leakage through a 610 mm x 610 mm weighted backdraft damper not to exceed 101.2 L/s/m² against 0.25 kPa differential static pressure at standard air.

.2 Backdraft dampers to have stainless steel construction when used with stainless steel duct systems.

2.6 Fire Dampers

.1 Minimum requirements:

.1 Fire dampers to be ULC or Warnock Hersey tested and to bear the testing agency's label.

.2 All fire dampers to be “dynamic”; rated to close under airflow.

.3 Constructed of the same material as the connecting ductwork, factory fabricated for fire rating requirement to maintain integrity of fire separation.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type in horizontal position with vertical airflow.

.5 Fire dampers in low-pressure ductwork may be multi-blade or curtain type.

.6 Fire dampers in medium and high-pressure ductwork to be curtain type.

.7 Curtain fire dampers to have blades retained in a recess so free area of connecting ductwork is not reduced.

.8 Fusible links: ULC approved with a melting point of 74°C on supply, return and exhaust air systems. Use fusible links with a melting point of 141°C on all return and exhaust air systems if used for smoke venting.

2.7 Outdoor Air Control Dampers

.1 Minimum requirements:

.1 Frame:

.1 Extruded aluminum (6063-T5), minimum thickness 2 mm, frame depth minimum 100 mm insulated with polystyrofoam on four sides, thermally broken frame with polyurethane resin pockets.

.2 Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper.

.2 Blades:

.1 Extruded aluminum (6063-T5) profiles internal insulated with expanded polyurethane foam, thermally broken. Blade shall have an insulating factor of 0.436 w/m^2K.

.2 Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper.

.3 Bearings:

.1 Celcon inner bearing fixed to 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

.4 Linkage:

.1 Hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.5 Dampers are to be designed for operation in temperatures ranging between minus 40°C and 100°C.

.6 Leakage:

.1 Dampers shall be AMCA rated for Leakage Class 1A at 0.25 kPa static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

.7 Dampers shall be opposed blade action for modulating airflow control and parallel blade for two position open – close action.

.8 Refer to Section 15910 for Damper Operators.

.9 Acceptable Manufacturers:

.1 Tamco.

.2 Ruskin.

.3 Greenheck.

.4 Or approved equivalent.

2.8 General Control Dampers

.1 Minimum requirements:

.1 Frame:

.1 Extruded aluminum (6063-T5), minimum thickness 2 mm, frame depth minimum 100 mm with mounting flanges on both sides of the frame.

.2 Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper.

.2 Blades:

.1 Extruded aluminum (6063T5) air-foil profiles.

.1 Blade seals shall be extruded EPDM, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper.

.3 Bearings:

.1 Celcon inner bearing fixed to 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

.4 Linkage:

.1 Hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.5 Dampers are to be designed for operation in temperatures ranging between minus 40°C and 100°C.

.6 Leakage:

.1 Dampers shall be rated Leakage Class 1A at 0.25 kPa static pressure differential. Standard air leakage data shall be certified under the AMCA Certified Ratings Program.

.7 Dampers shall be opposed blade action for modulating airflow control and parallel blade for two position open – close action.

.8 Refer to Section 15910 for Damper Operators.

.9 Acceptable Manufacturers:

.1 Tamco.

.2 Ruskin.

.3 Greenheck.

.4 Or approved equivalent.

2.9 Bubble Tight Dampers

.1 Minimum requirements:

.1 To be tested bubble tight to ANSI/AMCA Standard 500-D.

.2 To be of Type 316 stainless steel construction.

.3 Damper pressure rating to be higher than the duct pressure rating and the fan pressure rating.

.4 Acceptable Manufacturers:

.1 Greenheck.

.2 Ruskin.

.3 Or approved equivalent.

2.10 Instrument Test Ports

.1 Port to suit insulation thickness, gasketed, leakproof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain. Port material to match ductwork material.

2.11 Ductwork Drain Points

.1 20 mm diameter moisture drains with sheet metal funnel, and chrome plated brass threaded drain, nut and cap. Material to match duct material.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

3.2 Installation

.1 Duct Access Doors:

.1 Install in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Splitter Dampers:

.1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified in the Final Design. Install splitter dampers so they cannot vibrate and rattle and so that the damper operation mechanisms are in an easily accessible and operable location.

.3 Air Turning Vanes:

.1 Provide turning vanes in all ductwork elbows (supply, exhaust, return) where due to site installation routing and duct elbow radius of less than one and a half (1-1/2) times width (smooth radius elbows with a R/W of 1.5) is not possible, turning vanes and splitter vanes to be in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

.4 Manual Balancing (Volume) Dampers:

.1 Provide manual balancing dampers in all open end ductwork, in all supply and return air duct mains, in all branch ducts, at each individual grille, register, diffuser and wherever else shown and/or specified.

.2 Install the dampers so that the operating mechanism is accessible and positioned for easy operation, and so that the dampers cannot move or rattle.

.3 Where a duct for which a balancing damper is required has dimensions larger than the dimensions of the maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.

.5 Backdraft Dampers:

.1 Provide backdraft dampers where indicated in the Final Design.

.2 Install and secure the dampers so that they do not move or rattle.

.6 Fire Dampers:

.1 Provide fusible link dampers where shown and/or specified in the Final Design. Ensure that the damper rating (1-1/2 or 3 hours) is suitable for the fire barrier it is associated with.

.2 Install dampers with retaining angles on all four sides of the sleeve on both sides of the damper and connect with ductwork in accordance with the damper Manufacturer's instructions.

.3 Provide expansion clearance between the damper or damper sleeve and the opening in which the damper is required. Ensure that the openings are properly sized and located, and that all voids between the damper sleeve and the opening are properly sealed to maintain the rating of the fire barrier.

.4 All dampers to be installed in the closed position and opened prior to air balancing.

.5 Where the size of the fire barrier opening requires the use of a sectionalized fire damper assembly, provide multiple fusible link dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

.7 Functional Testing: All fusible link dampers to be tested in accordance with NFPA 80 and NFPA 105 as follows:

.1 An operational test to be conducted after the building's HVAC system has been balanced.

.2 The operational test to be conducted under normal HVAC airflow conditions as well as static flow conditions. The damper is to fully close/seal under both test conditions.

.3 Dynamic Fire Dampers. After the installation of a damper is completed, an operational test to be conducted.

.1 The damper is to fully close from the open position.

.2 Dynamic dampers to be verified that the system airflow where the damper is installed is within the velocity.

.4 All inspections and testing to be documented, indicating the location of the fire damper, date(s) of inspection, name of inspector, and deficiencies discovered. The documentation is to have a space to indicate when and how the deficiencies were corrected rating of the damper listing.

.8 Demonstrate re-setting of all fire dampers to Design Builder after fan start/air handling unit start-up and air balancing.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the general requirements for monitoring and controlling HVAC equipment.

.2 All HVAC systems and sub-systems, with the exception of Odour Control Removal are to be controlled by the Process Control System (PCS).

.3 The Odour Control Removal system will be controlled by the PCS system.

.4 All control systems are to meet the requirements of Schedule 18 Technical Requirements Section C11.4 with the exception of C.11.4.1 (b). Building control can be provided directly by the PCS with all alarming and warnings reported to the PCS.

1.2 General

.1 Automation system programming, configuration, testing and commissioning to be the responsibility of the automation system integrator under supervision of the controls lead see Section 17800.

.2 The HVAC system is to be complete with all necessary control components and connections to achieve the specified functions and to permit the HVAC systems to perform in accordance with the Technical Requirements.

.3 Furnish all materials, including all Human Machine Interface (HMI) hardware and software, operator input/output peripherals, standalone local control panels, automation sensors and controls, wiring and interface systems shall be in accordance with Section 17800.

.4 The control system is to be set up and adjusted to achieve energy efficient operation of the HVAC system. This includes sequencing, timing and re-adjustment, as required.

.5 This section is a performance Specification clarified in certain sections to establish minimum standard of equipment, installation and level of control.

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

   .1 Manufacturer's descriptive literature for materials.

   .2 Control centre layouts.

   .3 Interconnection schematics.

   .4 Wiring and piping diagrams.

   .5 One-line diagram from sensor and control points to Field Interface device and/or standalone DDC panel including all components and cables.

.6 Terminal cabinets, including termination listing.

.7 Written description indicating sequence of operation. Shop Drawings are to be rejected if the written description is not included with the submission. Sequences should reference english descriptors and labels for each point described. Follow any established client cable and equipment tagging system.

.8 All input/output points which are to include the following information associated with each point.

.1 Sensing element type and location.

.2 Details of associated field wiring schematics and schedules.

.3 Software and programming details.

.9 Detailed block diagrams of transmission trunk routing and configuration.

.10 Valve and damper schedules indicating size, configuration, capacity and locations.

.11 Detailed description/list of HVAC controls, alarms and setpoints available on the PCS.

1.4 Freeze Protection

.1 All air supply handling units containing coils are to have a non-recycling, manual reset, electric line voltage freeze protection controller that stops the system upon sensing 4°C.

.2 The freeze protection controllers are to contain an additional set of dry contacts that closes on freeze detection for remote alarm indication at the PCS.

.3 The freeze protection contacts are to be connected on the common line after the HOA. selector switch.

.4 PCS to shut down all supply air handling units containing coils, upon sensing air off the coils at 4°C.

.5 Allow up to three (3) restarts, over short period before generating an alarm.

1.5 Alarms - General

.1 No alarm is to be triggered for a device until the device has been started and is in stable operation. Use software time delays to achieve this requirement.

.2 Generate an alarm on the PCS if any equipment is not in the intended operating condition or if any analog input is not within the intended operating range.

2. PRODUCTS

2.1 Nameplates and Tags

.1 Per Schedule 18 c.11.4 Control Requirements.

2.2 Stand-alone Digital Controllers (SDC's)

.1 Inputs:

.1 Provide input function integral to the SDC. Provide input type(s) as required by the systems design. For each type of input used on high-level controllers, provide at least one similar spare input point per controller.

.2 Analog Inputs: Allowable input types are 100-ohm (or higher) platinum RTDs, 4-20 mA, and 2-10 VDC. Direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall have 16-bit minimum resolution.

.3 Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications.

.2 Outputs:

.1 Provide output function integral to the direct digital controller. Provide output type(s) as required by the systems design. For each type of output used on high-level controllers, provide at least one (1) similar spare output point per controller.

.2 Analog Outputs: Provide controllers with 16-bit minimum output resolution. Output shall be 4-20 mA or 2-10 VDC.

.3 Digital Outputs: Provide contacts rated at a minimum of 1 ampere at 24 V.

.3 PID Control:

.1 Provide controllers with proportional integral and derivative control capability.

.2 The upper level digital controllers shall be capable of networking with other similar upper level controllers. Upper level controllers shall also be capable of communicating over a network between buildings.

.4 Communications Ports:

.1 Controller-to-Controller LAN Communications Ports: Controllers in the PCS system shall be connected on a communications network. Controllers shall have controller to controller communication ports to both peer controllers (upper level controllers) and terminal controllers (lower level controllers). Network may consist of more than one level of local area network and one level may have multiple drops. Communications network shall permit sharing information between controllers, allowing execution of dynamic control strategies, and coordinated response to alarm conditions. Minimum speed for all LAN's is 100 Mbps.

.2 Interface Ports: Provide a RS-232 or RS-485 communications ports for each digital controller that allows direct connection of a computer or handheld terminal and through which the controller may be fully accessed. Controller access shall not be limited to access through another controller. Interface communication ports shall be in addition to the communications port(s) supporting controller to controller communications. Communication rate is 9600 Baud minimum. Every controller on the highest level LAN shall have a communications port supporting direct connection of a computer; a hand held terminal port is not sufficient. By connecting a computer to this port, every controller in the direct digital control system shall be accessible and programmable. The following operations shall be available: downloading and uploading control programs, modifying programs and program database, and retrieving or accepting trend reports, status reports, messages, and alarms.

2.3 Digital Controller Cabinet:

.1 Each indoor digital controller cabinet shall protect the controller from dust and rated NEMA 1, unless specified otherwise. Refer to Drawing 00-E100 – Main Level Classifications for area classifications and categories. Each outdoor digital controller cabinet shall protect the controller from all outside conditions and rated NEMA 4. Cabinets for high level controllers shall be hinged door, lockable, and have offset removable metal back plate.

.2 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.3 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum twenty-five (25) conductors to each wire bundle.

.4 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position.

.5 Provide interface communication with plant PCS. Interface with PCS shall be hardware signals and Modbus TCP/IP communication.

2.4 Main Power Switch:

.1 Each controller on the highest level LAN or each control cabinet shall have a main external power switch for isolation of the controller from AC power.

2.5 Terminal Control Units (TCUs):

.1 The same company as the digital controllers shall manufacture TCUs.

.2 TCUs shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a digital controller on a higher level LAN.

.3 TCUs do not require an internal clock if they get time information from a higher level digital controller.

2.6 Wire

.1 Control wiring for digital functions shall be 18 AWG minimum with 300 V insulation control wiring for analog functions shall be 18 AWG minimum with 300 V insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.2 Sensor wiring shall be 18 AWG minimum twisted and shielded, 2 or 3 wire to match analogue function hardware or 16 AWG as required by code.

.3 Transformer current wiring shall be 16 AWG minimum.

.4 Provide Modbus TCP/IP communication port.

.5 Refer to Section 17800 - General Requirements for Automation System.

2.7 Conduits and Cables

.1 All wiring shall be in conduit or trays. Conform to Division 16 requirements for conduit and tray Specifications.

.2 Seal conduit where such conduit leaves heated areas and enters unheated area.

.3 Run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable and wire at every termination point.

.5 Where applicable, mount field interface equipment (i.e., relays, transducers, etc.) in local device cabinets adjacent to field interface panels.

.6 Separate conduits shall be provided for pneumatic tubing and electrical wiring runs.

.7 Colour code all conductors and conduits by permanently applied colour bands on maximum 10 m intervals. Colour code shall follow base building schedule.

2.8 Related Accessories

.1 Provide and install all necessary transformers, transducers, interposing relays, interface devices, contractors, starters and LCPs to perform control functions required and provide interface with plant PCS.

.2 It is the responsibility of the Contractor to identify, at the time of tender submission, all additional items not specified that are required to meet the operational intent specified.

.3 Items required but not identified at the time of tender acceptance shall be the Contractor's responsibility.

2.9 Analog Input Sensors

.1 Temperature:

Application	Operating Range	End to End Accuracy	Remarks
Duct Mounted	Minus 65°C to 50°C	Plus or minus 0.5°C	
Pipe Well Mounted	0°C to 100°C	Plus or minus 0.5°C	complete with thermal wells

Application	Operating Range	End to End Accuracy	Remarks
Space	2°C to 46°C	Plus or minus 0.5°C	complete with tamper-proof cover
Outside Air	Minus 50°C to 50°C	Plus or minus 0.5°C	complete with solar-shield

.2 Pressure:

Application	Operating Range	End to End Accuracy	Remarks
Differential-Air	500 - 0 - 500 Pa	Plus or minus 0.5%	MUA & HRV Filter Condition

.3 Electrical

Application	Operating Range	End to End Accuracy	Remarks
Current Transformers	As required	Plus or minus 0.25% full scale	
From VFD	4-20 mA	Plus or minus 1% full scale	

2.10 Analog Output Devices

Application	Operating Range	End to End Accuracy	Remarks
To VFD	4-20 mA	Plus or minus 1% full scale	

2.11 Digital Input Devices

Application	Operating Range	End to End Accuracy	Remarks
Pressure Switches	As required	Plus or minus 1.5%	- adjustable set- point and differential - automatic reset
Temperature	As required	Plus or minus 1°C (1.8°F)	- adjustable set- point and differential - automatic reset - normal reset for freeze protection
Current Sensing Relays	As required	N/A	- adjustable trip complete with LED Status Indication
Motor Status Relays	As required	N/A	- auxiliary contacts

2.12 Digital Output Devices

Application	Operating Range	End to End Accuracy	Remarks
Relays	N/A	N/A	- Double voltage DPDT plug-in type with terminal base contacts rated at 5 A 120 VAC

2.13 Airflow Monitoring Station

.1 The airflow monitoring station shall consist of multiple type 316 stainless steel airflow measuring elements containing multiple total and static pressure sensing ports placed along the leading edge of the cylinder. The static pressure chamber shall incorporate dual offset static taps on opposing sides of the averaging chamber capable of accommodating flow angle variations of plus or minus 20 degrees in the approaching airstream. The probes shall be manifolded together in a 1.5 mm type 316 stainless steel duct section with 90-degree undrilled flanges, fabricated to the duct size, and shall contain multiple interconnected airflow traverse elements.

.2 Where primary flow elements are located outside of the Manufacturer's published installation guidelines the Manufacturer shall be consulted, and approve of any special configurations, such as air equalizers and/or additional and strategically placed measuring points, as may be required.

.3 The airflow traverse elements shall be capable of producing steady, non-pulsating signals of true total and static pressure. Signal amplifying sensors requiring flow correction (K factors) for field calibration are not acceptable.

    .1 Accuracy: plus or minus 2%.

    .2 Operating Velocity Range: 0.5 to 25 m/s.

    .3 Operating Temperature Range: minus 40 to 40°C.

    .4 Air Pressure Drop: < 45 Pa at 20 m/s.

    .5 Generated Noise Level: < NC40.

    .6 Acceptable Manufacturers: PCI or Ebtron.

.4 Station shall be CSA approved for use in a Zone 2 environment as required.

2.14 Room Pressure Transducer

.1 CSA approved enclosure based on area classification applications complete with integral, viewable LCD display, 4-20 mA loop powered, HART protocol. Scales for -75-0-75 Pa differential pressure, 316L SST isolating diaphragm, Coplanar flange ¼-18NPT 316 SST process connection, Coplanar flange bracket, 50 mm pipe or panel mounting, all SST.

.2 Standard of acceptance: Rosemount model 3051S2C0A or approved equal.

2.15 Door Contact Switch

.1 High security balanced, triple-biased ANSI mount door position switches shall be provided and installed where required for door position confirmation; including all required mounting hardware, brackets, etc.

.2 Switch shall contain balanced biasing magnets for additional protection against attempted defeat by application of external magnets.

.3 Switch shall be installed in accordance with Manufacturer's recommendations and shall be located such that the contacts change state whenever the leading edge of the door is moved 1 inch or more from the door jamb.

.4 Switch shall be compatible with door construction.

.5 Door contact switches for all air-lock doors (provide Class 1, Zone 2 rated door contacts for all doors in rated areas).

.6 Door contact switches shall be CSA or cUL certified.

.7 Honeywell 960 or approved equal.

.8 Provide 200 mm x 200 mm x 150 mm NEMA 12 Door Junction Box above each door for wiring terminations of door contact switch.

2.16 Electronic Relative Humidity Sensors

.1 Bulk polymer sensing element, for wall or duct installation as required. Provide space humidity sensors complete with temper proof covers.

.1	Accuracy	plus or minus 3%, 20 to 95% RH including hysteresis, linearity and repeatability.
.2	Operating Range	0-99% RH.
.3	Operating Temperature	minus 1°C to 54°C (30°F to 130°F).
.4	Temperature Effect	Less than 0.1%/°C (0.06%/ºF).
.5	Output Signal	4-20 mA, 0-100% linear, proportional.
.6	Voltage Requirement	12 to 36 VDC.

2.17 Thermowells

.1 Provide stainless steel wells for domestic water and corrosive liquid applications.

.2 Refer to Section 15022.

2.18 Damper Operators

.1 Electronic Operators for Modulating Damper:

.1 Spring return, 24 VAC operating voltage, 0 to 10 VDC input signal, 0 to 10 VDC position output signal, seventy (70) seconds maximum running time for 90° opening and thirty (30) seconds maximum closing time with feedback to the PCS.

.2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one damper operator per damper section.

.3 Provide manual override gear release or crank.

.4 Provide position indicator.

.5 Provide two (2) auxiliary switches for position proofing, one (1) at 10º rotation and one (1) adjustable up to 90º rotation.

.6 Provide Zone 2 rated actuators or explosion-resistant enclosures where required.

.2 Electronic Operators for Two Position Damper:

.1 Spring return, 24 VAC operating voltage, seventy (70) seconds maximum running time for 90° opening and thirty (30) seconds maximum closing time.

.2 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one damper operator per damper section.

.3 Provide manual override gear release or crank.

.4 Provide position indicator.

.5 Provide two (2) auxiliary switches for position proofing, one (1) at 10º rotation and one (1) adjustable up to 90º rotation.

.6 Provide Zone 2 rated actuators or explosion-resistant enclosures where required.

2.19 Combustible/Toxic Gas Monitoring Systems

.1 Provide a multi-point wired systems as shown for combustible and toxic gas monitoring and control of the ventilation systems per the sequence of operations.

.2 The system shall consist of sensor transmitters (at locations to be determined by airflow pattern testing), Central Monitor Panel, link to PCS, and all necessary hardware/software to make the system operational. Locate Central Monitor Panel in as required.

2.20 Variable Speed Drive Controller

.1 See Divisions 16 and 17.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer's recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Program each standalone local control panel immediately following installation.

.4 Set up and calibrate all control loops and sensors during the initial start-up of the systems and check, recalibrate and readjust as necessary during commissioning.

.5 Upon completion of the installation, perform all necessary testing and debugging operations satisfactorily.

.6 All sensors are to be stabilized to such a level as to permit on-the-job installations that require minimum field adjustments or calibration.

.7 Sensor assemblies are to be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

.8 Outdoor installation is to be weatherproof construction in NEMA 4X enclosures.

.9 Install space instruments requiring or allowing operator adjustment or monitoring at a height of 1.5 m above the finished floor, unless otherwise indicated.

.10 Install corridor instruments at a height of 2.1 m above the finished floor.

.11 Confirm Operator Workstation location with Engineer prior to installation.

.12 Install damper motors on outside of ducts. Do not locate in air stream.

.13 Wire "hand/off/auto" selector switches such that automatic operating controls and not safety controls and electrical over current protection shall be overridden when switch is in the "hand" position.

.14 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building.

.15 Install all safety limits at the operator’s level.

.16 All toxic and combustible gas monitoring sensors are to be located with the aid of a field air pattern test using the method recommended by the monitor system Manufacturer. The test is to be performed by or under the supervision of the monitor system’s Manufacturer’s representative. The monitor system’s Manufacturer’s representative will provide a recommendation for all sensor locations based on the test results. Documentation of the test results and recommendations will be provided to the City within the operating and maintenance manuals.

.17 Coordinate and confirm all controller set points with the balancing Contractor to verify all minimum and maximum air volumes on VSD controlled fans, air handlers and make-up air units. Programming of workstation shall conform to City of Winnipeg Automation Design Guide Standard.

.18 Provide copies of proposed control screens to Engineer for review prior to implementation.

3.2 Running Test

.1 A running test of seven (7) consecutive days shall be conducted on the complete and total installed and operational control system to demonstrate that it is functioning properly in accordance with the Specifications.

  .1 Running test will require the PCS integrated systems to be functional.

.2 The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialized control programs and algorithms, diagnostics and all other software.

.3 In the event of the failure of function, during the test, of any of the hardware components or software application or routines, the test will recommence and run until seven (7) failure-free test days have occurred.

.4 After successful completion of the running test, the Engineer will issue written acceptance of the control system.

.5 Prior to acceptance of the Work, submit hard copy and electronic copy on disk of final database listings.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Provide all remote sensing points and instrumentation as required for the complete operational capability of the facility.

.2 All instruments of a particular category shall be of the same type and Manufacturer.

.3 All external trim material shall comply with the Corrosion Study as specified in Schedule 18 Technical Requirements, with all internal parts assembled in watertight, shockproof, vibration proof, heat resistant assembly.

.4 Use standard conduit box termination with screwdriver connector block unless stated otherwise.

.5 Operating conditions 0-40°C with 10-90 percent RH (non-condensing) unless stated otherwise.

.6 All equipment and components shall be rated and labelled for the electrical hazard zone classification and corrosion category of the space in which they are installed.

.7 Where required all components shall be capable of communication with the PCS.

1.2 Standards

.1 American National Standards Institute (ANSI).

.2 National Electrical Manufacturers Association (NEMA).

1.3 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

- .1 Manufacturer's descriptive literature for materials.

2. PRODUCTS

2.1 Current Sensing (CR)

.1 Acceptable Manufacturers:

- .1 Nelsen-Kuljian.
- .2 Greystone.
- .3 Veris.
- .4 RIB (Functional Devices).
- .5 Or approved equivalent.

.2 Range: 0-120 amps.

.3 Accuracy: plus or minus 1 percent.

.4 Interface care:

.1 Plus or minus 1 percent accuracy.

.2 Integral zero and span adjustment.

.3 1-5 VDC or 4-20 mA output for full range input.

2.2 Control Damper Actuators

.1 General:

.1 Damper operators shall allow smooth operation of the damper throughout its entire range and assure tight shut-off against system pressure.

.2 Damper actuator shall be easily removed from the damper assembly for replacement.

.3 Spring return for "fail-safe" in Normally Open or Normally Closed position as required by the Final Design.

.4 Size actuators to control dampers against maximum pressure or dynamic closing pressure whichever is greater.

.5 Size damper actuators so that they provide smooth and full travel of the dampers while stroking in both directions.

.6 Where individual dampers are installed, install a separate damper actuator for each damper.

.7 Where multi-section dampers are installed, install a separate damper actuator for each section.

.8 Locate damper actuator so that they shall be easily accessible for testing and servicing.

.9 Where damper actuator operates outdoor and exhaust air dampers, pretension the damper drive linkage to ensure tight closure.

.10 Where a damper actuator is installed on an insulated surface of a duct or plenum, mount it on a stand-off bracket, so as not to interfere with the continuity of the insulation.

.11 Where a damper actuator is installed in an electrical hazard classified area it shall be rated to satisfy the zone classification requirements.

.2 Electric Two Position Damper Actuators:

.1 Include position feedback and end switches.

.3 Incremental Control Damper Actuators:

.1 The damper actuator is to modulate the control damper between the fully open and minimum open position based upon a 3-wire control signal (24 VAC). The actuator is to remain in position until the signal is applied.

.2 The damper is to maintain its shutoff force even if power is lost.

.4 Proportional Control Damper Actuators:

.1 The damper actuator is to modulate the control damper between the fully open and minimum open position based upon a 0-10 VDC or 4-20 mA control signal. The actuator is to remain in its position until the applied signal changes. In the event of a control signal loss, the actuator is to move to the zero voltage input position.

.2 The damper is to maintain its shutoff force even if power is lost.

.3 Include position feedback and end switches.

2.3 Control Valve Actuators

.1 General:

.1 Valve operators shall allow smooth operation of the valve throughout its entire range and assure tight shut-off against system pressure.

.2 Valve actuator shall be easily removed from the valve body for replacement.

.3 Spring return for "fail-safe" in Normally Open or Normally Closed position as required by the Final Design.

.4 Where a valve actuator is installed in an electrical hazard classified area it shall be rated to satisfy the zone classification requirements.

.2 Electric Two Position Valve Actuators:

.1 Include position feedback and end switches.

.3 Incremental Control Valve:

.1 The valve actuator is to modulate the control valve between the fully open and closed position based upon a 3-wire control signal (24 VAC). The actuator is to remain in position until the signal is applied.

.2 The valve is to maintain its shutoff force even if power is lost.

.3 The control system is to calculate valve position based on the motor speed and duration of control signal. The valve shall be driven to a full position and the calculation reset once every twenty-four (24) hours.

.4 Proportional Control Valve Actuators:

.1 The valve actuator is to modulate the control valve between the fully open and closed position based upon a 0-10 VDC or 4-20 mA control signal. The actuator is to remain in its position until the applied signal changes. In the event of a control signal loss, the actuator is to move to the zero-voltage input position.

.2 The valve is to maintain its shutoff force even if power is lost.

.3 Include position feedback and end switches.

2.4 Differential Pressure Transmitters (DPT)

.1 Provide differential pressure indicating transmitters having the following minimum specifications:

.1 Internal materials shall be suitable for continuous contact with the process material measured including compressed air, water, or glycol as applicable.

.2 Output signal of 4 - 20 mA into a maximum of 500 ohm load.

.3 Output variations of less than 0.2 percent full scale for supply voltage variations of plus or minus 10 percent.

.4 Combined non-linearity, repeatability and hysteresis effects not to exceed plus or minus 1 percent of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effect of plus or minus 1.5 percent full scale/50°C or less.

.7 Output short circuit and open circuit protection.

.8 Over-pressure input protection to a minimum of twice rated input.

2.5 Position Switches - Smoke Dampers

.1 End switches shall provide positive status indication of full open and full closed blade position. Provide 2 switches per damper if necessary.

2.6 Electric Relays

.1 Provide DPDT relays for control and status indication of alarms and/or electrical starters and equipment.

.2 Relays shall be plug in type with termination base.

2.7 Flow Switches

.1 Acceptable Manufacturers:

.1 McDonnell Miller.

.2 Johnson Controls.

.3 Or approved equivalent.

.2 Minimum Requirements:

.1 Single pole double throw action (vapour proof on chilled water).

.2 Adjustable sensitivity.

.3 Extended trimmable paddles.

.4 Selected for minimum flow condition.

.3 Installation:

.1 Install in upright position in horizontal run of pipe.

.2 Install a minimum of five (5) pipe diameters downstream of any valves, elbows, orifices or any other obstructions.

2.8 Freeze Protection

.1 Freeze protection thermostats shall be manual reset type with 6 m averaging element. Provide multiple thermostats for large duct cross sectional areas.

.2 For liquids, elements shall be rigid bulb type mounted in separable wells.

.3 Freeze protection elements shall be hard wired to the fan starter and wired to the PCS or alarm system.

2.9 Pressure Switches

.1 Provide pressure or differential pressure switches for ranges as indicated.

.2 Pressure sensing elements shall be Bourbon tube, bellows or diaphragm type.

.3 Adjustable setpoint and differential.

.4 Pressure switches shall be snap action type rated at 120 VAC, 15 A or 24 VDC.

.5 Sensor assembly is to operate automatically and reset automatically when condition returns to normal.

2.10 Temperature Sensors

.1 General: Temperature sensors shall be thermistor, resistance or thermocouple type; however, thermocouples shall be restricted to temperature range plus 200°C and above.

.2 The following is to apply to thermistor, resistance or thermocouple temperature sensors as applicable.

.1 RTDs shall be 100 ohm or 1,000 ohm at 0øC (plus or minus 0.2 ohm) nickel or platinum element with strain minimizing construction and 3 integral anchored leadwires coefficient of resistivity of 0.000385 ohms/ohm/ oC. Thermistors shall be 3,000 or 10,000 ohms.

.2 Sensing element shall be hermetically sealed.

.3 Stem and tip construction shall be copper or Type 304 stainless steel as noted.

.4 Sensors to have a time constant response of less than three (3) seconds to a temperature change of 10°C.

.5 Sensors shall operate over the following ranges with the accuracies over the noted range of the sensor.

.1 Minus 50°C to plus 50°C, plus or minus 0.5°C.

.2 0°C to plus 50°C, plus or minus 0.25°C.

.3 0°C to 25°C, plus or minus 0.1°C.

.4 0°C to 100°C, plus or minus 1°C.

.6 Immersion wells shall be of stainless steel materials for steam and domestic hot water and brass for other applications. Heat transfer compound shall be compatible with sensor.

.3 Temperature sensors shall be of the following types:

.1 Room type (RTS) - suitable for wall mounting, with or without protective guard. Element length of 10-50 mm with ceramic tube or equivalent mode of mechanical protection.

.2 General purpose duct type (DTS) - suitable for insertion into air ducts at any angle, insertion length shall be suitable for application. Copper sheathed construction.

.3 Spring-loaded thermowell type (ITS) - spring loaded construction with compression fitting for 20 mm NPT well mounting. Lengths shall be suitable for application. Stainless steel sheathed construction.

.4 Averaging duct type (ATS) - continuous filament with immersion length of 6000 mm minimum. Probe shall be bent, at field installation time, to a minimum radius of 100 mm at any point along the probe length without degradation in performance. Copper sheathed construction. Or multiple sensors mounted on a cable connected to provide an average temperature reading.

.5 Outside air type (OTS) - complete with non-corroding shield designed to minimize solar and wind effects, threaded fitting for mating to 12 mm conduit, probe length of 100 – 150 mm.

2.11 Temperature Switches

.1 Provide high/low temperature switches for ranges as required for the Final Design.

.2 Temperature sensing element shall be liquid, vapour or bimetallic type.

.3 Adjustable setpoint and differential.

.4 Snap action type rated at 120 V, or 24 V DC as required.

.5 Sensors shall operate automatically and reset automatically. Sensors used for freeze detection or fire detection shall be manually reset type.

.6 Temperature accuracy shall be plus or minus 1°C.

.7 Temperature switches shall be of the following types:

  .1 Room type - suitable for wall mounting on standard electrical box with or without protective guard.

  .2 General purpose duct type - suitable for insertion into air ducts, insertion length of 45 mm.

  .3 Thermowell type - with compression fitting for 20 mm NPT well mounting, length of 100 mm. Immersion wells shall be brass (stainless steel for domestic water and steam).

  .4 Freeze detection type - continuous element with insertion length of 6000 mm minimum, suitable for duct mounting to detect the coldest temperature in any 30 mm section of its length.

  .5 Strap-on type - with helical screw stainless steel clamps.

2.12 Velocity Pressure Transmitters

.1 Output of 4 - 20 mA linear into maximum of 500 ohm load.

.2 Calibrated span: not greater than twice the static pressure at maximum flow.

.3 Calibrated accuracy: plus or minus 1.0 percent of span.

.4 Repeatability: within 0.1 percent of output.

.5 Linearity: 0.5 percent of span.

.6 Deadband or Hysteresis: 0.1 percent of span.

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 All sensors shall be stabilized to such a level as to permit on-the-job installations that require minimum field adjustments or calibration.

.4 Sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

.5 Outdoor installation shall be weatherproof construction in NEMA 4X enclosures. Install space instruments at a height of 1.5 m above the finished floor, unless otherwise indicated.

.6 Install corridor instruments at a height of 2.1 m above the finished floor.

.7 Locate instruments in the same vertical centreline as light switches.

.8 Where instruments are indicated on an outside wall install on a stand-off wall bracket which provides an air space between the instrument and the wall; or on an insulating base (e.g., a cork pad).

.9 Install protective metal guards on instruments in areas where they may be subject to damage (loading areas, workshops, public corridors and storage areas). Bolt guards, independent of instruments to separate baseplates. Provide backing in wall for securing mounting bases.

.10 Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only and shall not be located in dead air spaces.

 .1 The location shall be within the vibration and velocity limits of the sensor.

 .2 Where an extended surface element is required to properly sense the average temperature, sensor shall be securely mounted within the duct to measure the best average temperatures.

 .3 Elements shall be thermally isolated from brackets and supports to respond to air temperature only.

 .4 Sensor element shall be supported separately and not connected to coils or filter racks.

.11 Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to affect proper flow across the entire area of the well. Wells shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area.

.12 Temperature transmitters, controllers and relays shall be installed in NEMA 4X enclosures.

.13 Panels shall be either free standing or wall mounted ANSI 61 polyester powder coated steel cabinets with hinged and key locked front door. Arrange for conduit and tubing entry from top, bottom or either side.

.14 Panels shall be modular multiple panels being used if required for capacity in any particular location.

.15 All panels shall be lockable with same key.

.16 Panels shall be ANSI/UL 1203 for explosion-proof applications in classified electrical hazard locations.

.17 All wiring within panels shall be located in trays or individually clipped to back of panel, and clearly identified.

.18 Mount electrical instruments on standard electrical rough-in boxes fastened to structure.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section specifies the requirements for testing, adjusting and balancing the HVAC system.

.2 All Work shall be in accordance with the latest edition of the Associated Air Balance Council National Standards. If these contract documents set forth more stringent requirements than the AABC National Standards, these contract documents shall prevail.

1.2 Standards

.1 Associated Air Balance Council (AABC).

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

1.3 Qualifications

.1 Agency Qualifications: the TAB Agency shall be a current member of the AABC.

1.4 Submittals

.1 Provide submittals in accordance with Section 01300 and the following:

  .1 Manufacturer's descriptive literature for materials.

.2 Submit testing and balancing documentation and reports as specified in this Section.

1.5 System Preparation

.1 Prior to air system testing, adjusting and balancing (TAB), all systems including fans, dampers VFD’s and controls should be commissioned and operational. The following work should be completed and verified.

  .1 As-built construction drawings, Shop Drawings, Specifications should be available.

  .2 Duct leakage rate in accordance with Specifications.

  .3 Ducts are clean.

  .4 Air filters are clean and installed correctly. Testing to be based on 50 percent filter loading.

  .5 Dampers are operational and set at the appropriate initial setting prior to balancing.

  .6 Controls are operational and calibrated. VFDs are operational.

  .7 Fans are operational. Fan rotation, installation, lubrication, and safety requirements are satisfactory.

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

1.6 Tests

.1 Provide five (5) Business Days' notice prior to carrying out any testing activities.

1.7 Testing and Balancing

.1 Employ an acceptable independent testing and balancing agency to test and balance the following systems:

- .1 Heating hot water and glycol system(s).
- .2 Supply air system(s).
- .3 Return air system(s).
- .4 Outdoor air system(s).
- .5 Exhaust air system(s).
- .6 Odour control exhaust air system(s).
- .7 Emergency shower/eyewash system(s).

.2 Prior to finalizing contractual arrangements with the balancing agency, submit the names, qualifications and years of direct field testing and balancing experience in the testing and balancing field for all members of the balancing team that is scheduled to carry out the balancing work. The senior site technologist to have a minimum of ten years testing and balancing experience of similar projects. Provide a list of a minimum of ten comparable projects successfully completed by all key members of the balancing team.

.3 Procedures are to be in general accordance with AABC'S National Standards for Field Measurement and Instrumentation and ASHRAE Standards.

.4 The testing agency will:

- .1 Ensure that all mechanical systems are complete and ready to be balanced and provide sufficient time for testing and balancing prior to substantial performance.
- .2 Make corrections to achieve system balance without delay, include all corrections and adjustments made during the balancing procedure on As-Built Documents.
- .3 Adjust fan drives, change blade pitch angles and change sheaves and belts as directed by the agency. Allow for additional sheaves to obtain specified performance.
- .4 Maintain all systems in full operation during the complete testing and balancing period.
- .5 Employ control technicians to make adjustments to the control systems to facilitate the balancing process.

.6 Employ the journeyman millwright to check the alignment of any V-belt drives and/or shaft coupling drives if they have been adjusted during the balancing process. Belt tension correctness to be verified.

.5 Complete air balance before commencing water balance where heating coils are installed in the air system. Balancing is to not commence until systems have been cleaned and treated and the air removed from within the piping systems.

.6 Accuracy: Balance to maximum flow deviation of plus or minus 10 percent at equipment, unless there are reasons beyond the control of the TAB technician. Small fans below 47 L/s is to be plus or minus 5 L/s. Deficiencies are to be noted in the TAB report.

.7 The balancing agency is to remove and re-install ceiling tile to provide access to ductwork and piping. The balancing agency is to make good any damage or soiling caused by his forces.

.8 Secure, permanently mark, seal and record the final settings on valves, dampers and other adjustment devices. Set and lock all memory stop balancing devices.

.9 Seal all holes with snap plugs or approved alternate method, used for flow and pressure measurements.

.10 The balancing agency is to assist in providing measurements to confirm and adjust the calibration of the control systems.

.11 The balancing agency will allow for checking and making adjustments during the warranty period, when weather conditions provide natural loads and in cases where complaints arise.

.12 Submit a draft balance report for review and include “REVIEWED” documents in O&M Information. Provide field notes in the balance report to clearly identify unusual conditions, problem areas and report on any cases where the specified flow rates or conditions could not be achieved by adjustment.

.13 Employ the testing and balancing agency to test all fire dampers as follows:

.1 Test all fire dampers (including combination smoke/fire dampers). The test is to be made by releasing the fusible link and witnessing closure of the damper. All fire dampers are to be left in the open position.

.2 A set of prints is to be marked up to show that each damper has checked for closure, accessibility and installation or provide schematic mechanical drawing showing all fire damper locations, label all fire dampers on drawing and reference on a signed and sealed report form. The prints are to be certified correct by the agency and submitted with completed test certificate.

.14 Air Systems – Balancing:

.1 Adjust duct and terminal balance dampers and adjust or change drive sheaves and fan blade pitch angles to obtain design quantities (within +/-10 percent) at each outlet and inlet.

.2 Use terminal balance dampers to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. The sheet metal sub-contractor is to provide additional dampers where required by the balancing agency to achieve a satisfactory balance without creating noise problems.

.3 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross-sectional area of duct. Provide a pitot tube traverse test sheet for each major duct branch.

.4 Measure air quantities at each air terminal.

.5 Maintain the design relationship between the supply and exhaust air system quantities, and the required space pressurization.

.6 Check to ensure that supply and return air quantities provide reasonable building pressurization. Test building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. Exit doors and elevator shafts should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.7 Where space pressurization is required for classified areas and areas adjacent to classified areas or areas requiring pressurization to protect equipment or contain chemicals or odours, provide pressurization as required to meet the Final Design. Provide pressure readings and volumetric readings of supply and exhaust airflows in these areas.

.8 Provide volumetric readings for all spaces and systems, and balance as required to meet the Final Design.

.9 Air systems are to be balanced with filter loading simulated 50 percent loaded.

.10 Set and verify the outdoor air damper minimum position on all air handling units. Measure the O/A volume during minimum O/A condition when the air valves/mixing boxes are at a simulated minimum system condition.

.11 Set and verify the relief air damper minimum position. Measure the relief air volume during minimum O/A condition (when the air handler is not in economizer mode).

.12 Upon completion of each system balance, check to ensure that the fan motor does not overload and that the main duct pressure does not change substantially when the system is switched over to minimum O/A condition.

.13 Test the following areas to ensure that the air flow into or out of the rooms is in the correct direction:

  .1 Electrical Rooms: balance to maintain the required pressures and confirm how well the rooms are sealed.

  .2 Mechanical Rooms: balance to maintain the required pressures and confirm door opening force.

.3 Classified areas and areas adjacent to classified areas.

.14 Include in the air balance report:

.1 Date of test, name and address of building and balancing technician's name.

.2 Range of outdoor air temperature during the balancing period.

.3 System schematics indicating damper positions, design and measured air quantities at each inlet and outlet. Show room numbers and floors.

.4 If installation permits, record both air terminals and fan discharge traverse air volumes to establish system leakage.

.5 Main branch duct traverses. Maximum and minimum outdoor air quantities.

.6 Measure and record the final static pressure resistance of the duct system and the static pressure drop across coils, filters and other losses. Check for pressure drop across filters and compare with Manufacturer’s specifications.

.7 Face velocities across major components such as filter or coils.

.8 Static pressure across each fan. Measure and record static pressure at fan suction and discharge.

.9 Fan and motor speed.

.10 Motor size, amps and voltage and compare with design specifications.

.11 Coil air entering and leaving temperatures (D.B. and W.B.).

.12 Maximum and minimum zone supply air temperatures under prevailing conditions at time of test.

.13 Provide fan performance curve for each air handling system.

.14 Provide filter and coil pressure drop readings for all air handling and make-up air units.

.15 Record the test data and design specifications on the data sheet. Record nameplate data on fan, motor and air handling equipment. Record size of sheaves and belts.

.16 Where plant processes may impact the associated space processes ensure these processes are operating in a mode with the highest influence during balancing.

.17 In the event airflows deviate more than 10% from design in order to achieve the required pressurization consult the design engineer for direction.

.15 Liquid Systems – Balancing:

.1 Set balance valves and balance fittings to provide required or design flow rates for each system component.

.2 Use installed balancing valves to determine flow rates for system balance. Where flow measuring devices are not installed, base flow balance on the air and liquid temperature difference across terminal heating/cooling elements and coils, acknowledging the different design temperature drops/rises used in the design of the systems.

.3 Effect system balance with automatic control valves fully open to heat transfer elements.

.4 Check air vents to ensure that they are correctly installed and are operating properly. Verify that all air is removed from within the piping system and that there is flow throughout all piping systems before the balancing is started.

.5 Include in the liquid balance report:

.1 Date of test, name and address of building and balancing technician's name.

.2 Range of outdoor air temperature during the balancing procedure.

.3 Pumps: Tag, service, location, Manufacturer, model and size. Specified and actual flow and head pressure. Motor size, speed, amps and voltage.

.4 Heat Exchangers: Tag, service, location, Manufacturer, model and size. Specified and actual capacity, liquid flow rates (HRS & GLS), inlet & outlet temperatures (HRS & GLS). HRS – Heat Reservoir Supply, GLS – Glycol Supply.

.5 Heating/Cooling Coils: Tag, service & location. Specified and actual capacity, flow, liquid pressure drop, liquid entering and leaving temperatures, air-side entering and leaving temperatures.

.6 System schematics: Specified and actual flow rates.

.7 Provide pump performance curve for each new pump system.

.8 Emergency shower/eyewash systems.

.16 Odour Control Systems – Balancing:

.1 Adjust duct and terminal balance dampers to obtain design quantities (within plus or minus 10 percent) at each outlet and inlet.

.2 Use terminal balance dampers to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Consult with Design Builder if additional dampers are required by the balancing agency to achieve a satisfactory balance without creating noise problems.

.3 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross-sectional area of duct. Provide a pitot tube traverse test sheet for each major duct branch.

.4 Maintain the design relationship between the supply and exhaust air system quantities, and the required space pressurization.

.5 Check to ensure that supply and exhaust air quantities meet building pressurization set out in the Design and Construction Specifications and Final Design. Test building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. Exit doors and elevator shafts should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.6 Upon completion of each system balance, check to ensure that the fan motor does not overload and that the main duct pressure does not change substantially when the system is switched over to minimum O/A condition.

.7 Where plant processes may impact the associated space processes ensure these processes are operating in a mode with the highest influence during balancing.

.8 In the event airflows deviate more than 10% from design in order to achieve the required pressurization consult the design engineer for direction.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 General

.1 Install in accordance with Manufacturer’s recommendations and as required by the Final Design.

.2 Undertake commissioning phases as specified in the Schedule 18 Technical Requirements.

.3 Provide testing, adjusting and balancing for entire facility.

.4 Following completion of testing and balancing the system is to be left in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

.5 Supplementary balancing will be provided as required during the warranty period to ensure pressurization and flow requirements are met under all HVAC and process operating conditions.

END OF SECTION