Mechanical Specification

Southway Retirement Home

2431 Bank Street
Ottawa, Ontario

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PART 1 GENERAL

1.1 Definitions

.1 For the purposes of these specifications, the following definitions shall apply:

.1 'Concealed' - hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.

.2 'Exposed' - all mechanical work normally visible, including in equipment rooms, crawl spaces, etc.

.3 'Provide' - (and tenses of 'provide') supply, install and connect complete.

.4 'Install' - (and tenses of 'install') install and connect complete.

.5 'Supply' - supply only.

.6 'Authority Having Jurisdiction' (AHJ) - the organization, office or individual responsible for approving equipment, an installation, or a procedure.

.7 'Approved' - acceptable to the authority having jurisdiction and/or acceptable to the Engineer.

.8 'Identified' - capable of being recognized by a person of normal vision without causing uncertainty about the location or operating process of the identified item.

1.2 Codes and Standards

.1 All work shall be performed as per the latest editions of the Ontario Building Code, Plumbing Code, all applicable codes and standards in the Province of Ontario, and to the satisfaction of the AHD.

.2 Comply with the latest editions and amendments of the following Codes and Standards:

.1 Ontario Building Code 2012.

.2 Ontario Plumbing Code 2012.

.3 Ontario Electrical Safety Code (most recent edition).

.4 Canadian Standards Association (CSA).

.5 Underwriters Laboratories of Canada (ULC).

.6 Canadian Gas Association (CGA).

.7 National Fire Protection Association (NFPA).

.8 American Society of Heating, Refrigerating and Air-Conditioning (ASHRAE).

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

.10 Technical Standards and Safety Authority (TSSA).

.11 Model National Energy Code (MNECB) - most recent edition.

.3 Where conflicts in requirements occur the most stringent standard shall apply.

1.3 Equipment List

.1 Contractor shall furnish a list of equipment and materials to be used on this project and forming part of tender documents by compiling manufacturer’s name, model number and details of materials, and submit for approval.

.2 Submit for approval within ten (10) working days after the award of the contract.

1.4 Drawings and Measurements

.1 Drawings do not necessarily indicate exact architectural, structural or mechanical features. Examine drawings prior to laying out, fabricating and installing work to ensure no interference exists. Report conflict with work to Engineer before proceeding.

.2 Drawings show general design and arrangement of mechanical system installation, and are in part diagrammatic.

.3 Do not scale drawings to order material. Take field measurements before ordering material and make material conform to site conditions.

.4 As part of this contract the drawings, specifications, change notices and site instructions are intended to include all work materials, wiring and accessories for the proper execution and completion of all mechanical systems, whether explicitly shown on drawings or not.

.5 Division 15 shall coordinate its work with all other trades.

1.5 Permits, Fees

.1 Contractor shall obtain all permits and pay all fees required.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Workmanship

.1 Only first class workmanship is acceptable.

3.2 Equipment Installation

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

.2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated. Provide access doors or insulated panels where required for equipment servicing.

.3 Equipment drains: pipe to floor drains or hub drains. Includes all condensate drains for all air handlers and splits and all acid neutralizing equipment for heat producing equipment.

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

.5 Upon delivery of kitchen sink, lavatory, bathtub, shower, water closet, washer/dryer, other plumbing fixtures, range hood, etc., the contractor is responsible for [storage], [unpacking], installation, levelling, and final mechanical hook-up.

.6 All equipment and materials shall be installed as per manufacturer's instructions and details, wiring schematics, venting arrangements, controls, piping connections, etc.

.7 Coordinate all installation with millwork drawings.

.8 Rough-in and final connection to all owner supplied equipment by Division 15. (Dishwashers, fridges, fireplaces, clothes washers, dryers, etc.).

.9 Provide all mechanical rough-in for all equipment supplied by others as per suppliers' rough-in details. Make all final mechanical connections to all equipment as required. This applies to commercial kitchen equipment, commercial laundry equipment, and other equipment and systems indicated.

3.3 Anchor Bolts and Templates

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

3.4 Responsibility for Trial Usage

.1 Obtain written permission from Engineer to start, test permanent equipment and systems prior to acceptance by Owner.

.2 Contractor may use equipment and systems for test purposes prior to acceptance. Supply labour, material and instruments required for testing.

3.5 Protection of Openings, Material and Equipment during Construction

.1 Protect piping, equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system. Open ends of ducts must be protected at all times.

.2 Temporary Storage: Job site sheet-metal material (for any end use) storage areas shall be located away from high dust generating processes such as masonry or tile cutters, cutoff saws, drywall sanding, mortar and plaster mixers, roof pitch kettles, portable electric generators, and main walkways that will be constantly broom swept. The general contractor shall designate a suitable area for temporary storage. Contractor shall provide pallets or blocking to keep material above the floor surface. If there is risk of water runoff from above or

dusty work areas cannot be avoided, coverage shall be used to protect stored materials.

3.6 Electrical

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

.1 Supplier and installer responsibility is indicated in Motor list and elsewhere.

.2 Control wiring and conduit is specified in Division 16 except for wiring and connections below 50 V which are related to control systems (Plumbing and HVAC.) specified in Division 15. Refer to Division 16 for quality of materials and workmanship.

.3 Power wiring and conduit for Division 15 equipment shall be provided by Division 16. Disconnects and starters, except where indicated, shall be provided by Division 16.

.4 All line and low voltage thermostats and line voltage motorized dampers will be supplied and installed by Division 15. All control wiring above 50V will be by Division 16.

.5 Div. 15 shall provide control wiring for:

.1 All boilers.

.2 All hot water heaters and storage tanks.

.3 Fan coil units, air handlers, make-up air units, air-cooled condensers, roof top units and VRF systems.

.4 Heat recovery ventilators.

.5 Division 15 shall provide all necessary control transformers to suit the load of the controls.

3.7 Motors

.1 Provide motors for mechanical equipment as specified.

.2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by

Engineer for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

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

.4 Motors ½ hp and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 104°F (40°C), 3 phase 600V, unless otherwise specified or indicated.

.5 Motors shall conform to ASHRAE 90.1 and Sections 7.2.4.1-1 and Table 2 of MNECB.

3.8 Equipment Supports

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

.2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of Section 05121-Structural Steel for Building. Submit structural calculations with shop drawings. Provide all necessary equipment supports required to comply with seismic restraint requirements.

.3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 4" (100 mm) high and 2" (50 mm) larger than equipment dimensions all around. Concrete specified in Section 03300-Cast-in place Concrete.

3.9 Sleeves

.1 Pipe and duct sleeves: at points where pipes or ducts pass through masonry, concrete or fire rated assemblies and as indicated. Coordinate with general contractor on location and extent of all sleeves. Leave spare sleeves where structure permits and as indicated. Provide sleeve locations on fabrication and interference drawings.

.2 Schedule 40 steel pipe, Proset or Mason acoustic type as indicated. Equivalents acceptable after review.

.3 Sleeves with annular fin continuously welded at midpoint:

.1 Through foundation walls.

.2 Where sleeve extends above finished floor.

.4 Sizes: minimum 1/4" (6 mm) clearance all around, between sleeve and uninsulated pipe or duct or between sleeve and insulation.

.5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 1" (25 mm) above other floors.

.6 Fill voids around pipes and ducts:

.1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.

.2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.

.3 Ensure no contact between copper tube and pipe and ferrous sleeve or support.

.4 Fill future-use sleeves with lime plaster or other easily removable filler.

.5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Andt-Mar-78.

.6 Treat acoustically sensitive penetrations as indicated on drawings.

3.10 Preparation for Firestopping and smoke seals

.1 Firestopping and smoke seal material and installation within annular space between pipes, ducts, insulation, conduits, wiring, access panels, covers, inserts, wall boxes, electrical boxes (supplied by Division 15) etc. and adjacent fire separation: responsibility of Division 15.

.2 Uninsulated unheated pipes or ducts not subject to movement: no special preparation.

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

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

.5 All fire stopping devices and smoke seal materials shall be of approved type, ULC listed. Suppliers of fire/smoke stopping materials will review and certify all fire and smoke seal installations.

3.11 Escutcheons

.1 On pipes passing through walls, partitions, floors and ceilings in finished areas.

.2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.

.3 Outside diameter to cover opening or sleeve.

.4 Inside diameter to fit around finished pipe.

.5 On exposed ducts passing through walls, ceilings or floors, see Section 15820 Duct Accessories.

3.12 Tests

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

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

.3 Conduct tests in presence of Engineer or Engineer’s designate.

.4 Bear costs including retesting and making good.

.5 Piping:

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

.2 Test natural gas systems to CAN1-B149.1 and requirements of authorities having jurisdiction.

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

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

.5 Test fire systems in accordance with authorities having jurisdiction and as specified elsewhere and to relevant NFPA Standards.

.6 Equipment: test as specified in relevant sections.

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

.6 Test heating water systems at 1.5 times the operating pressure or at 125 psi (860 kPa), whichever is greater.

3.13 Spare Parts

.1 Furnish spare parts as follows:

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

.2 Two sets of keys for each lockable cabinet.

3.14 Special Tools

.1 Provide one set of special tools required to service equipment as recommended by manufacturers.

3.15 Access Doors

.1 Supply access doors to all concealed mechanical equipment for operating, inspecting, adjusting and servicing. Supply fire rated access doors where required.

.2 Flush mounted 24" x 24" (600 mm x 600 mm) for body entry and 12" x 12" (300 mm x 300 mm) for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. "Provide fire rated doors in rated walls or partitions. In insulated walls, soffits etc., the access doors shall have thermal insulation equal to the thermal resistance of the surrounding structure." Where required for equipment servicing provide access panels, acoustically insulated sizes as recommended by the manufacturer. This applies to, but is not restricted to:

.1 Fan coil units.

.2 Concealed fans.

.3 Concealed air handlers where indicated.

.3 Material:

.1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as indicated on arch. plans.

.2 Other areas: Prime coat.

.4 Installation:

.1 Locate so that concealed items are accessible.

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

.3 Installation shall be by general contractor.

3.16 Dielectric Couplings

.1 General:

.1 To be compatible with and to suit pressure rating of piping system.

.2 Where pipes of dissimilar metals are joined.

3.17 Drain Valves

.1 Locate at all low points of all domestic water and hydronic systems, at sections between isolating valves and as indicated.

.2 Minimum NPS 3/4" (DN 20) unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.

3.18 Demonstration or Instructions

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

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

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

.4 Where deemed necessary, Owner may record these demonstrations on video tape for future reference.

.5 Allow adequate time for instruction by controls system manufacturer prior to final building opening.

3.19 Fabrication, Interference and Sleeving Drawings

.1 Submit fabrication, sleeving and interference drawings for all ductwork and plumbing and heating/chilled water piping to the Engineer for review prior to commencing work. Duct fabrication drawings not to be done till after suite mockups have been completed. Drawings to be to scale and show all access doors, allowances for other mechanical work and electrical work, etc. Drawings are required for:

.1 All systems on Ground level.

.2 One representative suite of each type.

.3 All risers and core/corridor areas.

.4 All systems in the basement area.

.5 All mechanical rooms.

.6 Contractor to satisfy himself that systems not listed above can be installed as shown on contract documents.

.2 Include fabrication and interference drawings in as-built submission.

3.20 Cleaning

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

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

3.21 Standard of Acceptance

.1 Means that item named and specified by catalogue or by other means number forms part of specification and sets standard

regarding performance, quality of material and workmanship. Any alternates to specified products, in this specification or drawings or motor list, must receive approval from the Engineer and noted by addenda prior to tender closing. No submission will be acceptable within three (3) working days of tender closing.

.2 Should contractor propose the use of any approved alternate equipment or materials to those specified, he must so state in writing at the time of tendering, naming the proposed substitutions and stating what difference, if any, will be made in the amount of his cost estimate for each substitution, should it be accepted.

.3 Changes in the work from the drawings and specifications shall not be made unless the contractor has written authorization for the change, and no claim for addition to or deduction from the contract sum shall be valid unless so ordered.

.4 The mechanical contractor shall bear any additional costs arising from the acceptance of any alternates.

3.22 Painting

.1 Painting shall be provided by Division 9 except as indicated.

.2 All equipment and materials provided by Division 15 shall be left in suitable condition for painting.

.3 If equipment and material is available in optional colours/finishes not indicated then architect shall make selection.

.4 Division 15 shall touch-up paint and finishes not painted by Division 9.

3.23 Cost Breakdown

.1 Within 10 days of award of contract contractor shall submit labour and materials breakdown based upon each spec section.

3.24 Progress Draw Form

.1 Immediately upon award of contract submit proposed progress draw form to engineer for review.

.2 Form shall show labour and material amounts for sections.

.3 Show the following:

.1 Total contract amount.

.2 Dollar amount complete to date.

.3 Percent amount complete to date.

.4 Dollar amount this period.

.5 Percent amount this period.

.6 Dollar amount last period.

.7 Percent amount last period.

.8 Breakout prices.

.9 Extra prices.

3.25 Excavation and Backfill

.1 Excavation and backfill shall be provided by the general contractor.

3.26 Start-Up and Substantial Performance Requirements

.1 Contractor shall provide documentation that certifies that work has been carried out and systems are performing according to the contract documents and manufacturer’s specs.

.2 Checklist for substantial completion as follows:

.1 Pressure test reports for all domestic water systems.

.2 Pressure test reports for storm piping system.

.3 Pressure test reports for sanitary system.

.4 Pressure test reports for Division 15 installed gas pipe systems.

.5 Pressure test reports for all hydronic systems.

.6 Pressure test reports for standpipe and sprinkler systems.

.7 Start-up and commissioning report for snow melting and radiant heat systems.

.8 Start-up and commissioning report for all fans.

.9 Start-up and commissioning report for all make-up air units, roof top units and VRF systems.

.10 Start-up and commissioning report for all fan coil units and air handlers.

.11 Start-up and commissioning report for all mechanical systems.

.12 Testing, Adjusting and Balancing reports of mechanical systems completed.

.13 All pipe and duct insulation completed.

.14 Any specialized acoustic treatment complete, a manufacturer commissioning report required if indicated.

.15 All identification complete.

.16 Suite plumbing fixtures all installed and tested.

.17 Standby generator mechanical systems complete.

.18 All fire dampers installed and inspected.

.19 As-builts complete.

.20 Maintenance manuals complete.

.21 Control sequences and diagrams up to date as per as-builts.

.22 Enbridge Gas acceptance of systems.

.23 Site cleaned up and temporary coverings, etc. removed.

.24 Paint and finishes touched up.

.25 Equipment and pipe isolation complete and tested.

.26 Pipe expansion joints complete and tested.

.27 AHD reports/deficiencies rectified.

.28 Manufacturer acceptance of all equipment installation.

.29 Contractor report on incomplete work.

.30 All TSSA tags and reports for standby generator.

.31 Backflow preventers tested and complete.

3.27 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with site practise.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

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

3.28 Energy Efficiency Requirements

.1 All mechanical equipment shall conform to efficiencies indicated in the O.B.C. Section SB-10 - Supplementary Standard - Division 2, Section 6, H.V.A.C.

.2 Motor efficiencies as per Table 10.4.1.A.(b).

.3 All mechanical H.V.A.C. equipment efficiencies shall meet requirements of the following tables of Section 6:

.1 Table 6.8.1.A Air Conditioners.

.2 Table 6.8.1.B Heat Pumps.

.3 Table 6.8.1.C Chilled Water.

.4 Table 6.8.1.D Packaged Air Conditioners.

.5 Table 6.8.1.E Furnaces.

.6 Table 6.8.1.F Boilers.

.7 Table 6.8.1.G Heat Rejection.

.4 Service water heating equipment shall conform to table 7.8.

3.29 TSSA Review and Sign-off

.1 TSSA review is required for all natural gas installation, piping and equipment prior to final occupancy.

.2 TSSA review is required for all Genset and fuel system installation, piping and equipment prior to final occupancy.

.3 The above reviews shall take the form of a report by a TSSA employed inspector, signed by that inspector. The contractor shall arrange for and pay for all site visits. The contractor shall make good, at his expense, all deficiencies found by the TSSA inspector. The inspector’s instructions shall be final

.4 The contractor shall coordinate TSSA review and any subsequent work with all other trades and the Owner.

.5 Final sign-off by the Engineer will not be granted until the TSSA inspector’s report is clear of deficiencies.

END.

PART 1 GENERAL

1.1 Summary

.1 This Section specifies general requirements and procedures for contractors submissions of shop drawings, product data, samples and mock-ups to Engineer for review. Additional specific requirements for submissions are specified in individual sections of Division 15.

.2 Do not proceed with work until relevant submissions are reviewed by Engineer.

.3 Present shop drawings, product data, samples and mock-ups.

.4 Verification of dimensions or the location of connections to the equipment shall be the full responsibility of the contractor.

.5 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract documents stating reasons for deviations.

.6 Contractor’s responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer’s review of submission, unless Engineer gives written acceptance of specific deviations.

.7 Make any changes in submissions which Engineer may require consistent with Contract Documents and resubmit as directed by Engineer.

.8 Notify Engineer, in writing, when resubmitting, of any revisions other than those requested by Engineer.

.9 The shop drawing review by the engineer is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the engineer approves the detail design inherent in the shop drawings responsibility for which shall remain with the contractor submitting same and such review shall not relieve the contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all the requirements of the

construction and contract documents. The contractor is responsible for dimensions to be confirmed and corrected at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of all sub-trades.

1.2 Submission

.1 Coordinate each submission with requirements of work and Contract Documents. Individual submissions will not be reviewed until all related information is available.

.2 Allow minimum five (5) working days for Engineer’s review of each submission.

.1 Work involving relevant product may not proceed until submission is reviewed.

.3 Accompany submissions with transmittal letter containing:

.1 Date.

.2 Project title and number.

.3 Contractor’s Company and contact name, address, phone and fax number, e-mail address.

.4 Identification and quantity of each shop drawing, product data and sample.

.5 Deviation from specified duties.

.6 Deviation from specified electrical requirements.

.7 Deviation from dimension specified or indicated.

.8 Other pertinent data.

.4 Submissions shall include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name, address phone and fax number of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Contractor’s stamp, signed by Contractors authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of work as applicable:

.1 Fabrication.

.2 Layouts, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

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

.12 Acoustic sound power data, where applicable.

.13 Points of operation on performance curves.

.14 Manufacturer to certify as to current model production.

.15 Certification of compliance to applicable codes.

.6 After Engineer’s review, distribute copies.

1.3 Shop Drawings

.1 Shop drawings: original drawings, or modified standard drawings provided by Contractor, to illustrate details of portions of Work, which are specific to project requirements.

.2 Submit six (6) copies of shop drawings to construction manager. One copy will be retained by the Engineer, one copy will be marked up and returned to the Construction manager, one copy by the Architect and the final copy will be copied to all relevant remaining parties by construction manager.

REVIEW	( )
REVIEWED AS MODIFIED	( )
REVISE AND RESUBMIT	( )
NOT REVIEWED	( )

THIS REVIEW BY QUADRANT ENG. IS FOR THE SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH THE GENERAL DESIGN CONCEPT. THIS REVIEW SHALL NOT MEAN THAT QUADRANT ENG. APPROVES THE DETAIL DESIGN INHERENT IN THE SHOP DRAWINGS RESPONSIBILITY FOR WHICH SHALL REMAIN WITH THE CONTRACTOR SUBMITTING SAME AND SUCH REVIEW SHALL NOT RELIEVE THE CONTRACTOR OF HIS RESPONSIBILITY FOR ERRORS OR OMISSIONS IN THE SHOP DRAWINGS OR OF HIS RESPONSIBILITY FOR MEETING ALL REQUIREMENTS OF THE CONSTRUCTION AND CONTRACT DOCUMENTS. THE CONTRACTOR IS RESPONSIBLE FOR DIMENSION TO BE CONFIRMED AND CORRECTED AT THE JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUE OF CONTRACTION AND INSTALLATION AND FOR COORDINATION OF THE WORK OF ALL SUB TRADES.

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BY: DATE:

.3 Cross-reference shop drawing information to applicable portions of Contract Documents.

.4 Shop drawings are required for, but not limited to:

.1 Fans.

.2 Pumps.

.3 Fan coil units, condensing units, VRF systems.

.4 Fire Protection Systems.

.5 Plumbing fixtures and brass.

.6 Grilles and diffusers.

.7 Dampers, louvres, vents.

.8 Pressure reducing valves.

.9 Fire extinguishers/cabinets.

.10 Domestic water and hydronic shut-off valves.

.11 Access doors.

.12 Acoustic insulation.

.13 Back flow preventers.

.14 Thermal insulation/acoustic insulation.

.15 Plastic piping.

.16 Fire Hose Cabinets.

.17 Flexible connections.

.18 Expansion joints.

.19 Snow melting and radiant heating.

.20 Exhaust stacks.

.21 Roof top units and make-up air units.

.22 Heat exchangers.

.23 Fire rated sleeves.

.24 Plastic piping.

.25 Pipe joining systems.

1.4 Product Data

.1 Product data: manufacturers catalogue sheets, brochures, literature, performance charts and diagrams, used to illustrate standard manufactured products.

.2 Submit six (6) copies of product data.

.3 Delete information not applicable to project.

.4 Supplement standard information to provide details applicable to project.

.5 Cross-reference product data information to applicable portions of Contract Documents.

1.5 Samples

.1 Samples: examples of materials, equipment, quality, finishes, workmanship.

.2 Where colour, pattern or texture is criterion, submit full range of samples.

.3 Reviewed and accepted samples will become standard of workmanship and material against which installed work will be verified.

1.6 Mock-ups

.1 Mock-ups: field-erected example of work complete with specified materials and workmanship. One suite of each type to be used as the mock-up suite.

.2 Erect mock-ups at locations acceptable to Engineer, Architect and Owner.

.3 Reviewed and accepted mock-ups will become standards of workmanship and material against which installed work will be verified.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

END.

PART 1 GENERAL

1.1 Section Includes

.1 As-builts, samples, and specifications.

.2 Equipment and systems.

.3 Product data, materials and finishes, and related information.

.4 Operation and maintenance data.

.5 Spare parts, special tools and maintenance materials.

.6 Warranties and bonds.

.7 Final site survey.

1.2 Submission

.1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.

.2 Copy(ies) will be returned after final inspection, with Engineer's comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two weeks prior to Substantial Performance of the Work, submit to the Engineer, four final copies of operating and maintenance manuals in English.

.5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in work.

.6 If requested, furnish evidence as to type, source and quality of products provided.

.7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.8 Pay costs of transportation.

1.3 Format

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, three (3) 'D' ring, loose leaf 8.5"x11" or 8.5"x14" with spine and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems, process flow, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in .dwg (AutoCAD) format via email, by CD or by USB Flash Drive.

1.4 Contents - Each Volume

.1 Table of Contents: provide title of project;

.1 Date of submission; names;

.2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

.6 Training: Refer to applicable specification sections.

1.5 As-builts and Samples

.1 In addition to requirements in General Conditions, maintain at the site for Engineer one record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to the Contract.

.5 Reviewed shop drawings, product data, and samples.

.6 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Engineer.

1.6 Recording Actual Site Conditions

.1 Record information on set of blue line black line opaque drawings, and in copy of Project Manual, provided by Engineer.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

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

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

1.7 Final Survey

.1 Submit final site survey certificate, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.8 Equipment and Systems

.1 Each Item of Equipment and Each System: Include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Include installed colour coded wiring diagrams.

.3 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.4 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.5 Provide servicing and lubrication schedule, and list of lubricants required.

.6 Include manufacturer's printed operation and maintenance instructions.

.7 Include sequence of operation by controls manufacturer.

.8 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.9 Provide installed control diagrams by controls manufacturer.

.10 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.11 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.12 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.13 Include test and balancing reports.

.14 Additional requirements: As specified in individual specification sections.

1.9 Spare Parts

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in work.

.3 Deliver to site location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.10 Maintenance Materials

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in work.

.3 Deliver to site location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.11 Special Tools

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to site location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.

1.12 Storage, Handling and Protection

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and to satisfaction of Engineer.

1.13 Warranties and Bonds

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

.8 Standard warranty shall be for two (2) years parts and labour.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

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END.

PART 1 GENERAL

1.1 Operation and Maintenance Manual

.1 Provide operation and maintenance data for incorporation into manual.

.2 Operation and maintenance manual to be reviewed by, and final copies deposited with, Engineer before final inspection.

.3 Operation data to include:

.1 Control schematics for each system including environmental controls.

.2 Description of each system and its controls.

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

.4 Operation instruction for each system and each component.

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

.6 Valve schedule and flow diagram.

.7 Colour coding chart.

.8 Warranties, list all manufacturer’s names, addresses, phone and fax numbers.

.4 Maintenance data shall include:

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

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

.5 Performance data to include:

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

.2 Equipment performance verification test results.

.3 Special performance data as specified elsewhere.

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

.6 Approvals:

.1 Submit two (2) copies of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted.

.2 Make changes as required and resubmit as directed by Engineer.

.7 Additional data:

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

.8 Binder(s) shall not be more than 3/4 full, and shall be letter or legal size as required.

.9 Permanently identify each binder on the front cover with:

.1 Project Name.

.2 Binder Title.

.3 Mechanical Contractor’s Name, Address, Phone number (including emergency) and Fax number.

1.2 As-built Drawings

.1 Site records:

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

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

.3 Use different colour waterproof ink for each service.

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

.2 As-built drawings:

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

.2 All drawings to be prepared for distribution as CAD files on removable media and six (6) print sets.

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

.4 Submit to Engineer for approval and make corrections as directed.

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

.6 Submit completed reproducible as-built drawings complete with CAD files, in the form of both paper/vellum plots and CAD files on removable media, with Operating and Maintenance Manuals.

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

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

END.

PART 1 PART 1 - GENERAL

1.1 1.1 As-built Drawings

.1 Site records:

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

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

.3 Use different colour waterproof ink for each service.

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

.2 As-built drawings:

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

.2 All drawings to be prepared for distribution as CAD files, AutoCAD R2004 or later, media and six (6) print sets.

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

.4 Submit to Engineer for review and make corrections as directed.

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

.6 Submit completed reproducible as-built drawings complete with CAD files, in the form of both paper/vellum plots and CAD files on removable media, with Operating and Maintenance Manuals.

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

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

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END.

PART 1 GENERAL

1.1 Samples

.1 Submit samples in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit one sample of each type of hand entry access door.

.3 Submit one sample of each type of body entry door.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.

PART 2 PRODUCTS

2.1 Access Doors

.1 Supply and install as necessary, whether indicated on drawings or not, to gain access to all concealed mechanical equipment for operating, inspecting, adjusting, servicing.

.2 Sizes: Except as indicated otherwise, to be minimum sizes as follows:

.1 For body entry: 24" x 24" (600mm x 600mm).

.2 For hand entry: 12" x 12" (300mm x 300mm).

.3 For equipment servicing: as recommended by the manufacturer.

.3 Construction: Rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180˚. Doors shall maintain fire rating of wall or partition into which they are installed. Access doors for equipment shall be acoustically insulated.

.4 Materials

.1 Tiled or marble surfaces and other special areas: Stainless steel with brushed satin or polished finish as directed by Engineer.

.2 All other areas: Prime coated steel.

.5 Access doors in thermally insulated walls or ceilings shall be thermally insulated with thermal insulation having the thermal resistance equal to the surrounding structure.

2.2 Exclusions

.1 Lay-in tile ceilings. In this instance, use unobtrusive identification locators.

PART 3 EXECUTION

3.1 Installation

.1 Installation:

.1 Tiled or marble surfaces: to Architectural specification section by General Contractor (GC).

.2 Masonry surfaces: to Architectural specification section by GC.

.3 Drywall surfaces: Architectural specification section by GC.

.4 Other surfaces not provided by this division: to Architectural specification section by GC.

.5 Equipment or material supplied by Division 15: by Division 15.

3.2 Location

.1 Location: Ensure that equipment is clearly within view and accessible for operating, inspecting, adjusting, servicing without the need for special tools.

END.

PART 1 GENERAL

1.1 Use of Systems

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

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

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

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

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

.5 Supply ventilation systems are protected by 60% filters, which shall be inspected daily, changed every week or more frequently as required.

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

.7 All systems will be:

.1 Operated as per manufacturer's recommendations or instructions.

.2 Operated by Contractor.

.3 Monitored continuously by Contractor.

.8 Warranties and guarantees are not thereby relaxed.

.9 Regular preventive and all other manufacturers recommended maintenance routines are performed by Contractor at his own expense and under supervision of Engineer and owner.

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

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

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

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

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END.

PART 1 GENERAL

1.1 Design Requirements

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

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.

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

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

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

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-ups.

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

.1 All bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

PART 2 PRODUCTS

2.1 General

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

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

2.2 Pipe Hangers

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Steel hangers in contact with copper piping shall be epoxy coated.

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

.1 Cold piping NPS 2 (DN 50) maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut.

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

.2 Cold piping NPS 2½ (DN 65) or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers. UL listed.

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

.1 Cold piping NPS 2 (DN 50) maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.

.2 Cold piping NPS 2½ (DN 65) or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete.

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

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed.

.5 Hanger rods: galvanized threaded rod.

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

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

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

.1 Attachments for steel piping: Carbon steel galvanized.

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

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

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

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

.9 U-bolts: carbon steel to MSS SP-69 with two (2) nuts at each end to ASTM A 563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: Galvanized, with formed portion epoxy coated.

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

2.3 Riser Clamps

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

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

.3 Bolts: To ASTM A 307.

.4 Nuts: To ASTM A 563.

2.4 Insulation Protection Shields

.1 Insulated cold piping:

.1 4 lb/ft3 (64 kg/m3) density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 10' (3 m) span.

.2 Insulated hot piping:

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

2.5 Spring Hangers

.1 As per Section 15072 - Vibration Isolation.

2.6 Equipment Supports

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

.2 As per Section 15072 - Vibration Isolation.

2.7 Equipment Anchor Bolts and Templates

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

2.8 House-keeping Pads

.1 For base-mounted equipment: Concrete, at least 4" (100mm) high, 8" (200mm) larger all around than equipment, and with chamfered edges.

.2 Provided by general contractor.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

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

.3 Clamps on riser piping:

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

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

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

.4 Cast iron pipes: Install below joint.

.5 Install vibration isolators as indicated.

.4 Clevis plates:

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

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

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 1/2" (13mm) or more.

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

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25 % of total load.

3.2 Hanger Spacing

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

.2 Fire protection: To applicable Fire Code.

.3 Gas and fuel oil piping: up to NPS 1/2 (DN 15): Every 6' (1.8 m).

.4 Copper piping: up to NPS 1/2 (DN 15): Every 5' (1.5 m).

.5 Flexible joint roll groove pipe: In accordance with table below, but not less than one hanger at joints.

.6 Within 6" (300mm) of each elbow.

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

1Maximum Pipe Size: NPS, " (DN, mm)	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4 (32)	7' (2.1 m)	6' (1.8 m)
1-1/2 (40)	9' (2.7 m)	8' (2.4 m)
2 (50)	10' (3.0 m)	9' (2.7 m)
2-1/2 (65)	12' (3.6 m)	10' (3.0 m)
3 (80)	12' (3.6 m)	10' (3.0 m)
3-1/2 (90)	13' (3.9 m)	11' (3.3 m)
4 (100)	14' (4.2 m)	12' (3.6 m)
5 (125)	16' (4.8 m)	
6 (150)	17' (5.1 m)	

3.3 Hanger Installation

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

.2 Adjust hangers to equalize load.

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

.4 Hanger shall be outside all installation.

3.4 Horizontal Movement

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4° from vertical.

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

3.5 Final Adjustment

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

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

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

END.

PART 1 GENERAL

1.1 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Provide system shop drawings complete with performance and product data.

.3 Descriptive Data:

.1 Schedules of flexibly mounted equipment, referencing drawings by number.

.2 Catalogue cuts or data sheets on vibration isolators.

.4 Drawings:

.1 Submit details of equipment bases including dimensions, structural member sizes and support point locations.

.2 Submit details of isolation hangers for ceiling hung equipment, piping and ductwork.

.3 Submit details of mountings for floor supported equipment, piping and ductwork.

.4 All hanger, mounting or pad drawings shall indicate deflections and model numbers as well as any other requirements in the specifications.

.5 Spring diameters, rated loads and deflections, heights at rated load and closed height shall be provided for all springs shown in the submittals in tabular form.

.6 Complete flexible connector details.

PART 2 PRODUCTS

2.1 General

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

.2 Neoprene mountings:

.1 Shall have a minimum static deflection of 0.35" (9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.

.2 Mountings shall be type ND or rails type DNR as manufactured by Mason Industries, Inc.

.3 Spring isolators:

.1 Shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" (6mm) neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

.2 Mountings shall be type SLF, as manufactured by Mason Industries, Inc.

.4 Restrained spring mountings:

.1 Shall have a Mason SLF mounting as described in their Specification B, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" (12mm) shall be maintained

around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment there must be an internal isolation pad in addition to the friction pad on the bottom.

.2 Mountings shall be SLR as manufactured by Mason Industries, Inc.

.5 Hangers:

.1 Shall consist of rigid steel frames containing minimum 1 1/4" (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification B seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30° capability.

.2 Hangers shall be type 30N as manufactured by Mason Industries, Inc.

.6 Bases:

.1 Concrete Inertia Base: Inertia bases shall be of welded steel construction with concrete in-fill supplied by the installing contractor on site and shall incorporate 15M (No.4) reinforcing bars, welded 12" (300mm) maximum on centers each way.

.2 Inertia bases for pumps shall be of sufficient size to accommodate supports for pipe elbows at pump suction and discharge connections.

.3 Inertia bases for fans shall include motor slide rails as indicated.

.4 The weight of each inertia base shall be at least equal to the weight of the equipment mounted thereon or sufficient to lower the center of gravity to or below the isolator support plane.

.5 Inertia bases shall be minimum 4" (100mm) thick.

.6 Height-saving brackets or welded steel pockets shall be incorporated to ensure a 2" (50mm) minimum clearance under each inertia base.

.7 All-directional acoustical pipe anchor:

.1 Shall consist of two sizes of steel tubing separated by a minimum 1/2" (12mm) thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material shall not exceed 500 psi (3.45 MPa) and the design shall be balanced for equal resistance in any direction.

2.2 Elastomeric Pads

.1 Type EP1 - neoprene waffle, 1/2" minimum thick, 50 durometer, maximum loading 51 psi (350 kPa).

.2 Acceptable material: Mason SW, Vibro-Acoustics, Vibron.

2.3 Elastomeric Mounts

.1 Type M1 - captive neoprene mount, colour coded; bridge-bearing quality neoprene in shear, maximum durometer of 60, threaded insert and bolt-down holes, cap screw and washer.

.2 Acceptable material: Mason BR, Vibro-Acoustics, Vibron.

2.4 Spring Mount

.1 Type M2 - retrained single and multiple spring: 3" (75mm) deflection, support on bonded 1/4" (6mm) minimum thick ribbed neoprene or rubber friction and acoustic pad.

.1 Acceptable material: Mason, Vibro-Acoustics, Vibron.

.2 Type M3 - captive spring for restrained service.

.1 Acceptable material: Mason SLRS.

2.5 Hangers

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

.1 Acceptable material: Mason HD, Vibro-Acoustics, Vibron.

.2 Type H2 - 30° swing spring and double deflection neoprene.

.1 Acceptable material: Mason 30-N.

2.6 Acoustic Barriers for Anchors and Guides

.1 Acoustic barriers: between pipe and support, consisting of 1" (25mm) minimum thick heavy duty duck and neoprene isolation material.

.2 Acceptable material: Mason, Vibro-Acoustics, Vibron.

PART 3 EXECUTION

3.1 Installation

.1 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

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

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

.1 Up to NPS 4 (DN 100): first three (3) points of support.

.2 NPS 5 to NPS 8 (DN 125 to DN 200): first four (4) points of support.

.3 NPS 10 (DN 250) and over: first six (6) points of support.

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

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

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

.6 The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

.7 Coordinate work with other trades to avoid rigid contact with the building.

.8 Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the architects/engineer’s attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor’s expense.

.9 Bring to the Architects/Engineer’s attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor’s expense.

.10 Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor’s expense.

.11 Locate isolation hangers as near to the overhead support structure as possible.

.12 Rooftop equipment isolators must be bolted to the equipment and structure. Mountings must be designed to resist 100m/h (160 km/h) wind loads.

.13 Horizontal pipe isolation: The first three pipe hangers in the main lines near the mechanical equipment shall be as isolated with spring hangers. Horizontal runs in all other locations throughout the building shall be isolated by hangers as described in Mason specification D for piping 2" (50mm) and larger. Floor supported piping shall rest on isolators as described in section .4. Heat exchangers and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces the first three hangers shall have 3/4" (20mm) deflection for pipe sizes up to and including 3" (75mm), 1-1/2" (40mm) deflection for pipe sizes over 3" (75mm) and up to and including 6"(150mm), and 2 1/2" (63mm) deflection thereafter. Where piping connects to mechanical equipment install double spherical isolators described elsewhere.

.14 Riser isolation: Risers shall be suspended from section .5 hangers or supported by section .2 mountings, anchored and guided as described elsewhere. Steel spring deflections shall be a minimum of 3/4" (20mm) except in those expansion locations where additional deflection is required to limit load changes to + 25% of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure and spring deflection changes.

3.2 Site Visit

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

.2 Provide Engineer with notice 24h in advance of visit.

.3 Make adjustments and bear costs of corrections in accordance with written report.

END.

PART 1 GENERAL

1.1 Related Work Specified Elsewhere

.1 Section 15072 - Vibration Isolation.

1.2 Work Furnished But Not Installed

.1 The materials and systems specified in this section shall be purchased by the mechanical contractor from a single seismic snubber restraint materials manufacturer to assure sole source responsibility for the performance of the seismic restraints used.

1.3 Description of System

.1 The requirements of this seismic restraint section are in addition to other requirements as specified elsewhere for the support and attachment of equipment and mechanical services, and for the vibration isolation of same equipment.

.2 The work under this section shall include furnishing all labor, materials, tools, appliances, and equipment, and performing all operations necessary for the complete execution of the installation of seismic snubber restraint assemblies as shown, detailed, and/or scheduled on the drawing and/or specified in this section of the specifications.

.3 All seismic snubber restraint assemblies shall meet the following minimum requirements:

.1 Impact surface shall have a high quality elastomeric facing.

.2 Resilient material shall be easy to visually inspect for damage and be replaceable.

.1 Resilient material used in snubber assemblies to be a minimum of 0.25" (6 mm) thick.

.2 Resilient material used in snubber grommets to be a minimum of 0.12" (3 mm) thick.

.3 Assembly must be designed to offer seismic restraint in all directions, unless otherwise noted below.

.4 Clearance between resilient material and contacting isolated equipment surface must not exceed 0.25" (6 mm).

.5 Seismic restraints capacities to be verified by an independent test laboratory or certified by an experienced registered Professional Engineer to ensure that the design intent of this specification is realized.

1.4 Alternate Systems

.1 Provisions of the General Conditions and Supplemental Conditions of the specifications shall govern the use of alternate systems to those specified.

.2 Manufacturers not listed as approved in Part 2 of this section must secure approval to bid a minimum of three (3) days prior to the project bid date.

1.5 Installation

.1 Installation of all seismic restraint materials specified herein shall be accomplished following the manufacturer's written instructions. Installation instructions shall be submitted to the engineer for approval prior to the beginning of the work.

1.6 System Design

.1 Seismic snubber manufacturer shall be responsible for the structural design of attachment hardware as required to attach snubbers to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.

.2 The contractor shall furnish a complete set of approved shop drawings of all mechanical equipment which is to be restrained to the seismic restraint manufacturer, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings furnished shall include basic equipment layout, length and width dimensions, installed operating weights of the equipment to be restrained and the distribution of weight at the restraint points.

.3 All piping and ductwork is to be restrained per the latest revision of the SMACNA manual. The seismic restraint

manufacturer will provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.

.4 The contractor shall ensure that all housekeeping pads used are adequately reinforced and are properly attached to the building structural flooring, so to withstand anticipated seismic forces. The size of the housekeeping pad is to be coordinated with the seismic restraint manufacturer so to ensure that adequate edge distances exist in order to obtain desired design anchor capabilities.

1.7 Submittals

.1 Samples: The contractor shall submit samples of specified seismic snubber devices upon request of the engineer for approval.

.2 Shop drawings: The contractor shall have prepared by the seismic snubber restraint materials manufacturer, and shall submit to the engineer for approval, drawings showing the construction of the seismic snubber to be used, including specific selection of snubbers for the equipment to be furnished for this project, and shall include as a minimum a tabulation of the design data for each snubber, including specific anchorage details.

.3 Drawings are to be prepared and sealed by a registered Professional Engineer, with a minimum of five (5) years working experience in this field, certifying that the submitted snubber and anchorage details satisfy the seismic specification requirements as written

.4 The engineer noted above shall provide a sealed letter, prior to Occupancy, stating the installation specified herein is complete and acceptable. The letter shall warrant that all contract documents are in hand and have been reviewed by the engineer, that all change orders are in hand and have been reviewed by the engineer and shall include an index list of said documents. The letter shall warrant that regular site reviews have been done by the engineer.

1.8 12" rule

.1 THE SO-CALLED 12" RULE SHALL NOT APPLY. Any items using this "rule" must meet the following conditions. a) have 12" (300mm) clearance on each side so that items can swing freely, b) have

a non-moment generating connection, c) have all hanger rods in a run less than 12" (300mm) long.

PART 2 PRODUCTS

2.1 Source of Materials

.1 All seismic snubbers and combination snubber / vibration isolation materials specified herein shall be provided by a single manufacturer to assure sole source responsibility for the proper performance of the materials used.

.2 Mechanical anchor types and sizes are to be per the design data as provided by the seismic restraint manufacturer.

.3 Acceptable product:

.1 Materials and systems specified herein and detailed or scheduled on the drawings are based upon materials manufactured by Kinetics Noise Control, Inc., or approved equivalent.

2.2 Seismic Snubber Types

.1 References:

.1 ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) Handbook, HVAC Applications most recent edition, Chapter 53 "Seismic and Wind Restraint Design".

.2 Type A): Coil Spring Isolator Incorporated Within A Ductile Iron Or Cast Aluminum Housing.

.1 Cast iron or aluminum housings are brittle when subjected to shock loading and are therefore not approved for seismic restraint applications.

.3 Type B): Coil Spring Isolator Incorporated Within A Steel Housing.

.1 Spring isolators shall be seismic control restrained spring isolators, incorporating a single or multiple coil spring element, having all of the characteristics of free standing coil spring isolators as specified in the

vibration isolation portion of this specification. Springs shall be restrained using a housing engineered to limit both lateral and vertical movement of the supported equipment during an earthquake without degrading the vibration isolation capabilities of the spring during normal equipment operating conditions.

.2 Vibration isolators shall incorporate a steel housing and neoprene snubbing grommet system designed to limit motion to no more than 1/4" (6 mm) in any direction and to prevent any direct metal-to-metal contact between the supported member and the fixed restraint housing. The restraining system shall be designed to withstand the seismic design forces in any lateral or vertical direction without yield or failure. Where the capacity of the anchorage hardware in concrete is inadequate for the required seismic loadings, an adapter base plate to allow the addition of more or larger anchors will be fitted to fulfill these requirements. In addition to the primary isolation coil spring, the load path will include a minimum 1/4" (6 mm) thick neoprene pad.

.3 Spring elements shall be color coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000 hour rating when tested in accordance with ASTM B-117.

.4 Isolator shall be designed in such a way that the coil spring element can be removed without the requirement to lift or otherwise disturb the supported equipment.

.5 Acceptable product

.1 Kinetics Noise Control model FHS, or approved equivalent.

.4 Type C): Coil Spring Isolator Incorporated Within A Steel Housing.

.1 Spring isolators shall be seismic control restrained spring isolators, incorporating one or more coil spring elements, having all of the characteristics of free standing coil spring isolators per the vibration isolation

section of this specification, for equipment which is subject to load variations and/or large external forces. Isolators shall consist of one or more laterally stable steel coil springs assembled into fabricated welded steel housings designed to limit movement of the supported equipment in all directions.

.2 Housing assembly shall be made of fabricated steel members and shall consist of a top load plate complete with adjusting and levelling bolts, adjustable vertical restraints, isolation washers, and a bottom load plate with internal non-skid isolation pads and holes for anchoring the housing to the supporting structure. Housing shall be hot dipped galvanized for outdoor corrosion resistance. Housing shall be designed to provide a constant free and operating height within 1/8" (3 mm).

.3 The isolator housing shall be designed to withstand the project design seismic forces in all directions.

.4 Coil spring elements shall be selected to provide static deflections as shown on the vibration isolation schedule or as indicated or required in the project documents. Spring elements shall be color coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000 hour rating when tested in accordance with ASTM B-117.

.5 Spring isolators shall be Model FLSS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.03 through 1.07 inclusive, and sections 2.01 and 2.02 C.

.5 Type D): Coil Spring Isolator Incorporated Within A Steel Housing.

.1 Spring isolators shall be lateral restrained spring isolators, incorporating a single coil spring element, having all of the characteristics of free standing coil spring isolators as previously specified. Springs shall be assembled into a welded steel housing engineered to limit lateral movement of supported equipment during an

earthquake without degrading the vibration isolation capabilities of the spring during normal operating conditions.

.2 Vibration isolators shall incorporate a steel angle and plate motion limiting assembly and steel coil spring, designed as a system to accept a force in any lateral direction in excess of the design seismic requirement for the isolator without yield or failure. Isolator shall limit lateral movement of the equipment to less than 1/4" (6 mm) in any direction. The lateral limit stop shall incorporate a neoprene grommet to prevent the potential for metal-to-metal contact. The vibration isolation element shall include a 1/4" (6 mm) thick ribbed neoprene noise stop pad, positioned outside of the housing anchorage path. The housing shall incorporate drilled holes for attachment to the supporting structure.

.3 Acceptable product.

.1 Kinetics Noise Control model FYS, or approved equivalent.

.6 Type E): All Direction Neoprene Isolator.

.1 Vibration Isolators shall be neoprene, moulded from oil resistant compounds, designed to operate within the strain limits of the isolator so to provide the maximum isolation and longest life expectancy possible using neoprene compounds. Isolators shall include encapsulated cast-in-place top steel load transfer plate for bolting to equipment and a steel base plate with anchor holes for bolting to the supporting structure. Ductile iron or cast aluminium components are not acceptable alternatives and shall not be used due to brittleness when subjected to shock loading.

.2 Isolator shall be capable of withstanding the design seismic loads in all directions with no metal-to-metal contact.

.3 Isolator shall have minimum operating static deflections as shown on the project Vibration Isolation Schedule or as otherwise indicated in the project documents and shall not exceed published load capacities.

.4 Acceptable product:

.1 Kinetics Noise Control model RQ, or approved equivalent.

.7 Type F): All Direction External Seismic Snubber Assembly.

.1 Equipment shall be restrained against excessive movement during a seismic event by the use of 3-axis resilient snubbers, designed to withstand the project required seismic forces.

.2 Snubbers shall be of welded steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of 1/4" (6 mm) in any direction.

.3 Snubbers shall include a minimum 1/4" (6 mm) thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Maximum neoprene bearing pressure shall not exceed 1500 psi (10.4 MPa). Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.

.4 Acceptable product:

.1 Kinetics Noise Control three-axis seismic snubbers, model HS-3 or approved equivalent.

.8 Type G): All Direction Lateral External Seismic Snubber Assembly.

.1 Equipment shall be restrained against excessive lateral movement during a seismic event by the use of 2-axis horizontal resilient snubbers, designed to withstand the project required seismic forces.

.2 Snubbers shall be of welded steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location to a maximum of 1/4" (6 mm).

.3 Snubbers shall include a minimum of 1/4" (6 mm) thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.

.4 Acceptable product:

.1 Kinetics Noise Control two-axis lateral seismic snubbers, model HS-2 or approved equivalent.

.9 Type H): Two-Axis External Seismic Snubber Assembly.

.1 Equipment shall be restrained against excessive vertical and horizontal movement during a seismic event by the use of 2-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of four (4) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all three directions.

.2 Snubbers shall be of welded steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of 1/4" (6 mm) in any direction.

.3 Snubbers shall include resilient neoprene pads with a minimum thickness of 1/4" (6 mm) to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.

.4 Acceptable product

.1 Kinetics Noise Control two-axis seismic snubbers, model HS-4 or approved equivalent.

.10 Type I): Single-Axis External Seismic Snubber Assembly.

.1 Equipment shall be restrained against excessive horizontal one-axis movement during a seismic event by the use of single-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of four (4)

snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all lateral directions.

.2 Snubbers shall be of welded steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location in the direction of impact to a maximum of 1/4" (6 mm).

.3 Snubbers shall include resilient neoprene pads with a minimum thickness of 1/4" (6 mm) to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to eliminate any contact during normal equipment operation.

.4 Acceptable product

.1 Kinetics Noise Control single-axis seismic snubbers, model HS-1 or approved equivalent.

.11 Type J): Cable Restraints For Suspended Piping and Ductwork.

.1 Seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist seismic loads, arranged so to offer seismic restraint capabilities for piping, ductwork, and suspended equipment in all lateral directions.

.2 End connection fittings shall be designed to swivel in order to ensure proper cable alignment and to avoid bending of rope. Protective thimbles shall be used at connection points so to eliminate bending cable across sharp edges.

.3 Anchoring hardware at each end of the cable shall be designed so to exceed the working project design load of the wire cable by a minimum of 50%.

.4 Acceptable product

.1 Kinetics Noise Control seismic cable restraints, model SCR or approved equivalent.

PART 3 EXECUTION

3.1 Installation

.1 Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions.

.2 Upon completion of installation of all seismic restraint materials and before start up of restrained equipment, all debris shall be cleaned from beneath all protected equipment, leaving equipment free to contact snubbers.

.3 No rigid connections between the equipment and the building structure shall be made which degrades the seismic restraint system herein specified. All electrical conduit to restrained equipment shall be looped to allow free motion of equipment without damage to the electrical wiring.

3.2 Inspection

.1 The contractor shall notify the local representative of the seismic restraint materials manufacturer prior to installing any seismic restraint devices. The contractor shall seek the representative's guidance in any installation procedures with which he is unfamiliar.

.2 The local representative of the seismic snubber materials manufacturer shall conduct periodic inspections of the installation of the materials herein specified, and shall report in writing to the contractor any deviations from good installation practice observed.

.3 Upon completion of the installation of all seismic restraint devices herein specified, the local representative of the seismic snubbers manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected snubber devices, or other fault in the system which could affect the performance of the system.

.4 The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps to be taken by the contractor to properly complete the seismic restraint work as per the specifications. The final

report shall be certified by the contractors'/manufacturer's Engineer.

3.3 Seismic Restraint for Piping and Ductwork

.1 Piping

.1 Seismically restrain all piping listed below. Use Type J Cable Restraints for all piping supported by vibration isolation hanger assemblies, including:

.1 Natural gas piping, medical gas piping, vacuum piping, petroleum based liquid piping, and compressed air piping equal to or greater than 1" (25 mm) in inside diameter.

.2 All piping located within mechanical equipment and service rooms equal to or greater than 1-1/4" (32 mm) in inside diameter.

.3 All other piping equal to or greater than 2-1/2" (64 mm) in inside diameter.

.2 Type J cable seismic restraint sizes, quantities, locations, and mounting details per SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition.

.2 Ductwork

.1 Seismically restrain all ductwork listed below. Use Type J Cable Restraints for all piping supported by vibration isolation hanger assemblies, including:

.1 All rectangular and oval ducts with cross sectional area equal to or greater than 6 ft^2 (0.55 m^2).

.2 All round ducts with diameters equal to or greater than 28" (710 mm).

.2 Type J cable seismic restraint sizes, quantities, locations, and mounting details per SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition.

.3 Fire Protection Piping

.1 Fire protection, sprinkler piping, and related equipment is considered as "Life Safety Equipment" and is to be seismically restrained per guidelines as published by NFPA (National Fire Protection Association).

.4 Piping, Ductwork, and Conduit Exclusions

.1 Per the UBC (Uniform Building Code), the following do not require additional seismic restraint over and above the normal suspension hardware:

.1 Piping

.1 Natural gas piping, medical gas piping, vacuum piping, petroleum based liquid piping, and compressed air piping less than 1" (25 mm) in inside diameter.

.2 All piping located within mechanical equipment and service rooms less than 1-1/4" (32 mm) in inside diameter.

.3 All other piping less than 2-1/2" (64 mm) in inside diameter.

.2 Ductwork

.1 All rectangular and oval ducts with cross sectional area less than 6 ft^2 (0.55 m^2).

.2 All round ducts with diameters less than 28" (710 mm).

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 9900-Interior Painting.

1.2 References

.1 Canadian General Standards Board (CGSB).

.2 Canadian Gas Association (CGA).

.3 National Fire Protection Association (NFPA):

.1 NFPA13.

.2 NFPA14.

1.3 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

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

1.4 Samples

.1 Submit samples in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

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

PART 2 PRODUCTS

2.1 Manufacturer's Equipment Nameplates

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

.2 Lettering and numbers to be raised or recessed.

.3 Information to include, as appropriate:

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

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

2.2 System Nameplates

.1 Colours:

.1 Hazardous: red letters, white background.

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

.2 Construction:

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

.3 Sizes:

.1 Conform to following table:

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

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

.4 Locations:

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

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

.5 Identification for PWC Preventive Maintenance Support System (PMSS):

.1 Use arrangement of Main identifier, Source identifier, Destination identifier.

.2 Equipment in Mechanical Room:

.1 Main identifier: Size #9.

.2 Source and Destination identifiers: Size #6.

.3 Terminal cabinets, control panels: Size #5.

.6 Equipment elsewhere: Sizes as appropriate.

2.3 Piping Systems Governed by Codes

.1 Identification:

.1 Natural gas: To CAN/CGA B149.1 authority having jurisdiction.

.2 Sprinklers: To NFPA13.

.2 Standpipe and hose systems: To NFPA14.

2.4 Identification of Piping Systems

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

.2 Pictograms:

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

.3 Legend:

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

.4 Arrows showing direction of flow:

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

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

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

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

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

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

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

.2 All other pipes: Pressure sensitive plastic-coated cloth vinyl with protective over-coating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150˚C and intermittent temperature of 200˚C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Engineer .

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

Background Colour:	Legend, arrows:
Yellow Green Red	Black White White

.3 Background colour marking and legends for piping systems:

Contents	Background Colour:	Legend
City water Hot water heating supply Hot water heating return Make-up water	Green Yellow Yellow Yellow	CITY WATER HEATING SUPPLY HEATING RETURN MAKE-UP WTR

Contents	Background Colour:	Legend
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HW re-circulation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Conduit for low voltage	To Section 15950	control wiring
Condensate	Yellow	CONDENSATE

2.5 Identification, Exposed Ductwork Systems

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

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

2.6 Valves, Controllers

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

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

2.7 Control Components Identification

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

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

2.8 Language

.1 Identification to be in English.

PART 3 EXECUTION

3.1 Timing

.1 Provide identification only after all painting specified painting has been completed.

3.2 Installation

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

3.3 Nameplates

.1 Locations:

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

.2 Standoffs:

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

.3 Protection:

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

3.4 Location of Identification on Piping and Ductwork Systems

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 56' (17m) intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

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

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

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

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

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

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

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

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

3.5 Valves, Controllers

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

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

.3 Number valves in each system consecutively.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 07900 - Joint Sealers.

.2 [LEED] General conditions and Division 1, General Requirements, shall govern the work of this Section. For LEED certification requirements confirm to section 01352 and other related LEED specifications.

1.2 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, current edition.

.2 American Society for Testing and Materials (ASTM)

.1 Current Standards.

.3 Canadian General Standards Board (CGSB)

.1 Current Standards.

.4 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters' Laboratories of Canada (ULC)

.1 Current Standards.

1.3 Definitions

.1 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.5 Samples

.1 Submit samples in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 1/2" (12mm) plywood board. Affix typewritten label beneath sample indicating service.

1.6 Manufacturer's Instructions

.1 Submit manufacturer's installation instructions in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.7 Qualifications

.1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.

1.8 Delivery, Storage and Handling

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather, construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions required by manufacturer.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 75°F (24°C) mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code A-1:

.1 Rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: To CAN/CGSB-51.9.

.2 Maximum "k" factor: To CAN/CGSB-51.9.

.4 TIAC Code A-2:

.1 Rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: To CAN/CGSB-51.2.

.2 Maximum "k" factor: To CAN/CGSB-51.2.

.3 Design to permit periodic removal and re-installation.

.5 TIAC Code A-3:

.1 Rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: To CAN/CGSB-51.9.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: To CAN/CGSB-51.9.

.6 TIAC Code A-6:

.1 Flexible unicellular tubular elastomer.

.1 Insulation: To CAN/CGSB-51.40 with vapour retarder jacket.

.2 Jacket: To CGSB 51-GP-52Ma.

.3 Maximum "k" factor: To CAN/CGSB 51.40.

.4 To be certified by manufacturer to be free of potential stress corrosion cracking corrodants.

.7 TIAC Code C-2:

.1 Mineral fibre blanket faced [with] [without] factory applied vapour retarder jacket (as scheduled in PART 3 of this section).

.1 Mineral fibre: To CAN/CGSB-51.11.

.2 Jacket: To CGSB 51-GP-52Ma.

.3 Maximum "k" factor: To CAN/CGSB -51.11.

.8 SPECIAL-1:

.1 Acoustic barrier wrap, operating temperature of - 40 to 220°F (4 to 104°C). Composite mat shall incorporate a 1" (25mm) quilted fiberglass decoupler and 1 lb/ft^2 (4.9 g/m^2) loaded vinyl with aluminum facing. Equals may be considered prior to tender close.

2.3 Insulation Securement

.1 Tape: Self-adhesive, aluminum, 2" (50mm) wide minimum.

.2 Contact adhesive: Quick setting.

.3 Canvas adhesive: Washable.

.4 Tie wire: 1/16" (1.5mm) diameter stainless steel.

.5 Bands: Stainless steel, 3/4" (19mm) wide, 0.02" (0.5mm) thick.

.6 SPECIAL-1: aluminum tape, bands or mechanical fasteners.

2.4 Cement

.1 Thermal insulating and finishing cement:

.1 To CAN/CGSB-51.12.

.2 Hydraulic setting or air drying on mineral wool, to ASTM C 449.

2.5 Vapour Retarder Lap Adhesive

.1 Water based, fire retardant type, compatible with insulation.

2.6 Indoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 Outdoor Vapour Retarder Finish

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 0.062 lb/ft^2 (220 g/m^2).

2.8 Jackets

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.

.2 Colours: To match adjacent finish paint.

.3 Minimum service temperatures: -4°F (-20°C).

.4 Maximum service temperature: 150°F (65°C).

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.02" (0.5mm).

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.8 Locations: Exposed indoors.

.2 ABS Plastic:

.1 One-piece moulded type and sheet with pre-formed shapes as required.

.2 Colours: to match adjacent finish paint by Engineer.

.3 Minimum service temperatures: -40°F (-40°C).

.4 Maximum service temperature: 180°F (82°C).

.5 Moisture vapour transmission: 0.012 perm.

.6 Thickness: 0.03" (0.75mm).

.7 Fastenings:

.1 Solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.8 Locations:

.1 Exposed piping in mechanical rooms, garbage rooms and all roofs and in all areas subjected to damage.

.3 Canvas:

.1 0.045 lb/ft^2 (220 g/m^2) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.3 Locations: Exposed indoors.

.4 Aluminum:

.1 To ASTM B 209.

.2 Thickness: 0.02" (0.5mm) sheet.

.3 Finish: Smooth.

.4 Joining: Longitudinal and circumferential slip joints with 2" (50mm) laps.

.5 Fittings: 0.02" (0.5mm) thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 3/4" (19mm) wide, 0.02" (0.5mm) thick at 12" (300mm) spacing.

.7 Locations: As indicated.

PART 3 EXECUTION

3.1 Pre-Installation Requirement

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.2 Installation

.1 Install in accordance with TIAC National Standards.

.2 Install on full length of piping unless indicated.

.3 Apply materials in accordance with manufacturers' instructions and this specification.

.4 Use two layers with staggered joints when required nominal wall thickness exceeds 3" (75mm).

.5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.6 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

.7 Allow for installation of SPECIAL-1 sound isolating covering as indicated.

.8 Where SPECIAL-1 type is used provide type A-1 thermal insulation on piping.

3.3 Removable, Pre-fabricated, Insulation and Enclosures

.1 Application: At expansion joints and as indicated.

.2 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: Same as system.

.2 Jacket: PVC.

3.4 Installation of Elastomeric Insulation

.1 Insulation to remain dry at all times. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 Piping Insulation Schedules

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securement: Tape at 12" (300mm) on centre (oc).

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-2.

.1 Insulation securement: SS wire or bands at 12" (300mm) oc

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.4 TIAC Code: A-3.

.1 Securement: Tape at 12" (300mm) oc.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code 1501-C.

.5 Code: A-6.

.1 Insulation securement: Per manufacturer's recommendations.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-CA

.6 TIAC Code: C-2.

.1 Insulation securement: Per manufacturer's recommendations.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-C.

.7 Thickness of insulation to be as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Hot Water Heating	60 - 94	[A-1]	25	38	38	38	38	38
Hot Water	up to	[A-1]	25	25	25	25	38	38

Heating	59							
Glycol Heating	60 - 94	[A-1]	25	38	38	38	38	38
Glycol Heating	up to 59	[A-1]	25	25	25	25	38	38
Domestic HWS		[A-1]	25	25	25	38	38	38
Domestic CWS		[A-3]	25	25	25	25	25	25
Domestic CWS with vapour retarder		[C-2]	25	25	25	25	25	25
Refrigerant [hot gas][liquid][suction]	4 - 13	[A-6]	25	25	25	25	25	25
Refrigerant [hot gas][liquid][suction]	below 4	[A-6]	25	25	38	38	38	38
RWL and RWP		[C-2]	25	25	25	25	25	25
Cooling Coil cond. drain		[C-2]	25	25	25	25	25	25

.8 Finishes:

.1 Exposed indoors visible to public: PVC.

.2 Exposed in mechanical rooms: PVC.

.3 Concealed, indoors: Canvas on valves, fittings.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Outdoors: Water-proof ABS jacket.

.6 Finish attachments: SS bands, at 6" (150mm) oc.

.7 Installation: To appropriate TIAC code CRF/1 through CPF/5.

.9 Fire protection and other piping in the unheated garages and spaces to be heat traced as indicated by Division 16 in addition to insulation provided by this Division.

.10 All hydronic piping installed outside shall be insulated with 3-1/2″ (89 mm) thick insulation and waterproof ABS jacket. All heat tracing by Div.16.

.11 Insulate all:

.1 Air eliminators.

.2 Expansion tanks.

.3 Heat exchangers.

.4 Pumps.

.5 Valves.

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END.

PART 1 GENERAL

1.1 References

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, current edition.

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

.1 Current Standards.

.3 Canadian General Standards Board (CGSB)

.1 Current Standards.

.4 Manufacturer's Trade Associations.

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters Laboratories of Canada (ULC)

.1 M88, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 Definitions

.1 TIAC Codes:

.1 CRD: Code Round Ductwork,

.2 CRF: Code Rectangular Finish.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.4 Samples

.1 Submit samples in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 1/2" (12mm) plywood board. Affix typewritten label beneath sample indicating service.

1.5 Manufacturer's Instructions

.1 Submit manufacturer's installation instructions in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.6 Qualifications

.1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.

PART 2 PRODUCTS

2.1 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 Insulation

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 75°F (24°C) mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1:
Rigid mineral fibre board to CAN/CGSB 51.10, with factory

applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2:
Mineral fibre blanket to CAN/CGSB-51.11 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to CAN/CGSB-51.11.

.2 Jacket: To CGSB 51-GP-52Ma.

.3 Maximum "k" factor: To CAN/CGSB-51.11.

.5 5. Minimum thermal resistance

.1 Ducts: R-value 5 [$ft^2 \cdot h^oF/Btu$] (RSI 0.88 [$m^2 \cdot {}^oC/W$])

.2 Run-outs: R-value 3.3 [$ft^2 \cdot h^oF/Btu$] (RSI 0.58 [$m^2 \cdot {}^oC/W$])

2.3 Jackets

.1 Canvas:

.1 0.045 lb/ft^2 (220 g/m^2) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.3 Aluminum---.

2.4 Accessories

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: Hydraulic setting on mineral wool, to ASTM C 449.

.4 ULC Listed Canvas Jacket:

.1 0.045 lb/ft² (220 g/m²) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921 untreated.

.5 Tape: self-adhesive, aluminum, 2" (50mm) wide minimum.

.6 Contact adhesive: Quick-setting.

.7 Canvas adhesive: Washable.

.8 Tie wire: 1/16" (1.5mm) stainless steel.

.9 Banding: 1/2" (12mm wide), 0.020" (0.5mm) thick stainless steel.

.10 Facing: 1" (25mm) stainless galvanized steel hexagonal wire mesh stitched on one face both faces of insulation one face of insulation with expanded metal lath on other face.

.11 Fasteners: 0.079" (2mm) diameter pins with 1 3/8" (35mm) diameter square clips, length to suit thickness of insulation.

PART 3 EXECUTION

3.1 Pre-installation Requirements

.1 Pressure testing of ductwork systems to be complete, witnessed and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.2 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal thickness exceeds 3" (75mm).

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 15061 - Bases, Hangers and Supports:

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 12" (300mm) off centre in horizontal and vertical directions, minimum two rows each side.

.7 Thermal insulation on exhaust ducts shall be provided on last 10' (3m) of the duct.

.8 All fresh air/outside air ducts will be fully insulated.

3.3 Ductwork Insulation Schedule

.1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness
Rectangular cold/outside air supply ducts	C-1	yes	2" (50mm)
Round cold/outside air supply ducts	C-2	yes	2" (50mm)
Rectangular A/C-heating ducts	C-2	yes	1" (25mm)
Round A/C-heating ducts	C-2	yes	1" (25mm)
Supply, return and exhaust ducts Exposed in space being served	None		
Outside air ducts vent intakes and combustion air ducts	C-1	yes	2" (50mm)
Exhaust ducts last 1.8 M from outside wall	C-1	yes	1" (25mm)
Rectangular ducts outside	C-1	special	2" (50mm)
Round ducts outside	C-1	special	2" (50mm)
Acoustically lined ducts	None		

.2 Exposed round ducts 24" (600mm) and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: Conform to following table:

TIAC Code	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

.3 Thermal insulation is not required on residential suite ductwork unless indicated.

3.4 ULC - Zero Clearance Duct Insulation

.1 Supply and install ULC listed zero clearance - 3 hour - insulation (Pyroscat, Firemaster) on the following duct systems:

.1 Kitchen exhaust ducts.

.2 All ducts penetrating rated fire exits (exit stairs, corridors etc.)

.2 Use two layers of 1-1/2" (37.5mm) thick insulation and install as per manufacturer’s instructions.

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END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

1.2 References

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

.2 Canadian General Standards Board (CGSB).

.3 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).

.4 Underwriter's Laboratories of Canada (ULC).

1.3 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

PART 2 PRODUCTS

2.1 Duct Liner

.1 General:

.1 Fibrous glass duct liner: air stream side faced with mat facing.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.

.2 Rigid:

.1 Use on flat surfaces.

.2 1" (25mm) thick or as indicated, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.

.3 Density: 2.25 lb/ft^3 (36 kg/m^3) minimum.

.4 Thermal resistance to be minimum R-Value 4.38 [ft^2·^{o}F/Btu] (RSI 0.76 [m^2·^{o}C/W]) for 1" (25mm) thickness, R-Value 6.62 [ft^2·^{o}F/Btu] (RSI 1.51 [m^2·^{o}C/W]) for 2" (50mm) thickness

when tested in accordance with ASTM C 177, at 75°F (24°C) mean temperature.

.3 Flexible:

.1 Use on round or oval surfaces.

.2 1" (25mm) thick, to CGSB-51-GP-11M, fibrous glass blanket duct liner.

.3 Density: 1.50 lb/ft^3 (24 kg/m^3) minimum.

.4 Thermal resistance to be minimum R-Value 4.26 [ft^2·°F/Btu] (RSI 0.74 [m^2·°C/W]) for 1" (25mm) thickness when tested in accordance with ASTM C 177, at 75°F (24°C) mean temperature.

2.2 Adhesive

.1 Meet requirements of NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -20°F (-29°C) to 200°F (93°C).

2.3 Fasteners

.1 Weld pins 0.079" (2.0mm) diameter, length to suit thickness of insulation. Metal retaining clips, 1 1/4" (32mm) square.

2.4 Joint Tape

.1 Poly-Vinyl treated open weave fibreglass membrane 2" (50mm) wide.

2.5 Sealer

.1 Meet requirements of NFPA 90A and NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -90°F (-68°C) to 200°F (93°C).

PART 3 EXECUTION

3.1 General

.1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.

.2 Line inside of ducts where indicated.

.3 Duct dimensions, as indicated, are clear inside duct lining.

.4 Acoustically insulate all supply and return air plenums of fan coil units, heat pumps, furnaces and all air handling units.

.5 Acoustically insulate all supply air ducts for first 10' (3m) from supply air plenums.

.6 Acoustically insulate first 10' (3m) of supply and return air ducts of roof top A/C units, make-up air units and all air handlers.

3.2 Duct Liner

.1 Install in accordance with manufacturer's recommendations, and as follows:

.2 Fasten to interior sheet metal surface with 100% coverage of adhesive.

.3 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 17" (425mm) on centres.

3.3 Joints

.1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:

.1 Bed tape in sealer.

.2 Apply two coats of sealer over tape.

.2 Replace damaged areas of liner at discretion of Engineer.

.3 Protect leading edges of duct sections, where indicated, with sheet metal nosing having 5/8" (15mm) overlap and fastened to duct.

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END.

PART 1 GENERAL

1.1 Related Sections

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

PART 2 PRODUCTS

2.1 Cleaning Solutions

.1 Tri-sodium phosphate: 6.95 lb / 1000 US gal (4.0 kg/m^3) water in system.

.2 Sodium carbonate: 6.95 lb / 1000 US gal (4.0 kg/m^3) water in system.

.3 Low-foaming detergent: 0.178 lb / 1000 US gal (0.1 kg/m^3) water in system.

PART 3 EXECUTION

3.1 Cleaning Hydronic Systems

.1 Timing:

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

.2 Cleaning Agency:

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

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

.4 Cleaning procedures:

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

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations to be used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

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

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

.5 Conditions at Time of Cleaning of Systems:

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

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

.3 Strainers to be clean prior to initial fill.

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

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning:

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

.7 Hydronic Systems:

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

.2 Fill expansion tanks one third to one half full, charge system with compressed air to at least 5psi (35 kPa) (does not apply to diaphragm type expansion tanks).

.3 Use water meter to record volume of water in system to ±0.5%.

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

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

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

.7 Add chemical solution to system.

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

.8 Glycol Systems:

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

.2 Test to prove concentration will prevent freezing to minus 104°F (40°C). Test inhibitor strength and include in procedural report. Refer to ASTM E 202.

3.2 Start-up of Hydronic Systems

.1 After cleaning is completed and system is filled:

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

.2 Ensure all air is removed.

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

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

.5 Clean out strainers repeatedly until system is clean.

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

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

.8 Repeat with water at design temperature.

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

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

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

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

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

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

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

.16 Check operation of drain valves.

.17 Adjust valve stem packing as systems settle down.

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

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

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

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END.

PART 1 GENERAL

1.1 Related Sections

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

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Connections to Equipment

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement are not otherwise isolated.

3.2 Clearances

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 Drains

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

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

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

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

3.4 Automatic Air Vents

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

.2 Install isolating valve at each automatic air valve.

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

3.5 Dielectric Couplings

.1 General: Compatible with system, to suit pressure rating of system.

.2 Locations: Where dissimilar metals are joined.

.3 NPS 2 and under: Isolating unions or bronze valves.

.4 Over NPS 2: Isolating flanges.

3.6 Pipework Installation

.1 Screwed fittings to be jointed with Teflon tape, except diesel fuel fittings.

.2 Protect openings against entry of foreign material.

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

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of the main. Hole saw (or

drill) and ream main so as to maintain full inside diameter of branch line prior to welding saddle.

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

.7 Install concealed pipework so as to minimize furring space, maximize headroom, conserve space.

.8 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.

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

.10 Group piping wherever possible and as indicated.

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

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

.13 Provide for thermal expansion as indicated and specified.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above the horizontal position unless otherwise indicated.

.4 Valves to be accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.6 Use gate ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.

.7 Install butterfly valves between weld neck flanges to ensure full compression of liner.

.8 Install ball valves for glycol service.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.

3.7 Sleeves

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors - to have annular fins continuously welded on at mid-point.

.4 Sizes: 1/4" (6mm) minimum clearance all round between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

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

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

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.8 Escutcheons

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 Flushing out of Piping Systems

.1 In accordance with Section 15095 - Cleaning and Start-up of Mechanical Piping Systems.

3.10 Pressure Testing of Equipment and Pipework

.1 Advise Engineer a minimum of 48 hours prior to performance of pressure tests.

.2 Pipework: Test as specified in relevant sections of Division 15.

.3 Maintain specified test pressure without loss for four 4 hour minimum unless specified for longer period of time in relevant sections of Division 15.

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

.5 Conduct tests in presence of Engineer.

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

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

END.

PART 1 GENERAL

1.1 References

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

.1 ANSI/ASME B1.20.1-1983(R1992), Pipe Threads, General Purpose (Inch).

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

1.2 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups..

.2 Submit data for all valves specified in this section.

1.3 Closeout Submittals

.1 Submit maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 General

.1 Except for specialty valves, to be single manufacturer.

.2 All products to have CRN registration numbers.

2.2 End Connections

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: Screwed ends.

.2 Copper tube systems: Solder ends.

2.3 Lockshield Keys

.1 Where lock shield valves are specified, provide three (3) keys of each size: Malleable iron cadmium plated.

2.4 Gate Valves

.1 Requirements common to all gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: With hex. shoulders.

.3 Connections: With hex. shoulders.

.4 Inspection and pressure testing: To MSS SP-80. Tests to be hydrostatic.

.5 Packing: high grade non-asbestos packing.

.6 Handwheel: N on-ferrous. Nut: Bronze to ASTM B 62.

.2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125:

.1 Body: With long disc guides, screwed bonnet with stem retaining nut.

.2 WP = 203psi (1.4 MPa) WOG.

.3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:

.1 Body: With long disc guides, screwed bonnet with stem retaining nut.

.2 WP = 300psi (2.07 MPa) WOG.

.4 NPS 2 and under, rising stem, split wedge disc, Class 125:

.1 Body: With long disc guides, screwed bonnet.

.2 WP = 203psi (1.4 MPa) WOG.

.3 Disc: Split wedge, bronze to ASTM B 283, loosely secured to stem.

.5 NPS 2 and under, rising stem, solid wedge disc, Class 125:

.1 Body: With long disc guides, screwed bonnet.

.2 WP = 203psi (1.4 MPa) WOG.

.6 NPS 2 and under, rising stem, solid wedge disc, Class 150:

.1 Body: With long disc guides, screwed union bonnet.

.2 WP = 300psi (2.07 MPa) MPa WOG.

2.5 Globe Valves

.1 Requirements common to all globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: with hex. shoulders.

.3 Connections: with hex. shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.

.6 Handwheel: non-ferrous. Nut: bronze to ASTM B 62.

.2 NPS 2 and under, composition disc, Class 125:

.1 Body and bonnet: screwed bonnet.

.2 WP = 203psi (1.4 MPa) WOG.

.3 Disc and seat: renewable rotating disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.

.3 NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 WP = 300psi (2.07 MPa) MPa WOG.

.3 Disc and seat: renewable rotating disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.

.4 NPS 2 and under, plug disc, Class 150, screwed ends:

.1 Body and bonnet: union bonnet.

.2 WP = 150psi (1.03 MPa) steam, 300psi (2.07 MPa) WOG.

.3 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A 276, loosely secured to stem.

.5 Angle valve, NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 WP = 150psi (1.03 MPa) steam, 300psi (2.07 MPa) WOG.

.3 Disc and seat: renewable rotating disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.

2.6 Check Valves

.1 Requirements common to all check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: with hex. shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45˚, screw-in cap with hex head.

.2 WP = 203psi (1.4 MPa) WOG.

.3 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.3 NPS 2 and under, swing type, bronze disc:

.1 Body: Y-pattern with integral seat at 45˚, screw-in cap with hex head.

.2 Class 150, WP = 300psi (2.07 MPa) WOG.

.3 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.4 NPS 2 and under, swing type, composition disc, Class 200:

.1 Body: Y-pattern with integral seat at 45˚, screw-in cap with hex head. WP = 203psi (1.4 MPa) cold water.

.2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.

.5 NPS 2 and under, horizontal lift type, composition disc, Class 150:

.1 Body: with integral seat, union bonnet ring with hex shoulders, cap. WP = 392psi (2.7 MPa) WOG.

.2 Disc: renewable #6 composition rotating disc in disc holder having guides top and bottom, of bronze to ASTM B 62.

.6 NPS 2 and under, vertical lift type, bronze disc, Class 125:

.1 Body: with integral seat. WP = 203psi (1.4 MPa) WOG.

.2 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

2.7 Silent Check Valves

.1 NPS 2 and under:

.1 Body: cast high tensile bronze to ASTM B 62 with integral seat.

.2 Pressure rating: Class 125, WP = 203psi (1.4 MPa) WOG Class 150, WP = 300psi (2.07 MPa) WOG.

.3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.

.4 Disc and seat: renewable rotating disc.

.5 Stainless steel spring, heavy duty.

.6 Seat: regrindable.

2.8 Ball Valves

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B 62.

.2 Pressure rating: Class 125, WP = 203psi (1.4 MPa) WOG.

.3 Connections: Screwed ends to ANSI B1.20.1 and with hex. shoulders or solder ends to ANSI.

.4 Stem: tamper proof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable stainless steel or hard chrome solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

PART 3 EXECUTION

3.1 Installation

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Remove internal parts before soldering.

.3 Use gate valves:

.1 For isolation of chillers, cooling towers, boilers, pumps, heat exchangers.

.2 Use on piping 4" (100mm) dia. to 6" (150mm) dia.

.4 Use globe valves:

.1 For isolation of equipment, chillers, broilers, pumps, heat exchangers.

.2 Use on piping 1-1/2” (38mm) to 3" (75mm) dia.

.5 Use ball valves on all piping from 1/2" (13mm) to 1 1/4" (32mm) for equipment isolation.

.6 Provide check valves for domestic water supply to each suite, see drawings.

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END.

PART 1 GENERAL

1.1 References

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

.1 ANSI/ASME B16.1-1998, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

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

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.4 Underwriters Laboratories of Canada (ULC).

1.2 Product Data

.1 Submit product data in accordance with Section 15012 - Submittal Procedures.

.2 Submit data for valves specified in this section.

1.3 Closeout Submittals

.1 Submit maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 General

.1 Except for specialty valves, to be of single manufacturer.

.2 Standard specifications:

.1 Gate valves: MSS SP-70.

.2 Globe valves: MSS SP-85.

.3 Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: cast iron to ASTM B 209 Class B.

.2 Connections: Flanged ends plain face with 2mm raised face with serrated finish to ANSI B16.1.

.3 Inspection and pressure testing: To MSS SP-82.

.4 Bonnet gasket: Non-asbestos.

.5 Stem: To have precision-machined Acme or 60˚V threads, top screwed for handwheel nut.

.6 Stuffing box: Non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.7 Gland packing: Non-asbestos.

.8 Handwheel: Die-cast aluminum alloy to ASTM B 85 or malleable iron to ASTM A 49. Nut of bronze to ASTM B 62.

.9 Identification tag: With catalogue number, size, other pertinent data.

.4 All products to have CRN registration numbers.

2.2 Gate Valves

.1 NPS 2 ½ - 8, non rising stem, inside screw, bronze iron trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: With bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly. Class 125, WP = 125psi (860 kPa) steam, 203psi (1.4 MPa) CWP.

.2 Disc: Solid offset taper wedge, bronze to ASTM B 62 up to and including NPS 3, bronze rings rolled into cast iron disc on other sizes, secured to bronze stem to ASTM B 62.

.3 Seat rings: Renewable bronze to ASTM B 62, screwed into body.

.4 Stem: Bronze to ASTM B 62.

.2 NPS 10 - 24, non rising stem, inside crew, bronze iron trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: cast iron to ASTM A 126 Class B for sizes up to NPS 14, Class C for sizes NPS 16 and over, with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, body tie ribs between bonnet and end flanges.

.2 Pressure ratings: Class 125.

.1 NPS 10-12: WP = 203psi (1.4 MPa) CWP.

.2 NPS 14-24: WP = 150psi (1.03 MPa) CWP.

.3 Disc: Solid offset taper wedge, with bronze rings to ASTM B 62 rolled into cast iron disc, secured to stem.

.4 Seat rings: Renewable bronze to ASTM B 62 screwed into body.

.5 Stem: Bronze to ASTM B 62.

.6 Disc: Solid offset taper wedge, cast iron secured to stem.

.7 Seat: integral with body up to NPS 14, renewable nodular iron on other sizes.

.8 Stem: Wrought steel.

.9 Operator: Handwheel Manual gear: Hydraulic: Motor:.

.10 Bypass: complete with union and NPS gate globe valve as Section 15101, paragraph.

.3 NPS 2 ½-8, outside screw and yoke (OS&Y), bronze iron trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: With bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125, WP = 125psi (860 kPa) steam, 203psi (1.4 MPa) CWP.

.2 Disc: Solid offset taper wedge, bronze to ASTM B 62 up to NPS 3, cast iron with bronze disc rings on other sizes,

secured to stem through integral forged T-head disc-stem connection.

.3 Seat rings: Renewable bronze screwed into body.

.4 Stem: Nickel-plated steel manganese-bronze.

2.3 Underwriters Approved Gate Valve

.1 NPS 2 ½ - 14, OS&Y:

.1 Approvals: UL and FM approved for fire service.

.2 UL and FM Label: On valve yoke.

.3 Body, Bonnet: cast iron to ASTM A 126 Class B. Wall thicknesses to ANSI B16.1 and ULC 262 (B).

.4 Bonnet bushing, yoke sleeve: Bronze, to FM requirements.

.5 Packing gland: Bronze.

.6 Stem: Manganese bronze. Diameter to ULC C-262 (B).

.7 Stuffing box dimensions, gland bolt diameter: To ULC C-262 (B).

.8 Bosses for bypass valve, drain: On NPS 4 and over.

.9 Disc: Solid taper wedge. Up to NPS 3: Bronze. NPS 4 and over: cast iron with bronze disc rings.

.10 Disc seat ring: Self-aligning, Milwood undercut on NPS 3 - 12.

.11 Pressure rating:

.1 NPS 2-1/2 - 12: 247psi (1.7 Mpa) CWP.

.2 NPS 14-1.2: 174psi (1.2 MPa) CWP.

.12 Operator: Handwheel.

.13 Bypass: complete with union and NPS gate globe valve as Section 15111, paragraph.

2.4 Globe Valves

.1 NPS 2 ½ - 10, OSY:

.1 Body: With multiple-bolted bonnet.

.2 WP: 125psi (860 kPa) steam, 203psi (1.4 MPa) CWP.

.3 Bonnet-yoke gasket: Non-asbestos.

.4 Disc: Bronze to ASTM B 62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.5 Seat ring: Renewable, regrindable, screwed into body.

.6 Stem: Bronze to ASTM B 62.

.7 Operator: Handwheel Manual gear.

.8 Bypass: complete with union and NPS gate globe valve as Section 15111, paragraph.

2.5 Bypasses for Gate and Globe Valves

.1 Locations: On valves as indicated.

.2 Position of bypass valve on main valves.

.3 Size of bypass valve:

.1 Main valve up to NPS 8: NPS 3/4.

.2 Main valve NPS 10 and over: NPS 1.

.4 Type of bypass valves:

.1 On gate valve: Globe, with composition bronze disc, bronze trim, to Section 15111 - Valves - Bronze. Pressure rating to match main valve.

.2 On globe valve: Globe, with composition bronze disc, bronze trim, to Section 15111 - Valves - Bronze. Pressure rating to match main valve.

2.6 Valve Operators

.1 Install valve operators as follows:

.1 Handwheel: On valves except as specified.

.2 Handwheel with chain operators: On valves installed more than 8' (2400mm) above floor in boiler rooms and mechanical equipment rooms.

2.7 Check Valves

.1 Swing check valves, Class 125:

.1 Body and bolted cover: With tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.

.1 Up to NPS 16: Cast iron to ASTM A 126 Class B.

.2 NPS 18 and over: Cast iron to ASTM A 126 Class C.

.2 Ratings:

.1 NPS 2 ½ - 12: 125psi (860 kPa) steam, 203psi (1.4 MPa) CWP.

.2 NPS 14 - 16: 125psi (860 kPa) steam, 150psi (1.03 MPa) CWP.

.3 NPS 18 and over: 150psi (1.03 MPa) CWP.

.3 Disc: Rotating for extended life.

.1 Up to NPS 6: Bronze to ASTM B 62.

.2 NPS 8 and over: Bronze-faced cast iron.

.4 Seat rings: Renewable bronze to ASTM B 62 screwed into body.

.5 Hinge pin, bushings: Renewable bronze to ASTM B 62.

.6 Disc: A126 Class B, secured to stem, rotating for extended life.

.7 Seat: Cast iron, integral with body.

.8 Hinge pin: Exelloy; bushings: Malleable iron.

.9 Identification tag: Fastened to cover.

.10 Hinge: Galvanized malleable iron.

.2 Swing check valves, NPS 2 ½ - 8 Class 250:

.1 Body and bolted cover: Cast iron to ASTM A 126 Class B with tapped and plugged opening on each side for hinge pin.

.2 Flanged ends: 5/64" (2mm) raised face with serrated finish.

.3 Rating: 250 psi (1.7 MPa) steam; 500 psi (3.4 MPa) CWP.

.4 Disc: Rotating for extended life.

.1 Up to NPS 3: Bronze to ASTM B 61.

.2 NPS 4 - 8: Iron faced with ASTM B 61 bronze.

.5 Seat rings: Renewable bronze to ASTM B 61, screwed into body.

.6 Hinge pin, bushings: Renewable, bronze to ASTM B 61.

.7 Hinge: Galvanized malleable iron.

.8 Identification tag: Fastened to cover.

2.8 Silent Check Valves

.1 Construction:

.1 Body: Malleable or ductile iron with integral seat.

.2 Pressure rating: Class 125, WP = 125psi (860 kPa).

.3 Connections: Grooved ends.

.4 Disc: Bronze or stainless steel renewable rotating disc.

.5 Seat: Renewable, EPDM.

.6 Stainless steel spring, heavy duty.

PART 3 EXECUTION

3.1 Installation

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Use gate valves:

.1 For isolation of chillers, cooling towers, boilers, pumps, heat exchangers.

.2 Use on piping 4" (100mm) dia. to 8" (200mm) dia.

.3 Use globe valves:

.1 For insulation of equipment, chillers, boilers, pumps, heat exchangers.

.2 Use on piping 1-1/2" (38mm) to 3" (75mm) dia.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 15014 - Closeout Submittals.

1.2 References

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

.2 American Petroleum Institute (API).

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

.4 Manufacturer's Standardization Society: for the Valves and Fittings Industry Inc. (MSS).

1.3 Product Data

.1 Submit product data in accordance with Section 15012 - Submittal Procedures.

.2 Submit data for valves specified this section.

1.4 Closeout Submittals

.1 Submit maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Butterfly Valves - Resilient Seat - 200 psig (1.38MPag)

.1 Except to specialty valves, to be of single manufacturer.

.2 To be suitable for dead-end service.

.3 CRN registration number required for products.

.4 Sizes: NPS 2 to 30.

.5 Pressure rating for tight shut-off at temperatures up to maximum for seat material.

.1 NPS 2 - 12: 200 psig (1.38MPag).

.6 Minimum seat temperature ratings to 275°F (135°C).

.7 Application: On-off operation.

.8 Full lug body (threaded).

.9 Operators:

.1 NPS 2 - 6: Handles capable of locking in any of ten (10) positions - 0° to 90°. Handle and release trigger - ductile iron. Return spring and hinge pin: Carbon steel. Latch plate and mounting hardware: Cadmium plated carbon steel. Standard coating: Black lacquer.

.10 Designed to comply with MSS SP-67 and API 609.

.11 Compatible with ANSI Class 125/Class 150 flanges.

2.2 Mounting Flanges:

.1 Class 125 cast iron to ANSI B16.1 or Class 150 steel to B16.5 pipe flanges.

2.3 Electric Actuators:

.1 Operation: Designed to provide precise quarter turn electric operation.

.1 Torque range: Up to 0.833 lb-ft (1.130 N-m) and speed ranges from 10 seconds to 30 seconds to move from fully open to fully closed.

.2 Gear train within actuator to provide smooth continuous rotary power stroke for accurate automatic valve positioning. Factory-set, field adjustable cam-actuated travel limit switches to provide precise control of shaft rotation.

.2 Construction:

.1 Castings: Heavy duty industrial grade for rugged use.

.2 Actuators: Continuous duty with high efficiency single phase reversing capacitor motor with thermal overload protection.

.3 Gears and pinions constructed from hardened steel.

.4 Gear train to be permanently lubricated.

.5 Mechanical brake to ensure that gear is locked in precise position.

.3 Electrical:

.1 Standard voltage: 120 VAC. 60 Hz.

.2 Control options: 4-20 ma DC 0-10 V DC.

.3 CSA approved.

.4 Electrical rating: NEMA IV.

PART 3 EXECUTION

3.1 Preparation

.1 Valve and mating flange preparation.

.1 Inspect adjacent pipeline, remove rust, scale, welding slag, other foreign material.

.2 Ensure that valve seats and pipe flange faces are free of dirt or surface irregularities which may disrupt flange seating and cause external leakage.

.3 Install butterfly valves with disc in almost closed position.

.4 Inspect valve disc seating surfaces and waterway and eliminate dirt or foreign material.

3.2 Installation of Valves

.1 Install in accordance with manufacturer's instructions.

.2 Do not use gaskets between pipe flanges and valves unless instructed otherwise by valve manufacturer.

.3 Verify suitability of valve for application by inspection of identification tag.

.4 Mount actuator on to valve prior to installation.

.5 Handle valve with care so as to prevent damage to disc and seat faces.

.6 Valves in horizontal pipe lines should be installed with stem in horizontal position to minimize liner and seal wear.

.7 Ensure that valves are centred between bolts before bolts are tightened and then opened and closed to ensure unobstructed disc movement. If interference occurs due, for example to pipe wall thickness, taper bore adjacent piping to remove interference.

.8 Use on piping over 6" (150mm) dia.

3.3 Actuator Installation

.1 Air hoses or electrical connections to be made by actuator manufacturer.

.2 Cycle valve operation from fully closed to fully open then back to fully closed.

.3 At same time, check travel stop settings for proper disc alignment.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 15075 - Mechanical Identification.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit manufacturer's product data for following items:

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Wells.

PART 2 PRODUCTS

2.1 General

.1 Design point to be at mid point of scale or range.

2.2 Direct Reading Thermometers

.1 Industrial, variable angle type, liquid filled, 5" (125mm) scale length: To CAN/CGSB 14.4.

.1 Acceptable material: Trerice.

2.3 Thermometer Wells

.1 Copper pipe: Copper or bronze.

.2 Steel pipe: Brass.

2.4 Pressure Gauges

.1 4-1/2" (112mm), dial type: To ASME B40.1, Grade 2A, phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Snubber for pulsating operation.

.2 Gasketted pressure relief back with solid front.

.3 Bronze stop cock.

.4 Oil filled for high vibration applications.

PART 3 EXECUTION

3.1 General

.1 Install so they can be easily read from floor or platform.

.2 Install between equipment and first fitting or valve.

3.2 Thermometers

.1 Install in wells on piping. Provide heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Heat exchangers.

.2 Water heating and cooling coils.

.3 Water boilers.

.4 DHW tanks.

.5 Glycol systems.

.6 As indicated.

.3 Install wells as indicated and as required for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 Pressure Gauges

.1 Install in following locations:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of PRVs.

.3 Inlet and outlet of heat exchangers.

.4 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 15014 - Closeout Submittals.

1.2 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate for items as applicable:

.1 Manufacturer, model number, line contents, pressure and temperature rating.

.2 Movement handled; axial, lateral, angular and the amounts of each.

.3 Nominal size and dimensions including details of construction and assembly.

1.3 Closeout Submittals

.1 Submit maintenance data in accordance with Section 15014 - Closeout Submittals.

.2 Data to include:

.1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

PART 2 PRODUCTS

2.1 Bellows Type Expansion Joints

.1 For axial, lateral or angular movements, as indicated.

.2 Maximum operating pressure: 200 psi (1.38 MPa) min.

.3 Maximum operating temperature: 250°F (121°C).

.4 Type A, to NPS 2:

.1 Controlled flexing, factory tested to 1.5 times maximum working pressure. Furnish test certificates. Acceptable material: Flexonics Series H.

.5 Type B, above NPS 2:

.1 Externally pressurized, designed to eliminate pressure thrust, factory tested to 1.5 times maximum working pressure. Furnish test certificates. Acceptable material: Flexonics.

.6 Bellows:

.1 Multiple bellows, hydraulically formed, pressure and temperature, water treatment and pipeline cleaning procedures.

.7 Reinforcing or control rings:

.1 Two (2) piece nickel iron.

.8 Ends:

.1 To match pipe.

.9 Liner:

.1 Austenitic stainless steel in direction of flow.

.10 Shroud:

.1 Carbon steel, painted.

2.2 Spherical Joint Connection

.1 Type C, flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar tire cord frictioning.

.2 Any substitutions must have equal or superior physical and chemical characteristics.

.3 Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout.

.4 Sizes NPS 2 and larger shall have:

.1 Two spheres reinforced with a ductile iron external ring between spheres.

.5 Sizes NPS 3/4 to NPS 1 shall have:

.1 Threaded two piece bolted flange assemblies, one sphere and cable retention.

.6 Flanges shall be split ductile iron or steel with hooked or similar interlocks.

.7 Connectors shall be rated at 250 psi (1.72MPa) up to 170°F (77°C) with a uniform drop in allowable pressure to 215 psi (1.48MPa) at 250°F (121°C) in sizes through 14" (350mm).

.8 Higher rated connectors may be used to accommodate service conditions.

.9 All expansion joints must be factory tested to 150% of rated pressure for 12 minutes before shipment.

.10 Safety factors to burst and flange pullout shall be a minimum of three to one (3:1).

.11 Concentric reducers to the above ratings may be substituted for equal ended expansion joints.

2.3 Flexible Metal Hose Connection

.1 Application: To suit motion.

.2 Maximum diameter: 3/4 NPS.

.3 Minimum length in accordance with manufacturer's recommendations to suit offset.

.4 Inner hose: Stainless steel corrugated.

.5 Braided wire mesh stainless steel outer jacket.

.6 Diameter and type of end connection: As indicated.

.7 Operating conditions:

.1 Working pressure: 1100 psi (7.58 MPa).

.2 Working temperature: 850°F (454°C).

.3 To match non-acoustically sensitive system requirements.

2.4 Anchors and Guides

.1 Anchors:

.1 Provide as indicated and everywhere between expansion joints.

.2 Alignment guides:

.1 Provide Mason type VSG (Vertical Sliding Guide) as indicated and as recommended by conduit manufacturer.

.2 To accommodate specified thickness of insulation.

.3 Vapour barriers, jackets to remain uninterrupted.

.4 Flexonics type PGT shall be used in non-acoustically sensitive areas.

PART 3 EXECUTION

3.1 Installation

.1 Install expansion joints with cold setting on all heating domestic hot water/re-circulation systems.

.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.3 Install pipe anchors and guides as indicated and between expansion joints. Anchors to withstand 150% of axial thrust.

.4 Install expansion joints for every 33' (10 m) of horizontal run of straight pipe on heating/domestic hot water piping and/or as indicated.

.5 Install expansion joints for every 50' (15 m) of horizontal run of straight pipe on chilled water piping, heat pump loop/riser systems and/or as indicated.

.6 Install expansion joints on risers as indicated and at least one expansion joint for every 5 stories.

.7 Install spherical joint connections on all circulating pump assemblies (heating systems).

.8 Install flexible metal hose connections on all refrigerant piping at condensing units etc.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 15014 - Closeout Submittals.

.3 Section 15950 - Testing, Adjusting and Balancing of Mechanical Systems.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

.3 Submit product data of pump curves for review showing point of operation.

.4 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

1.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

1.4 Extra Materials

.1 Provide maintenance materials in accordance with Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Split Coupled Type

.1 Split Coupled Type Vertical In-Line Centrifugal pumping unit. The pumps shall be radially split, single stage centrifugal type with BF (Bronze Fitted) casing with equal size suction and discharge flanges and having separate tapped flush line and pressure gauge connections, bronze dynamically balanced impeller, stainless steel shaft, lower carbon throttle bushing, outside balanced type mechanical seal with Carbon rotating face, Ceramic stationary seat and Viton secondary seal.

.2 The squirrel cage induction type, TC-Frame, with ODP enclosure and shall be connected to the pump through a high tensile aluminum, split type spacer coupling to permit Servicing of the mechanical seal without disturbing pump, motor or electrical wiring. Coupling shall be protected by a guard.

.3 Motor shall be high efficiency for all pumps 1/2 HP (0.372 kW) and larger.

2.2 Motor Mount Type

.1 Motor Mount In-Line Centrifugal pumping unit suitable for 175 psig (1.21 MPa) working pressure with radially split BF (Bronze Fitted) casing, bronze impeller, and single inside type mechanical seal with flush line. The driving motor shall be solid shaft, squirrel cage, induction type, with ODP enclosure. The complete unit shall be suitable for the following service:

.1 Furnish and install on the discharge side of each pump an Armstrong Model FTV Flo-Trex Combination Valve incorporating three functions in one body: Tight shut-off, spring-closure type silent non-slam check and flow measurement/throttling.

.2 Valve body shall be cast iron with 125 psi (862 kPa) ANSI flanged ends. The body shall have two 1/4" (6mm) NPT connections on each side of the valve seat. Two connections to have brass pressure and temperature metering ports, with Nordel check valves and gasketted caps. Two (2) other connections to be supplied with brass drain plugs. Metering ports are to be interchangeable with drain ports to allow for measurement flexibility when installed in tight locations.

.3 The valve disc shall be bronze plug disc type with high impact engineered resin seat to ensure tight shut-off and silent check valve operation.

.4 The valve stem shall be stainless steel with flat surfaces provided for adjustment with open end wrench.

.5 The valve shall be selected and installed in accordance with the manufacturer's instructions and be suitable for the pressure and temperature encountered.

.6 Motor shall be high efficiency for all pumps 1/2 HP (0.372 kW) and larger.

PART 3 EXECUTION

3.1 Installation

.1 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.

.2 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.3 Pipe drain tapping to floor drain.

.4 Install volute venting pet cock in accessible location.

.5 Check rotation prior to start-up.

.6 Install pressure gauge test cocks.

3.2 Start-up

.1 General:

.1 In accordance with manufacturer's recommendations.

.2 Procedures:

.1 After starting pump, check for proper, safe operation.

.2 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.3 Check base for free-floating, no obstructions under base.

.4 Run-in pumps for 12 continuous hours.

.5 Verify operation of over-temperature and other protective devices under low-and no-flow condition.

.6 Eliminate air from scroll casing.

.7 Adjust water flow rate through water-cooled bearings.

.8 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.9 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.10 Eliminate cavitation, flashing and air entrainment.

.11 Adjust pump shaft seals, stuffing boxes, glands.

.12 Measure pressure drop across strainer when clean and with flow rates as finally set.

.13 Replace seals if pump used to degrease system or if pump used for temporary heat.

.14 Verify lubricating oil levels.

3.3 Performance Verification (PV)

.1 General:

.1 In accordance with manufacturer's recommendations.

.2 Exclusions:

.1 This paragraph does not apply to small in-line circulators.

.3 Assumptions: These PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.4 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of testing, adjusting and balancing (TAB). Refer to Section 15950 - Testing, Adjusting and Balancing of Mechanical Systems.

.6 Commissioning Reports: Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Report forms.

.3 Pump performance curves (family of curves).

END.

PART 1 GENERAL

1.1 References

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

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

.3 Manufacturer's Standardization Society of the Valve and Fittings Industry.

1.2 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit data for following: Valves, couplings, mechanical joints.

1.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Pipe

.1 Service water pipe: ductile iron cement mortar lined from 33'(1 m) outside of building.

.1 Ductile iron: ANSI/AWWA C151/A21.51.

.2 Cement mortar lining for ductile iron pipe: To ANSI/AWWA C104/A21.4.

.3 PVC class 150, DR 18 to AWWA C-900 and CSA B137.3.

2.2 Fittings

.1 NPS 3 and larger mechanical joints or flanged: to ANSI/AWWA C110/A21.10.

2.3 Joints

.1 Rubber gaskets for mechanical joints or flanges: To ANSI/AWWA C111/A21.11.

.2 Bolts, nuts, hex head with washers: To ASTM A 307, heavy series.

2.4 Gate Valves

.1 Rising stem: To MSS SP-70, class 125, 125psi (860 kPa), flat flange faces, cast-iron body, bronze trim, bolted bonnet.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

.2 Piping to be cut square, reamed, free of cuttings and foreign material.

.3 Where piping enters building, provide support, and seal against ingress of moisture. All to approval of authority having jurisdiction.

.4 Assemble all piping using fittings manufactured to ANSI standards and in accordance with manufacturer's instructions.

.5 Apply layer of protective coating to all buried piping.

3.2 Pressure Testing

.1 Conform to Section 15010 - Mechanical General Requirements.

3.3 Disinfection

.1 Coordinate with:

.1 Section 02511 - Water Mains.

.2 Section 15142 - Domestic Water Piping - Copper.

.3 Section 15143 - Domestic Water Piping – Plastic.

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END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Submittal Procedures.

.2 Section 15014 - Closeout Submittals.

.3 Section 15010 - Mechanical General Requirements.

1.2 References

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

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

.3 American Water Works Association (AWWA).

.4 Canadian Standards Association (CSA).

1.3 Product Data

.1 Submit product data in accordance with Section 15012 - Submittal Procedures.

.2 Submit data for following: valves.

1.4 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Piping

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground: copper tube, hard drawn, type L: to ASTM B 88M.

.2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B 88M, in long lengths and with no buried joints.

2.2 Fittings

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.3 Cast copper, solder type: To ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 NPS 2 and larger: Roll grooved to CSA B242.

2.3 Joints

.1 Rubber gaskets, 1/16" (1.6mm) thick: To ANSI/AWWA C111/A21.11.

.2 Bolts, nuts, hex head and washers: To ASTM A 307, heavy series.

.3 Solder: 95/5 (Tin/Antimony, lead free solder).

.4 Teflon tape: For threaded joints.

.5 Grooved couplings: Designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.

.6 Dielectric connections between dissimilar metals: Dielectric fitting to ASTM F 492, complete with thermoplastic liner.

2.4 Gate Valves

.1 NPS 2 and under, soldered:

.1 Rising stem: To MSS-SP-80, Class 125, 125psi (860 kPa).

.2 Bronze body, screw-in bonnet, solid wedge disc as specified Section 15111 - Valves.

.2 NPS 2 and under, screwed:

.1 Rising stem: To MSS-SP-80, Class 125, 125psi (860 kPa).

.2 Bronze body, screw-in bonnet, solid wedge disc as specified Section 15111 - Valves.

.3 NPS 2-1/2 and over, in mechanical rooms, flanged:

.1 Rising stem: to MSS-SP-70, Class 125, 125psi (860 kPa).

.2 Flat flange faces, cast-iron body, OS&Y bronze trim as specified Section 15112 Valves - Cast Iron.

.4 NPS 2-1/2 and over, other than mechanical rooms, flanged:

.1 Non-rising stem: to MSS-SP-70, Class 125, 125psi (860 kPa).

.2 Flat flange faces, cast-iron body, bronze trim, bolted bonnet as specified Section 15112 Valves - Cast Iron.

2.5 Globe Valves

.1 NPS 2 and under, soldered:

.1 To MSS-SP-80, Class 125, 125psi (860 kPa)

.2 Bronze body, renewable composition disc, screwed over bonnet as specified Section 15111 Valves - Bronze.

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 150, 150psi (1.03 MPa)

.2 Bronze body, screwed over bonnet, renewable composition disc as specified Section 15111 Valves - Bronze.

2.6 Swing Check Valves

.1 NPS 2 and under, soldered:

.1 To MSS-SP-80, Class 125, 125psi (860 kPa)

.2 Bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 15111 - Valves - Bronze.

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 125, 125psi (860 kPa).

.2 Bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 15111 - Valves - Bronze.

.3 NPS 2-1/2 and over, flanged:

.1 To MSS-SP-71, Class 125, 125psi (860 kPa).

.2 Cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap as specified Section 15112 Valves - Cast Iron.

2.7 Ball Valves

.1 NPS 2 and under, screwed:

.1 Class 150, 150psi (1.03 MPa).

.2 Bronze body, chrome plated brass stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon Bunan seat, steel lever handle as specified Section 15111 - Valves - Bronze.

.2 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150, 150psi (1.03 MPa).

.2 Bronze body, chrome plated brass stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon Bunan seat, steel lever handle, with NPT to copper adaptors as specified Section 15111 - Valves - Bronze.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

.2 Install pipe work in accordance with Section 15101 - Installation of Pipe Work, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install domestic cold water supply piping below and away from domestic hot water and other hot piping so as to maintain temperature of cold water as low as possible.

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

3.2 Valves

.1 Isolate equipment, fixtures and branches with gate or ball valves.

.2 Balance recirculation system using balancing valves. Mark settings and record on as-built drawings on completion.

3.3 Pressure Tests

.1 Conform to requirements of Section 15010 - Mechanical General Requirements.

.2 Test pressure: greater of 1.5 times maximum system operating pressure.

3.4 Flushing and Cleaning

.1 Flush entire system for eight (8) hrs. Ensure outlets flushed for two (2) hrs. Let stand for 24 hrs, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean. Let system flush for additional two (2) hrs, then draw off another sample for testing.

3.5 Pre-Start-up Inspections

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.6 Disinfection

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality for Engineer review.

.3 Coordinate with:

.1 Section 02511 - Water Mains

.2 Section 15143 - Domestic Water Piping - Plastic.

.3 Section 15141 - Domestic Water Piping - Ductile Iron

3.7 Start-up

.1 Timing: Start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring domestic hot water storage tank up to design temperature slowly.

.4 Monitor piping domestic hot water supply and return piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, and safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.8 Performance Verification

.1 Timing:

.1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 Testing, adjusting and balancing of hot water circulation.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize hot water circulation and heating water supply systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

.3 Reports:

.1 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

END.

PART 1 GENERAL

1.1 References

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

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

.3 Manufacturer's Standardization Society of the Valve and Fittings Industry.

.4 CSA-B137.5-M97.

1.2 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit data for following: Valves, couplings, mechanical joints.

1.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Tubing

.1 Tubing shall be cross-linked polyethylene (denoted PEX or aquaPEX below), rated at 180°f maximum working temperature and up to 100 psi working pressure (200°f @ 80 psi) in accordance with astm standard f876-877, as manufactured by wirsbo. Tubing shall be csa approved to csa standard csa-b137.5-m97.

.2 Tubing shall be manufactured by the "engel method."

.3 Tubing shall not leach toxins into the potable water.

.4 Tubing shall be manufacturer approved for continuous circulation.

.5 Tubing shall allow for repair of kinks with a heat gun with no damage to the tube.

.6 Tubing shall have a 25 flame spread classification, 50 smoke developed classification when tested in accordance with can/ulc s102.2-m88, standard for burning characteristics of flooring, floor covering and miscellaneous materials and assemblies.

.7 The minimum bend radius for cold bending of the tubing shall not be less than eight(8) times the outside diameter. Bends with a radius less than stated require the use of a bend support supplied by the tubing manufacturer. For this project.

2.2 Manifolds

.1 Shall be type "L" copper construction approved to CSA-B137.5-M97.

2.3 Tube fittings

.1 Shall be manufactured of dezincification resistant brass or polysulfone. Fittings to be supplied by the tubing manufacturer. Tube fitting shall consist of a combination insert/plumbing connection and colour coded PEX ring. Tube fittings shall be approved to CSA-B137.5-M97.

2.4 Drop ear bend supports

.1 Shall be used for tube exiting a wall membrane.

2.5 Concrete tube support brackets

.1 Shall be used to support tube exiting the slab at manifold and fixture end.

.2 Acceptable product: pre-manufactured PVC "J-Bracket".

2.6 Fixture shut-offs

.1 Shall be by tubing manufacturer or as indicated.

2.7 Firestop

.1 Refer to applicable subcontract documents for firestopping requirements. Approved firestop compound - Wirsbo aquaPEX firestop sealant.

2.8 Delivery, Storage and Handling

.1 General: comply with Division 1 product requirements sections.

.2 Ordering: comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

.3 Delivery: deliver materials to job site in manufacturer's original, unopened, undamaged containers with identification labels intact.

.4 Storage and protection: store materials protected from exposure to harmful weather and job site conditions.

.5 Store PEX tubing in cartons or under cover to avoid dirt or foreign material from being introduced into the tubing.

.6 Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, installer shall be responsible for providing cover to portions of tubing exposed to direct sunlight.

PART 3 EXECUTION

3.1 Qualifications:

.1 Installer qualifications: installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

.2 Installer shall provide, in writing, to project owner that the PEX tubing furnished under this specification conforms to the material and mechanical requirements specified herein.

3.2 Pre-installation meetings

.1 Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty require. Comply with division 1 project management and coordination (project meetings) section.

3.3 Installation

.1 Potable water tubing shall be installed in accordance with the manufacturer's recommendations.

.2 In structural slabs, tubing shall be sleeved with utility grade polyethylene tubing or rigid PVC conduit. Utility grade polyethylene sleeving shall be supported by "J-Bracket" where tubing enters/exits the slab. Tubing encased in concrete topping shall be sleeved with the approved appropriate material as required by the authority having jurisdiction.

.1 Tubing shall exit wall at fixture.

.3 Prior to commissioning the potable water system, the tubing shall be inspected by the local plumbing inspector and a report shall be obtained in writing.

.4 The contractor shall provide potable water or oil-free air for pressurizing testing.

3.4 Pressure Testing

.1 Conform to Section 15010 - Mechanical General Requirements.

.2 On completion of the installation, the system shall be:

.3 Charged with potable water or air to a pressure which meets local plumbing code requirements.

3.5 Field quality requirements

.1 Site tests (installation and post-installation testing): see spec.

.2 Manufacturer's field services: provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

3.6 Certificate:

.1 Submit certificate indicating certification as a manufacturer's trained installer.

3.7 Disinfection

.1 Coordinate with:

.1 Section 02511 - Water Mains.

.2 Section 15142 - Domestic Water Piping - Copper.

.3 Section 15141 - Domestic Water Piping - Ductile Iron.

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END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15101 - Installation of Pipework.

1.2 References

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

.2 Canadian Standards Association (CSA).

.3 CSA B67-1972 (latest edition), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.

.4 CAN/CSA-B70 (latest edition), Cast Iron Soil Pipe, Fittings and Means of Joining.

.5 CAN/CSA-B125 (latest edition), Plumbing Fittings.

PART 2 PRODUCTS

2.1 Copper Tube and Fittings

.1 Above ground sanitary storm and vent to: ASTM B 306.

.1 .Fittings.

.1 Cast brass: To CAN/CSA-B125.

.2 Wrought copper: To CAN/CSA-B125.

.2 Solder: to ASTM B 32.

2.2 Cast Iron Piping and Fittings

.1 Buried sanitary, storm and vent minimum NPS 3, to: CAN/CSA-B70.

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets: to ASTM C 564 or CAN/CSA-B70.

.2 Stainless steel clamps.

.2 Hub and spigot joints.

.1 Caulking lead: to CSA B67.

.2 Cold caulking compounds.

.2 Above ground sanitary, storm and vent: To CAN/CSA-B70.

.1 Hub and spigot joints.

.1 Caulking lead: To CSA B67.

.2 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

PART 3 EXECUTION

3.1 Installation

.1 In accordance with Section 15101 - Installation of Pipework.

.2 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

.3 Install all venting as per Plumbing Code. The stack vents may be grouped as per Code. All stack vents terminals shall be located at least 10' (3m) from any building opening or fresh air intake. Install and size headers as per Plumbing Code.

.4 Provide dedicated risers for all domestic clothes washers.

.5 Provide dedicated risers for all condensate drains serving AC/cooling units if connections to kitchen and bathroom risers are not practical. Use traps and check valves when connecting condensate drains to rain water leaders.

.6 For all additional and relevant items, see Section 15152 Drainage Waste and Vent Piping - Plastic Buried.

.7 Use metallic piping in ceilings of commercial areas and all common rooms.

3.2 Testing

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

.3 Provide CCTV review of all buried or otherwise inaccessible pipe systems prior to final handover.

3.3 Performance Verification

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage and roof drains:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) complete with directional arrows every floor or 15' (4.5 m), whichever is less.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15101 - Installation of Pipework.

1.2 References

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

.1 ASTM D2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA).

.1 CAN/CSA-Series B1800, Thermoplastic Non-pressure Pipe Compendium - B1800 Series.

PART 2 PRODUCTS

2.1 Piping and Fittings

.1 PVC/ABS drainage waste and vent piping to:

.1 CSA/CSA B1800.

2.2 Joints

.1 Solvent weld for PVC to ASTM D 2564.

.2 Solvent weld for ABS: to ASTM D2235.

PART 3 EXECUTION

3.1 Installation

.1 In accordance with Section 15101 - Installation of Pipework.

.2 Install in accordance with Provincial Plumbing Code and local Authority Having Jurisdiction. Refer to the Ontario Building Code Sections 3.1.5.16, 3.1.9.1 and 3.1.9.4.

.3 Plastic piping above ground is acceptable providing:

.1 It has flame spread less than 25.

.2 It has smoke development less than 50,

.3 No plastic piping allowed in return air plenum unless complies with items .1 and .2 above.

.4 All firestopping devices are of approved type and installed to the listed manufacturer’s installation details.

.5 No plastic piping allowed in vertical shafts.

.6 No plastic pipe allowed in common rooms.

.4 Install all venting as per Plumbing Code. The stack vents may be grouped as per Code. All stack vents terminals shall be located at least 10' (3 m) from any building opening or fresh air intake. Install and size headers as per Plumbing Code.

.5 Provide dedicated risers for all washers.

.6 Provide dedicated risers for all condensate drains serving AC/cooling units if connections to kitchen and bathroom risers are not practical. Use traps and check valves when connecting condensate drains to rain water leaders.

.7 Piping water pressure: copper "L" or PVC Schedule 40.

.8 Provide a complete subdrainage system consisting of a perimeter drain and interior subdrains spaced at ±20' (6 m) o.c. and connected to 6" (150mm) dia. main collector. Provide back water valve in an accessible pit and cover.

.9 Provide condensate drains for all roof top AC units, fan coil units, and any air handling system equipped with a cooling coil and condensing gas fired heat exchanger.

.10 Provide dedicated condensate drain stacks where connections to the nearest sanitary or storm drains are impractical. Bottom of the condensate drain will terminate above a hub drain,

trapped complete with trap seal primer. Vent the stack to outside as required by the Code.

.11 Provide all venting as required by the Code for:

.1 Grease traps.

.12 Terminate vents outside at safe distances from building openings. For low rise buildings up to four (4) stories terminate vents on the roof. Provide sketch to Engineer for review prior to installing vents for other building heights.

.13 Condensate drains from coolers and freezers shall terminate above 3" (75mm) dia. funnel floor drains. Condensate drain inside the freezer shall be insulated and traced by Div. 16.

.14 Provide a 3" (75mm) dia. drain riser for sprinkler system riser test connections on every floor. Connect to the nearest drain via trap and trap seal primer.

.15 Install a trapped hub drain at back flow preventer and pipe the water outlet to the drain. Use air gaps where practical.

3.2 Tests

.1 Pressure test buried systems before backfilling.

.2 Provide CCTV review of all buried or otherwise inaccessible pipe systems prior to final handover.

.3 Hydraulically test to verify grades and freedom from obstructions.

3.3 Performance Verification

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage and roof drains:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 All firestopping devices installed and reviewed by authority having jurisdiction.

.5 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.6 Affix applicable label (storm, sanitary, vent, pump discharge etc.) complete with directional arrows every floor or 15' (4.5m, whichever is less.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 15014 - Closeout Submittals.

.3 This section applies to the water source heat pump systems also.

1.2 References

.1 American Society of Mechanical Engineers (ASME).

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

.3 Canadian Standards Association (CSA).

1.3 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate on product data expansion tanks, air vents, separators, valves, strainers.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

1.5 Closeout Submittals

.1 Submit maintenance data in accordance with Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Diaphragm Type Expansion Tank

.1 Vertical (horizontal permitted) pressurized diaphragm type expansion tank.

.2 Capacity: Heating water system: [US gal. (L),] Chilled water system: [US gal. (L),] or as determined by manufacturer. Other systems (glycol, domestic hot water, other) as determined by manufacturer for system involved.

.3 Diaphragm sealed in elastomer suitable for 239°F (115°C) operating temperature.

.4 Working pressure: 125psi (860 kPa) with ASME stamp and certification.

.5 Air pre-charged to 12psi (84 kPa) (initial fill pressure of system).

.6 Saddles for horizontal installation, base mount for vertical installation as determined onsite.

.7 Supports: Provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

.8 Acceptable material: Taco, A.O. Smith.

2.2 Automatic Air Vent

.1 Standard float vent: Brass body and NPS 1/8 connection and rated at 100psi (690 kPa) working pressure.

.2 Float: solid material suitable for 239°F (115°C) working temperature.

2.3 Air Separator - Expansion Tank Fitting

.1 Complete with adjustable vent tube and built-in manual vent valve.

.2 Working pressure: 125psi (860 kPa).

2.4 Air Separator - In-Line

.1 Working pressure: 125psi (860 kPa).

.2 Size._____

2.5 Combination Separators/Strainers

.1 Steel, tested and stamped in accordance with ANSI/ASME BPVC, for 125psi (860 kPa) operating pressure, with galvanized steel integral strainer with 0.197" (5mm) perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.6 Pipe Line

.1 Strainer:

.1 NPS 1/2 to 2: Bronze body to ASTM B 62, solder end/screwed connections, Y pattern.

.2 NPS 2-1/2 to 12: Flanged connections.

.3 Blowdown connection: NPS 1.

.4 Screen: Stainless steel or brass with 0.047" (1.19mm) perforations.

.5 Working pressure: 125psi (860 kPa).

2.7 Suction Diffuser

.1 Body: Cast iron with connections to match pipe.

.2 Strainer: With built-in, disposable 0.047" (1.19mm) mesh, low pressure drop screen and NPS 1 blowdown connection.

.3 Permanent magnet particle trap.

.4 Full length straightening vanes.

.5 Pressure gauge tappings.

.6 Adjustable support leg.

PART 3 EXECUTION

3.1 General

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines and blow off connections to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 Strainers

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

3.3 Automatic Air Vents

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

.3 Install at the top of heating, water risers, air separators etc.

.4 Install manual air vents at:

.1 The top of each heating water coil.

3.4 Expansion Tanks

.1 Adjust expansion tank pressure to suit design criteria.

3.5 Pressure Safety Relief Valves

.1 Run discharge pipe to terminate above nearest drain.

3.6 Suction Diffusers

.1 Install on inlet to pumps having suction size greater than 50.

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END.

PART 1 GENERAL

1.1 References

.1 American National Standards Institute (ANSI).

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

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.4 This section applies to water source heat pump systems also.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

1.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Tubing

.1 Type A or B hard drawn copper tubing: To ASTM B88M.

2.2 Fittings

.1 Cast bronze threaded fittings: To ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: To ANSI/ASME B16.22.

.3 Cast iron threaded fittings: To ANSI/ASME B16.4.

.4 Cast copper alloy solder joint pressure fittings: To ANSI B16.18.

2.3 Flanges

.1 Brass or bronze: Threaded.

.2 Cast iron: Threaded.

.3 Orifice flanges: Slip-on, raised face, 305psi (2.1 MPa).

2.4 Joints

.1 Solder, tin-antimony, 95:5: To ASTM B32.

.2 Silver solder BCUP: To ANSI/AWS A5.8.

.3 Brazing: As indicated.

2.5 Valves

.1 Connections:

.1 NPS 2 and smaller: Ends for soldering.

.2 NPS 2-1/2 and larger: Flanged or grooved ends.

.2 Gate Valves Application: Isolating equipment, control valves, pipelines:

.1 NPS 2 and under:

.1 Mechanical Rooms: Class 125, rising stem split wedge disc.

.2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 15111 Valves - Bronze.

.2 NPS 2-1/2 and over:

.1 Mechanical Rooms: Rising stem, split wedge disc, bronze trim.

.2 Elsewhere: Non-rising stem, solid wedge disc, bronze trim.

.3 Globe valves: Application: Throttling, flow control, emergency bypass:

.1 NPS 2 and under:

.1 Mechanical Rooms: With PFTE disc.

.2 Elsewhere: Globe, with composition disc.

.2 NPS 2-1/2 and over:

.1 With composition bronze disc, bronze trim.

.4 Testing, Adjusting and Balancing:

.1 All sizes: Calibrated balancing valves, as specified this section.

.5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc.

PART 3 EXECUTION

3.1 Piping Installation

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

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.2 Valve Installation

.1 Install rising stem valves in upright position with stem above horizontal.

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

.3 Install globe valves in by-pass around control valves as indicated.

.4 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.

.5 Install chain operators on valves NPS 2-1/2 and over where installed more than 8' (2.4m) above floor in Boiler Rooms and Mechanical Equipment Rooms.

.6 Install plug cocks or ball valves for glycol service.

3.3 Circuit Balancing Valves

.1 Install flow measuring stations and Armstrong flow balancing valves as indicated.

.2 Remove handwheel after installation and testing, adjusting and balancing is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

.4 Install balancing valves:

.1 On each hydronic water riser.

.2 On each hydronic water loop.

.3 On each hydronic water supply to any fan coil unit, unit heater, cabinet heater, etc.

3.4 Flushing and Cleaning

.1 Flush and clean in presence of Engineer.

.2 Flush after pressure test for a minimum of four (4) hrs.

.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of eight (8) hrs.

.4 Refill system with clean water. Circulate for at least four (4) hrs. Clean out strainer screens/baskets regularly. Then drain.

.5 Refill system with clean water. Circulate for at least two (2) hrs. Clean out strainer screens/baskets regularly. Then drain.

.6 Drainage to include drain valves, dirt pockets, strainers, every low point in system.

.7 Re-install strainer screens/baskets only after obtaining Engineer's Consultant's approval.

3.5 Filling of System

.1 Refill system with clean water adding water treatment as specified - ethylene glycol.

3.6 Testing

.1 Test system in accordance with Section 15010 - Mechanical General Requirements.

.2 For ethylene glycol systems, retest after cleaning. Repair any leaking joints, fittings or valves.

3.7 Balancing

.1 Balance water systems to within plus or minus 5% of design output.

3.8 Glycol Charging

.1 Provide mixing tank and positive displacement pump for ethylene glycol charging.

.2 Retest for concentration to ASTM E 202 after cleaning.

.3 Provide report to Engineer.

END.

PART 1 GENERAL

1.1 References

.1 Canadian Standards Association (CSA).

.2 American National Standards Institute (ANSI).

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

.4 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.5 This section applies to water source heat pump systems also.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

PART 2 PRODUCTS

2.1 Pipe

.1 Steel pipe: to ASTM A53, Grade B, as follows:

.1 NPS 6, Schedule 40.

.2 NPS 8 and over, 10 Schedule 30.

2.2 Pipe Joints

.1 NPS 2 and under: Screwed fittings with Teflon tape or pulverized lead paste.

.2 NPS 2-1/2 and over: Welding fittings and flanges to CSA W47.1 and CSA W47.1S1.

.3 Roll grooved: Standard coupling to CSA B242.

.4 Flanges: Plain or raised face, weld neck.

.5 Orifice flanges: Slip-on raised face, 305psi (2.1 MPa).

.6 Flange gaskets: To ANSI/AWWA C111/A21.11.

.7 Pipe thread: Taper.

.8 Bolts and nuts: To ANSI B18.2.1 and ANSI/ASME B18.2.2.

2.3 Fittings

.1 Screwed fittings: Malleable iron, to ANSI/ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: To ANSI/ASME B16.1, Class 125.

.2 Steel: To ANSI/ASME B16.5.

.3 Butt-welding fittings: Steel, to ANSI/ASME B16.9.

.4 Unions: malleable iron, to ASTM A47M and ANSI/ASME B16.3.

.5 Fittings for roll grooved piping: Malleable iron to ASTM A47M.

2.4 Valves

.1 Connections:

.1 NPS 2 and smaller: Screwed ends.

.2 NPS 2-1/2 and larger: Flanged or grooved ends.

.2 Gate valves: Application: Isolating equipment, control valves, pipelines:

.1 NPS 2 and under:

.1 Mechanical Rooms: Class 125, rising stem, split wedge disc.

.2 Elsewhere: Class 125, non-rising stem, solid wedge disc.

.2 NPS 2-1/2 and over:

.1 Mechanical Rooms: Rising stem, split wedge disc, bronze trim.

.2 Elsewhere: Non-rising stem, solid wedge disc, bronze trim.

.3 Globe valves:

.1 NPS 2 and under:

.1 Mechanical Rooms: With PFTE disc.

.2 Elsewhere: Globe, with composition disc.

.2 NPS 2-1/2 and over:

.1 With composition bronze disc, bronze trim.

.4 Testing, Adjusting and Balancing:

.1 All sizes: Calibrated balancing valves, as specified this section.

.5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc.

PART 3 EXECUTION

3.1 Piping Installation

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

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.

.7 Assemble piping using fittings manufactured to ANSI standards.

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

3.2 Valve Installation

.1 Install rising stem valves in upright position with stem above horizontal.

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

.3 Install globe valves as indicated.

.4 Install chain operators on valves NPS 2-1/2 and over where installed more than 8' (2.4 m) above floor.

3.3 Circuit Balancing Valves

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and testing, adjusting and balancing is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

.4 Install balancing valves:

.1 On each hydronic water riser.

.2 On each hydronic water loop.

.3 On each hydronic water supply to any fan coil unit, unit heater, cabinet heater, etc.

3.4 Flushing and Cleaning

.1 Flush and clean in presence of Engineer.

.2 Flush after pressure test for a minimum of four (4) hrs.

.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of eight (8) hrs.

.4 Refill system with clean water. Circulate for at least four (4) hrs. Clean out strainer screens/baskets regularly. Then drain.

.5 Refill system with clean water. Circulate for at least two (2) hrs. Clean out strainer screens/baskets regularly. Then drain.

.6 Drainage to include drain valves, dirt pockets, strainers, every low point in system.

.7 Re-install strainer screens/baskets only after obtaining Engineer's approval.

.8 Contractor to provide temporary circulating pump and all necessary piping.

3.5 Filling of System

.1 Refill system with clean water adding water treatment as specified - ethylene glycol.

3.6 Testing

.1 Test system in accordance with Section 15010 - Mechanical General Requirements.

.2 For ethylene glycol systems, retest after cleaning. Repair any leaking joints, fittings or valves.

3.7 Balancing

.1 Balance water systems to within plus or minus 5% of design output.

3.8 Glycol Charging

.1 Provide mixing tank and positive displacement pump for ethylene glycol charging.

.2 Retest for concentration to ASTM E 202 after cleaning.

.3 Provide report to Engineer.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15401 - Plumbing Specialties and Accessories.

1.2 References

.1 American Society of Mechanical Engineers (ASME).

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

1.4 Closeout Submittals

.1 Submit operation and maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

.2 Include following:

.1 Log sheets as recommended by manufacturer.

PART 2 PRODUCTS

2.1 Closed Systems

.1 Provide complete water treatment equipment and chemicals for corrosion protection, and side stream filtration, for each closed system.

.2 Each Closed System to include the following water treatment equipment:

.1 One (1) bypass Feeder, 2 US Gallon (7.5L) capacity Ashland C2.

.2 One (1) bypass Filter Unit with the capacity to handle 2.5-5% of the recirculating pump flow rate.

.3 Case of 30 filter cartridges, 20 micron.

.4 Two (2) corrosion test coupons; one copper and one steel.

.5 [One (1) timer panel.]

.6 [One (1) Metering Pump sized suitable to inject against system operating pressure.]

.7 [Contact water meter.]

.3 Each ethylene glycol system to include water treatment equipment as indicated in section 2.2.1 with the addition of an automatic glycol feed system, Ashland Model E5800DW double-wall tank for leak containment. The feed system consists of the following:

.1 45 imperial gallon (205L) polyethylene tank complete with hinged cover, outer tank as leak containment.

.2 Top mounted rotary bronze gear pump, 1/3 HP (0.25 kW), 2.0 gpm (7.6 Lpm), 75 psi (517 kPa).

.3 Low level alarm.

.4 One control panel consisting of:

.1 H-O-A switch for gear pump with indicator light.

.2 Push alarm test button.

.3 Slider silence button c/w low level alarm and indicator light for pump protection.

.4 Power switch and light.

.5 Pressure switch to activate the glycol feed control panel.

.4 Provide sufficient new system cleaner to initially clean the closed system(s).

.5 Provide sufficient corrosion inhibitor to maintain required control levels in closed system(s) for a period of two (2) months after turnover.

.6 Provide a test kit for measuring inhibitor level.

.7 Provide sufficient ethylene glycol to fill the glycol feed unit after the systems are charged (50% formulated for HVAC Systems).

.8 Provide a test kit for glycol concentration.

PART 3 EXECUTION

3.1 Installation

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.2 Chemical Feed Piping

.1 Install crosses at all changes in direction. Install plugs in all unused connections.

3.3 Cleaning of Mechanical System

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Engineer.

.2 Thoroughly flush all mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.

.3 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

.4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions to be approved by authority having jurisdiction.

3.4 Water Treatment Services

.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

.1 Initial water analysis and treatment recommendations.

.2 System start-up assistance.

.3 Operating staff training.

.4 Visit plant during period of operation and as required until system stabilizes, and advise on treatment system performance.

.5 Provide necessary recording charts and log sheets for one year operation.

.6 Provide necessary laboratory and technical assistance.

.7 Instructions and advice to operating staff to be clear, concise and in writing.

3.5 Start-up

.1 Start up water treatment systems in accordance with manufacturer's instructions.

3.6 Commissioning

.1 Commissioning Agency: To be water treatment supplier or approved alternate.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After start-up and before testing, adjusting and balancing of connected systems.

.3 Pre-commissioning Inspections:

.1 Verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests to be performed, operating instructions.

.2 Suitability of log book.

.3 Currency and accuracy of initial water analysis.

.4 Required quality of treated water.

.4 Commissioning procedures - applicable to all Water Treatment Systems:

.1 Establish, adjust as necessary and record all automatic controls and chemical feed rates.

.2 Monitor performance continuously during commissioning of all connected systems and until acceptance of project.

.3 Establish test intervals, regeneration intervals.

.4 Record on approved report forms all commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise Engineer in writing on all matters regarding installed water treatment systems.

.5 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Analyse water in system.

.2 Based upon an assumed rate of loss approved by Engineer, establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.6 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O & M personnel.

.2 Train O & M personnel in softener regeneration procedures.

.7 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.8 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, all other data required by Engineer.

.9 Demonstrations: Allow for minimum of two (2) days or as required.

.10 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to Engineer.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 15014 - Closeout Submittals.

.3 Section 15095 - Cleaning and Start-Up of Mechanical Piping Systems.

.4 Section 15101 - Installation of Pipework.

1.2 References

.1 American Society of Mechanical Engineers (ASME).

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

.3 Canadian Standards Association (CSA).

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA).

1.3 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate on manufacturers catalogue literature following: Valves.

1.4 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Pipe

.1 Steel pipe: To ASTM A53/A53M, Schedule 40, seamless as follows:

.1 NPS 1/2 to 2, screwed.

.2 NPS 2 1/2 and over, plain end.

.2 Copper tube: To ASTM B75M.

2.2 Jointing Material

.1 Screwed fittings: Pulverized lead paste.

.2 Welded fittings: To CSA W47.1.

.3 Flange gaskets: Non-metallic flat.

2.3 Fittings

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: Screwed, banded, Class 150.

.2 Steel pipe flanges and flanged fittings: to ASME B16.5.

.3 Welding: Butt-welding fittings.

.4 Unions: Malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

.5 Bolts and nuts: To ASME B18.2.1.

.6 Nipples: Schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: To ASME B16.18.

.2 Wrought copper fittings: To ASME B16.22.

2.4 Valves

.1 Provincial Code approved, lubricated plug (exterior) or ball type (interior).

PART 3 EXECUTION

3.1 Piping

.1 Install in accordance with Section 15101 - Installation of Pipework, supplemented as specified herein.

.2 Install in accordance with applicable Provincial Codes.

.3 Install in accordance with CAN/CGA B149.1 CAN/CGA B149.2. latest revisions.

.4 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

3.2 Valves

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

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

3.3 Field Quality Control

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

.2 All installation shall be approved by TSSA.

3.4 Purging

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

3.5 Pre-start-Up Inspections

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 Cleaning and Start-Up

.1 In accordance with Section 15095 - Cleaning and Start-Up of Mechanical Piping Systems, supplemented as specified herein.

.2 In accordance with requirements of CAN/CGA B149.1 B149.2, supplemented as specified herein.

3.7 Equipment Connections

.1 Make gas pipe connections to all gas fired equipment.

.2 Each piece of equipment shall have an approved isolating valve.

.3 Each piece of cooking equipment shall have a hose connection with an approved isolating valve.

.4 Supply and install emergency gas valve and isolating shut-off valve for all kitchen gas fired cooking equipment.

.5 Install emergency shut-off valve located outside of boiler room.

.6 Vent all pressure reducing valves as required.

.7 Provide all final connections to all gas fired equipment supplied and installed by others:

.1 Dryers.

.2 Fireplaces.

.3 Furnaces, heaters, boilers, etc.

.8 Gas pipe riser inside the building will be installed in a rated shaft. Provide 1" (25mm) dia. pipe at the top of the shaft and vent to the outside, provide gooseneck.

.9 Expansion loops as per figure G1 of the CSA B149.

.10 Support for piping as per Code.

END.

PART 1 GENERAL

1.1 Reference Standards

.1 Provide design and do work to the following except where specified otherwise.

.2 Provincial, building and fire regulations as approved by Provincial Fire Marshal.

.3 National Fire Protection Association Standards (latest editions).

.4 Ontario Building Code.

1.2 Description of Systems

.1 Provide the following fire protection systems:

.1 Automatic sprinkler systems Section 15310 (NFPA-13).

.2 Dry pipe sprinkler systems Section 15315 (NFPA-13).

.3 Portable fire extinguishers (NFPA-10).

.4 Standpipe system (O.B.C., NFPA-14).

.5 Fire suppression system for commercial cooking equipment.

.6 Section 15305 Pumps - Fire Protection (NFPA-20).

1.3 Fire Marshal Approval

.1 Fire Marshal or his representative shall approve design, entire installation, equipment, materials as well as perform and supervise all tests.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 Shop Drawings, Product Data, Samples and Mock-ups.

.2 Shop drawings and hydraulic calculations for sprinkler and standpipe to be done by a professional engineer permanently licensed in the province of Ontario. Hydraulic Calculations

will finalize fire pump parameters (flow, static pressure, horse power).

.3 The fire protection contractor shall obtain a complete set of architectural and structural drawings for use in preparing the tender before submitting the tender.

.4 Fire protection contractor to submit shop drawings showing all head locations and main branch lines. Work shall not start until engineer and architect review is satisfied. Contractor shall provide two copies, over and above those required for Engineer's review, for submission to the authority having jurisdiction as a part of the building permit application.

.5 Contractor is responsible for ensuring that no conflicts with other trades occur. Shop drawings will be reviewed by the Engineer and the Architect.

.6 Contractor shall carry a price for [50] upright and pendent sprinkler heads and a reasonable amount of piping and labour for contingencies after shop drawings are reviewed. Engineer may, at his discretion, apply this price as needed.

.7 Contractor shall carry a price for [15] window sprinkler heads and a reasonable amount of piping and labour for contingencies after shop drawings are reviewed. Engineer may, at his discretion, apply this price as needed.

.8 Contractor shall install three (3) recessed fire extinguisher cabinets c/w 10lbs dry chemical extinguishers on each level of the building. Exact location shall be determined on site.

.9 Contractor shall carry a price for two (2) fire hose cabinets and a reasonable amount of piping and labour for contingencies after shop drawings are reviewed. Engineer may, at his discretion, apply this price as needed.

.10 The sprinkler contractor shall provide a statement that the sprinkler and standpipe systems have been designed, installed, inspected and all tests performed as per relevant Codes and Standards. This statement shall be sealed and signed by the contractor’s Engineer. The letter shall warrant that all contract documents are in hand and have been reviewed by the engineer, that all change orders are in hand and have been reviewed by the engineer and shall include an index list of said documents. The letter shall warrant that regular site reviews have been done by the engineer.

.11 Provide seismic restraint for all piping and equipment as described in Section 15073 - Seismic Restraint and as per requirements of NFPA-13.

.12 Contractor shall install three (3) recessed fire extinguishers cabinets complete with 10lbs (4.5kg) dry chemical extinguishers on each level of the building. Exact location shall be determined on site.

PART 2 PRODUCTS

.1 Not Used

PART 3 EXECUTION

3.1 Inspection

.1 Do not recess, paint or conceal piping accessories or work prior to inspection and approval by authorities having jurisdiction or authorized representative.

3.2 Installation

.1 Install system in accordance with manufacturer's recommendations and ULC standards and listings.

.2 Allow for expansion and contraction when installing pipe hangers.

.3 Discharge test drains to safe location outside building, allowing at least 4' (1.2 m) past drain valve.

.4 Install signs required by local fire protection department.

.5 Secure outdoor signs with stainless steel.

3.3 Field Quality Control

.1 Subject systems and equipment to operational test.

.2 Upon complete installation of piping and apparatus for sprinkler systems, test joints for tightness and good condition of piping inspected in presence of Fire Marshall. When testing with water, install pressure gauge at highest point of

installation. If impossible to test whole installation in single operation, subdivide into several zones and test each zone in manner described.

.3 During tests, stop any leaks and remove and repair any defective part. Perform test over again until satisfactory results are obtained.

.4 Provide hydraulic pump, temporary connections and labour required for tests.

.5 Hydrostatically test wet pipe system, except when low temperature will not permit testing with water. Conduct interim test with air. Conduct standard hydrostatic test when weather permits. Test at 40psi (275 kPa) air pressure for 24 hrs with maximum loss of pressure not over 1.5psi (10 kPa).

.6 Provide Certificate for the seismic restraint as per Section 15073 - Seismic Restraint for all piping and equipment.

3.4 Adjustment

.1 Adjust equipment to satisfaction of authorities having jurisdiction.

3.5 Protection of Completed Work

.1 Assume responsibility for protecting sprinkler heads during painting. Replace damaged and painted components.

3.6 Fire Protection

.1 A qualified fire protection contractor shall design, install and test a fire suppression system serving commercial cooking equipment. All design, installation and testing shall be done as per relevant ULC and NFPA Standards and to the satisfaction of authorities having jurisdiction.

END.

PART 1 GENERAL

1.1 References

.1 ANSI/NFPA 14 (latest edition), Installation of Standpipe and Hose Systems.

.2 Ontario Building Code (latest edition).

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups and ANSI/NFPA 14.

1.3 Engineering Data

.1 Design system to ANSI/NFPA 14 and the Ontario Building Code in conjunction with the parameters for fire pumps design.

1.4 Closeout Submittals

.1 Provide maintenance data for standpipe and hose system for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Pipe, Fittings and Valves

.1 Pipe:

.1 Ferrous: To ANSI/NFPA 14.

.2 Copper tube: To ANSI/NFPA 14.

.2 Fittings and joints to ANSI/NFPA 14:

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

.2 Copper tube: Screwed, soldered, brazed.

.3 Valves to ANSI/NFPA - 14:

.1 ULC listed for fire protection service.

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

.3 NPS 2-1/2 and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.

.4 Check valves: Swing type, composition disc.

.4 Pipe hangers:

.1 ULC listed for fire protection services.

.5 Drain valve: NPS 1, complete with hose end, cap and chain.

.6 Inspector's test connections: NPS 1 gate valve.

2.2 Cabinets

.1 To ANSI/NFPA 14 and ULC listed: flush, surface mount type as indicated, constructed of 0.063" (1.6mm) thick steel, 180° opening door of 0.098" (2.5mm) 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: Glass in prime coat panel [stainless steel][other finishes].

.4 Large enough to accommodate angle valve, hose rack, fire hose nozzle and spanner, fire extinguisher.

.5 Cabinet and cabinet door frame primed and ready for painting.

2.3 Fire extinguisher

.1 10 lbs (4.5kg), dry chemical type.

2.4 Hose Rack

.1 ULC listed, swivel type with pins to permit hose to be hung in fold. Locking device shall 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, 1-1/2" (38mm) nominal diameter, 9' (30m) long, synthetic jacket, synthetic rubber lined.

.2 Nozzle: ULC listed, 1-1/2" (38mm) nominal diameter, forged brass adjustable combination fog-straight stream with shut-off.

2.6 Angle Valves

.1 ULC listed for fire service. NPS 1-1/2 cast or forged brass complete with hand wheel, open or drip connections, or hydrolator valve. Where water pressure exceeds 100psi (690kPa), 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 3/4" (20mm) nominal diameter hose 9' (30m) long, and nozzle.

2.8 Pumper Connection

.1 To ANSI/NFPA 14, ULC listed, siamese type, location as indicated. Threads to be compatible with local fire department complete with threaded metal caps and chains.

.2 [Polished chrome plated, recessed with identifying sign cast on plate.]

.3 [Freestanding sidewalk type. Cast Brass Body, Brass or Red Aluminum escutcheon plate, Red aluminum break-off caps or brass plugs, 18" polished brass cover sleeve.

.4 Acceptable material: [National Fire Equipment model 229 or approved equal][National Fire Equipment model 207 or equal.].

2.9 Pressure Gauges

.1 90mm diameter, to Section 15122 - Thermometers and Pressure Gauges.

2.10 Finishes

.1 In finished areas, chrome plate valves, nozzles, fittings.

.2 Cabinets.

.1 Tub: Prime coated white.

.2 Door and frame: Prime coated white [other finishes].

PART 3 EXECUTION

3.1 Installation

.1 Install and test to acceptance in accordance with ANSI/NFPA 14.

.2 Testing to be witnessed by authority having jurisdiction.

.3 Install drain pipes and valves to drain all parts of systems and so arranged that any one standpipe riser can be drained without shutting down any other parts of systems.

.4 Install 90mm diameter pressure gauge in accordance with Section 15122 - Thermometers and Pressure Gauges at top of each riser and in accordance with ANSI/NFPA 14.

.5 Supply and install additional 10 lbs (4.5kg), dry chemical extinguishers, mounted on brackets in:

.1 All mechanical and electrical rooms.

.2 Garbage rooms.

.3 Commercial kitchens.

.4 Elevator machine rooms.

.6 Fire hose cabinets and piping installed in the outside walls shall be insulated and all piping and valves traced by Div. 16.

END.

PART 1 GENERAL

1.1 References

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

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals and in accordance with ANSI/NFPA 13, working plans and design requirements.

.2 All shop drawings and hydraulic calculations shall be sealed and signed by a professional engineer permanently licensed in the province of Ontario.

1.3 Engineering Design Criteria

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

.1 Hazard:

.1 To suit occupancy as indicated.

.2 Pipe size and layout:

.1 Hydraulic design.

.2 Sprinkler head layout: to ANSI/NFPA 13.

.3 Water supply:

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

.5 Sprinkler head layout indicated on drawings is for a general sprinkler system coverage. Final layout, reflected in the shop drawings, must be co-ordinated with architectural, structural, electrical and mechanical drawings.

1.4 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in Section 01300 - Submittals.

1.5 Maintenance Materials

.1 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

PART 2 PRODUCTS

2.1 Pipe, Fittings and Valves

.1 Pipe:

.1 Ferrous: to ANSI/NFPA 13.

.2 Copper tube: to ANSI/NFPA 13.

.3 CPVC: Listed for sprinkler system.

.2 Fittings and joints to ANSI/NFPA 13:

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

.2 Copper tube: screwed, soldered, brazed.

.3 CPVC: Listed for sprinkler system.

.3 Valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2 (DN 50): bronze, screwed ends, OS&Y gate.

.3 NPS 2-1/2 (DN 65) and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.

.4 Swing check valves.

.5 Ball drip.

.4 Pipe hangers:

.1 ULC listed and galvanized for fire protection services.

2.2 Sprinkler Heads

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

2.3 Sprinkler Head Type A

.1 Upright bronze. In areas with unfinished ceilings. Provide protective metal cages where sprinkler heads are likely to be damaged.

2.4 Sprinkler Head Type B

.1 [Pendant][recessed][concealed]glass bulb type. In areas with suspended ceilings, quick response.

2.5 Sprinkler Head Type C

.1 Sidewall in suites installed in the bulkheads, [concealed] [recessed] c/w covers. Quick response, extended coverage.

2.6 Alarm Check Valve

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

2.7 Supervisory Switches

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

.2 Valves:

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

.3 Flow switch type:

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

.4 Pressure alarm switch:

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

2.8 Excess Pressure Pump

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

.2 Motor: EEMAC Class B squirrel cage induction 1725 rpm, continuous duty, drip proof, ball bearing, maximum temperature rise 122°F (50°C).

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

.4 Electrical wiring by Division 16.

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

2.9 Pressure Gauges

.1 ULC listed and to Section 15122 - Thermometers and Pressure Gauges.

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

2.10 Signs

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

2.11 Spare Parts Cabinet

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

.2 Construct to sprinkler head manufacturers standard.

2.12 Water Gong

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

2.13 Fire Department Connection

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

.2 [.2] Polished chrome plated, flush, with identifying sign cast on plate. Threaded metal caps and chains.

.3 [.3] Sidewalk type, otherwise similar to Item .2 above.

PART 3 EXECUTION

3.1 Installation

.1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13. Submit certification sealed and signed by a Professional Engineer that the system has been designed, installed and tested as per NFPA-13.

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

.3 Testing to be witnessed by authority having jurisdiction.

.4 Install “dry type” heads in freezers, coolers, exit stairs subject to ventilation under O.B.C. 3.2.6 Section and any other areas subject to possible freezing.

.5 Install sprinkler heads in the garbage chute on the top level, alternate floor levels and on the level above the garbage room. Provide a tamper and a flow switch.

END.

PART 1 GENERAL

1.1 References

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

.2 FC 403 - Sprinkler Systems.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals and in accordance with ANSI/NFPA 13.

1.3 Samples

.1 Submit samples in accordance with Section 01300 - Submittals.

.2 Submit samples of following:

.1 Each type of sprinkler head.

1.4 Engineering Design Criteria

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

.1 Hazard:

.1 To suit occupancy as indicated.

.2 Pipe size and layout:

.1 Hydraulic design.

.2 Sprinkler head layout: to ANSI/NFPA 13.

.3 Water supply:

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

1.5 Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in Section 01300 - Submittals.

1.6 Maintenance Materials

.1 Provide maintenance materials in accordance with Section 01731 - Maintenance Materials, Special Tools and Spare Parts.

.2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

PART 2 PRODUCTS

2.1 Pipe, Fittings and Valves

.1 Pipe:

.1 Ferrous: to ANSI/NFPA 13.

.2 Copper tube: to ANSI/NFPA 13.

.2 Fittings and joints to ANSI/NFPA 13:

.1 Ferrous: screwed, or roll grooved.

.3 Auxiliary valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2 (DN 50): bronze, screwed ends, OS&Y gate.

.3 NPS 2-1/2 (DN 65) and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.

.4 Swing check valves.

.5 Ball drip.

.6 Tamper devices wired back to fire alarm panel.

.4 Pipe hangers:

.1 ULC listed for fire protection services.

2.2 Sprinkler Heads

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

2.3 Sprinkler Head

.1 Type F

.1 Upright bronze - in parking levels.

2.4 Auxiliary Supervisory Switches

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

2.5 Water Gong

.1 Valves:

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

.2 Flow switch type:

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

.3 Pressure alarm switch:

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

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

2.6 Fire Department Connection

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

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

.3 [.3] Sidewalk type, otherwise similar to Item .2 above.

2.7 Dry Pipe Valve

.1 ULC listed.

.2 Cast iron, flanged type, sized to suit water main.

.3 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.

2.8 Compressed Air Supply

.1 Automatic Air Compressor, voltage as indicated in electrical drawings.

.2 ULC listed.

.3 Capacity:

.1 To restore normal air pressure in the system within 30 min.

.2 To provide air pressure of 20psi (140 kPa) in excess of calculated trip pressure of dry pipe valve or in accordance with instruction sheet furnished with dry pipe valve.

.4 Piping: ferrous, NPS 3/4 (DN 20) screwed joints and fittings, to ANSI/NFPA 13.

2.9 Pressure Gauges

.1 ULC listed and to Section 15122 - Thermometers and Pressure Gauges.

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

2.10 Relief Valve

.1 ULC listed.

2.11 Spare Parts Cabinet

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

.2 Construct to sprinkler head manufacturers standard.

PART 3 EXECUTION

3.1 Installation

.1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13. Submit certification sealed and signed by a Professional Engineer that the system has been designed, installed and tested as per NFPA 13.

.2 Testing to be witnessed by authority having jurisdiction.

.3 Install water gong as indicated.

.4 Install fire department connection as required.

.5 Install spare parts cabinet as indicated.

.6 Pressure gauges:

.1 Location

.1 On water side and air side of dry pipe valve.

.2 At air receiver.

.3 In each independent pipe from air supply to dry pipe valve.

.4 At exhausters and accelerators.

.2 Install to permit removal.

.3 Locate so as not subjected to freezing.

.7 Valve identification:

.1 Identify drain valve, by-pass valves and main shut-off valve and all auxiliary valves.

Z:\specification\2014 SPEC\14-021 Southway\Mechanical\2015-##-## Issued for Pricing\MECHANICAL ISSUED FOR PRICING MAY 29 2015\15315 Dry Pipe Sprinkler Systems.doc

END.

PART 1 GENERAL

1.1 References

.1 ASTM A126-84(1991), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62-93, Specification for Composition Bronze or Ounce Metal Castings.

.3 ANSI/AWWA C700-90, Cold Water Meters-Displacement Type.

.4 ANSI/AWWA C701-88, Cold Water Meters-Turbine Type for Customer Service.

.5 ANSI/AWWA C702-86, Cold Water Meters-Compound Type.

.6 CAN/CSA-B64-07, Backflow Preventers and Vacuum Breakers.

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

.8 CSA-B356-00, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.9 PDI-G101-81, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.

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

1.2 Submittals

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

.2 For shop drawings, indicate dimensions, construction details and materials.

.3 For product data, indicate dimensions, construction details and materials for all items specified herein.

PART 2 PRODUCTS

2.1 Floor Drains (FD)

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

.2 FD-1: general duty; cast iron body round, adjustable head, sediment basket nickel bronze strainer, integral seepage pan, and clamping collar, trap seal primer connection. Ancon FD-200, 4 NPS.

.3 FD-3: Same as FD1 but for membrane floor.

.4 FD-5: FFD, Similar to FD-01 c/w funnel.

2.2 Area Drain (AD)

.1 AD-01: Watts Drainage FD-870-TG, round/square stainless steel grate, with chain, sediment bucket, weepholes, ballast guard, riser sections, deck clamp, perforated standpipe 4" (100mm) dia. Use round strainer in planting areas. Use square strainer in paved areas. Provide flow restricting device as indicated. Standpipe height to be determined on site.

2.3 Roof Drain (RD)

.1 RD-01: controlled flow, Watts Drainage RD-200, epoxy coated cast iron body, under deck clamp and sump receiver to suit roof construction, flashing clamp ring with integral gravel stop, bearing pan, flow control weir assembly, metal dome, 8" (200mm) diameter.

.2 RD-02: similar to RD-01 but for use in floating slab with snowmelt system, Kinetics standard isolation drain or approved equal.

2.4 Cleanout

.1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access covers:

.1 Wall access: face or wall type, polished nickel bronze or stainless steel square and or round cover with flush head

securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor access: rectangular round cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for unfinished concrete floors: nickel bronze round or square, gasket, vandal-proof screws.

.3 Cover for terrazzo finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.

.4 Cover for tile and linoleum floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.5 Cover for carpeted floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.5 Non Freeze Wall Hydrant (NFWH)

.1 NFWH: Recessed with integral vacuum breaker, NPS 3/4 (DN 20) hose outlet, removable operating key, cover. Chrome plated finish. Ancon HY-725.

.2 Allow for four (4) NFWH and a reasonable amount of piping over and above those shown on the plans. Connect nearest DCW header or main and provide isolating valve.

.3 Where NFWH are shown by symbols only provide shut-off valve and all piping required to connect to the nearest domestic cold water main.

2.6 Water Hammer Arrestor

.1 Stainless steel. Bellows type: to PDI-WH 201. Provide for each group of fixtures.

2.7 Back Flow Preventer

.1 To CAN/CSA-B64 Series.

.2 Application: as indicated.

.3 Reduced pressure principle type: Watts series [009], [909].

.4 Double check valve assembly: Watts series [009], [909].

.5 Back flow preventer with intermediate atmospheric vent or vacuum breaker: Watts.

.6 Pipe water outlets to hub drain, use air gaps and install as per Code.

2.8 Vacuum Breaker

.1 To CAN/CSA-B64 Series.

2.9 Hose Bibb (HB)

.1 HB-01 (HB): Hose bibb, bronze, complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated. Install in heated areas only. Chicago Faucet model 998-RCF.

.2 Allow for four (4) HB and a reasonable amount of piping over and above those shown on the plans. Connect to nearest domestic cold water header or main and provide isolating valve.

.3 Provide isolating valve.

2.10 Washer Dryer (WD)

.1 WD-01: Non metallic, valved domestic cold and hot water connections, 2 NPS (DN 50) drain for washer. Oatey or LSP Products. Also designated WD.

.2 WD-02: Metallic as above.

.3 All domestic clothes washing machines shall be provided with laundry mate, domestic cold and hot water connections, shut off valves, trap and drain.

.4 Use metallic washer box or rated washer box in fire separations.

2.11 Air Gap

.1 Watts 909-AG.

2.12 Trap Seal Primer

.1 All brass, with integral vacuum breaker, NPS 1/2 (DN 15) solder ends, NPS 1/2 (DN 15) drip line connection.

.2 ETSP: Electronic Trap Seal Primer shall be PPP Inc. PT series c/w vacuum breaker, 24 h clock, manual override switch, 120V solenoid valve, 120V 3-wire connection, 3/4" (19mm) FNPT connection, Calibrated manifold, 1/2" (12mm) outlet compression fittings.

2.13 Water Pressure Reducing Valves (PRV)

.1 Bronze body, bypass, pressure gauges, Watts 25AUB.

.2 Where indicated install auxiliary PRVs for low demand flows.

2.14 Pipe isolation within suite walls

.1 ACOUSTO-PLUMB or equal pipe isolation and mounting products, clamps, hangers, escutcheons for metallic piping.

2.15 Backwater Valve

.1 Supply and install 6" (150mm) dia. backwater valve on the sub-drainage system.

.2 Backwater valve shall be installed in a sump 40" x 24" (1000mm x 600mm) c/w cover.

.3 Provide access, clean-outs as required.

2.16 Running Trap

.1 Supply and install a running trap as required by the Ontario Building Code (OBC).

.2 Provide clean-outs and venting as required by OBC.

2.17 Hub Drains

.1 Install hub drains for all condensate drains serving all AC, cooling units and emergency/standby generator silencers.

.2 Provide trapped and primed connections to the nearest drains. All venting as per OBC. Trap seal primers shall be connected to the nearest cold water supplies.

2.18 Therapeutic Baths and Other Special Fixtures

.1 Provide complete rough-in for therapeutic baths and other special fixtures supplied by others. Make all final connections as required.

2.19 Expansion Tank

.1 Supply and install a diaphragm type expansion tank on DHW system at storage tanks, potable water rated.

2.20 Grease interceptor

1. Canplas ENDURA, 50 gpm capacity, install as per manufacturer's instructions. Shall be constructed of engineered thermoplastic Lid shall be capable of supporting 400 lbs minimum. 10 year warranty.

PART 3 EXECUTION

3.1 Installation

.1 Install all devices in accordance with provincial codes, and local authority having jurisdiction.

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

.3 Provide hot water washdown for the garbage chute c/w high hazard backflow preventer.

3.2 Cleanouts

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

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

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

3.3 Non Freeze Wall Hydrants

.1 Install 24" (600mm) above finished grade unless otherwise indicated.

.2 Install one NFWH on each side of the building, allow for 40' (12m) of water supply pipe for each NFWH.

3.4 Water Hammer

.1 Arrestors

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

3.5 Back Flow Preventers

.1 Install in accordance with CAN/CSA-B64 Series, where indicated and elsewhere as required by Code:

.1 For irrigation systems.

.2 For make-up water assemblies.

.3 For food processing systems etc.

.2 Pipe discharge to terminate over nearest drain.

.3 Provide test report.

3.6 Hose Bibbs and Sediment Faucets

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

.2 Install one hose bibb on every parking level. Allow for 20' (6m) of water supply for each hose bib and as indicated.

3.7 Washer Dryer Wall Boxes

.1 Install LM-01 in non rated walls, recessed. Install LM-02 in rated walls (STC or fire rated walls), surface mount if space permits, recessed otherwise. Recessed boxes shall be caulked all around and all air gaps caulked. Use fire caulk in rated walls.

.2 Install on a side of the washer for easy access.

3.8 Trap Seal Primers

.1 Install for all floor drains and elsewhere, as indicated. Allow for adequate length of piping.

.2 Install on cold water supply to nearest frequently used plumbing fixture.

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

.4 Install ETSP as per manufacturer’s instructions.

3.9 Floor Drains, Hub Drains

.1 Install floor drains in but not limited to:

.1 In all common laundry rooms.

.2 In all garbage rooms.

.3 In all public washrooms.

3.10 Pipe Isolation

.1 Install pipe acoustic isolation products in all suite party walls. Install isolating grommets at all piping passing through metal studs or other sharp obstructions.

3.11 Start-up

.1 Floor drains:

.1 Prime, using trap primer.

.2 Clean out baskets.

.2 Roof Drains:

.1 Clean out baskets.

.3 Rectify start-up deficiencies.

3.12 Commissioning

.1 In context of this paragraph, "verify" to include "demonstrate" to Engineer.

.2 Timing: commission only after start-up deficiencies rectified.

.3 Access doors: verify size and location relative to items to be services.

.4 Adjust to suit site conditions, including, but not necessarily limited to, following:

.1 Floor drains:

.1 Verify proper operation of trap primer, flushing features.

.2 Verify security and removability of strainers.

.2 Roof drains:

.1 Verify installation at low points in roof.

.2 Verify security and removability of dome.

.3 Adjust weirs to suit actual roof slope and meet requirements of design.

.4 Verify provision for movement of roof and integrity of roof drain piping system.

.3 Cleanouts:

.1 Verify covers are gas tight, secure and easily removable.

.2 Verify that cleanout rods can probe as far as next cleanout.

.4 Non-freeze wall, ground hydrants:

.1 Verify complete drainage.

.2 Verify operation of vacuum breaker.

.5 Water hammer arrestors:

.1 Verify accessibility.

.6 Backflow preventers, vacuum breakers:

.1 Verify installation of correct type to suit application.

.2 Adjust as necessary to ensure proper operation.

.3 Verify visibility of discharge

.4 Verify pipe to drain.

.7 Trap seal primers:

.1 Verify operation.

.2 Adjust flow rate to suit site conditions.

.3 Adjust ETSP discharge as Owner directs.

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END.

PART 1 GENERAL

1.1 Products Installed but not Supplied Under this Section

.1 Install rough-in for all equipment and appliances supplied by others, complete with valves on hot and cold water supplies, waste and vent.

.2 Equipment installed by others.

.1 Connect with unions.

.3 Equipment not installed.

.1 Capped for future connection.

.4 Obtain final detailed equipment layouts and list of equipment from suppliers (kitchen, laundry etc.) before proceeding with work.

.5 Make final connections to all equipment and fixtures supplied by others.

1.2 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 01355 - Waste Management and Disposal.

.3 Section 15014 - Closeout Submittals.

.4 Section 15401 - Plumbing Specialties and Accessories.

1.3 References

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-B45.5-02, Plumbing Fixtures.

.2 CAN/CSA-B125.3-05, Plumbing Fittings.

.3 CAN/CSA-B651-M95, Barrier-Free Design.

.4 Ontario Building Code (OBC) - 2012.

1.4 Shop Drawings

.1 Submit shop drawings and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate, for all fixtures and trim:

.1 Dimensions, construction details, roughing-in dimensions.

.2 Water flow rate.

.3 Maximum and minimum pressures.

.3 All plumbing fixtures shall be pre-approved by the Owner before a submission to the consultant is made. Contractor shall obtain final plumbing fixtures selection from the Owner.

1.5 Closeout Submittals

.1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 15014 - Closeout Submittals.

.2 Include:

.1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.

.2 Details of operation, servicing, maintenance.

.3 List of recommended spare parts.

PART 2 PRODUCTS

2.1 Manufactured Units

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.

.3 Exposed plumbing brass to be chrome plated.

.4 Number, locations: Architectural drawings to govern for all fixtures rough-in.

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

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

.7 WC-1: Water closet, barrier free, American Standard CADET 3 2886.500, elongated, 16.5" (413mm) high, 1.6 gpf (6 Lpf), elongated seat with cover, supply with angle stop. White.

.8 WC-2: Water closet, barrier free, American Standard CADET 3 2886.500, elongated, 16.5" (413mm) high, 1.6 gpf (6 Lpf), open front and cover, supply with angle stop. White.

.9 LAV-[1]: Suites lavatory, American Standard Cadet 9494.001, deck mount, 4" (100mm) centres, vitreous china, drain, P-trap, supplies with angel stops. Chrome. To fit [24][30][36]" ([600][750][900]mm) wide counter.

.1 Fitting faucet to be Delta model 520-WF, single lever, deck mount, 1 or 3 hole application, ceramic cartridge with high temperature rotational limit stop, pop-up.

.10 LAV-[2]: Barrier-free lavatory, same as LAV-1. To fit [24][30][36]" ([600][750][900]mm) wide counter.

.1 Faucet to be same as LAV-1 and with offset grid drain.

.2 Where water supply temperature to handicapped accessible lavatories exceeds 109°F (43°C) supply and install insulation on the complete exposed drain, hot water, and cold water, piping under the lavatory.

.3 Insulation kits shall be an integral skin white antibacterial/fungal polyurethane foam product equal to Skal Gard by TCI Products, or Prowrap by McGuire.

.11 LAV-[3]: China semi-counter basin American Standard Messo model 9960-908, drain, P-trap, supplies with angle stops chrome. To fit [24][30][36]" ([600][750][900]mm) wide counter.

.1 Faucet to be same as L1 and with offset grid drain.

.12 MS: Mop sink, shall be 24" x 24" (600mm x 600mm) moulded stone with 10" (250mm) high walls, with cadmium plated brass drain assembly, dome strainer and lint basket. Trim shall be chrome plated with vacuum breaker, integral stops, adjustable wall

brace, pail hook and hose spout. Also supply 30" (750mm) long hose, and hose holder, mop hanger, and vinyl bumper guard.

.1 Acceptable materials: Fiat MSB-2424 with Fiat 830AA trim.

.13 SH-1: Shower, shower acrylic base American Standard 3636.ST, non-slip surface, 36"x36" (900mm x 900mm), door shall be MAAX “Destiny” glass doors, 70" (1750mm) high, clear glass, chrome frame model No. 137685-900-084.

.1 Fittings: Delta model 1482, shower valve, cast brass valve and trim, pressure balancing controller, 2.1 gpm (7.9 Lpm) adjustable luxury shower head.

.14 SH-2: Shower stall Mirolin model S48 L/R, single piece acrylic sheet with reinforced with fibreglass, acrylic towel bar factory installed 24" (600mm) long grab bar, colour to match shower stall, chrome drains, trap.

.1 Door: Miroglide shower door M34, tri panel, is designed for the S48 series.

.2 Fitting: Shower valve, Delta model R10000-UNWS, single handle, pressure balance valve only with limit stops, lever handle Delta model T-17030,personal white ABS hand held shower with fixed spray with button on-off control, 69" (1725mm) double spiral hose, 36" (900mm) long slide/grab bar, 90º wall supply elbow with atmospheric vacuum breaker Delta model RPW336HDF.

.15 SH-3: Roll-in shower stall, one-piece, Mirolin model RS436L/R shower meets CSA/OBC/CNC Codes, acrylic surface with reinforced fibreglass, chrome floor drain, trap pre-installed white grab bars with backing, white curtain rod, white fold-up seat with stainless steel supports.

.1 Fitting: Shower valve, Delta model R10000-UNWS, single handle, pressure balance valve only, lever handle less insert, Delta model T-17030, 36" (900mm) long slide/grab bar, 90º wall supply elbow. Atmospheric vacuum breaker Delta model RPW336HDF.

.16 SH-4: Control valve and shower head shall be heavy duty, pressure balancing controller, max. temperature limit stop, single control metal lever handle, supply elbow with flange and in-line vacuum breaker.

.1 Shower head and grab bar: stainless steel ADA wall grab bar and hand shower system, 2.1 gpm (7.9 Lpm) flow adjustable hand shower spray with 36" (900mm) long wall grab bar system, 69" (1725mm) ultraflex hose.

.2 Acceptable material: Symmons model 1-250-X-62003-UF.

.17 HS: Hair sink, wall hung, Willoughby model No. 1911-WF-VB, wall carrier as required, crumb strainer, roll out spray, vacuum breaker, tempra valve tcp-2, pressure balancing located under the sink, water supplies c/w shut off valves, hair interceptor Smith model 8750.

.18 KS-1: Kitchen sink, Kindred model QSL1515/6, single bowl, stainless steel, sound deadening pad, crumb cup strainers, P-trap, drain. To fit [24][30][36]" ([600][750][900]mm) wide counter.

.1 Fittings: Delta model 470, single handle, signature pull-out spray, deck mount, quick snap hose installation, supplies with angle stops.

.19 KS-2: Kitchen sink, Kindred model QCL2027/8, large bowl/small bowl, stainless steel, sound deadening pad, crumb cup strainers, P-trap, drain. To fit [24][30][36]" ([600][750][900]mm) wide counter.

.1 Fittings: Delta model 470, single handle, signature pull-out spray, deck mount, quick snap hose installation, supplies with angle stops.

.20 KS-3: Kindred model QSL1719/8, single bowl, stainless steel, sound deadening pad, crumb cup strainers, P-trap, drain. To fit [24][30][36]" ([600][750][900]mm) wide counter.

.1 Fittings: Delta model 26C3933, rigid/swivel gooseneck spout, deck mount flow control aerator outlet, 3" (75mm) hooded lever handles, quick snap hose installation, supplies with angle stops.

.21 KS-4: Utility sink, Kindred model QSL2225/12 single bowl stainless steel, sound deadening pad, crumb cup strainers, P-trap, drain.

.1 Fittings: Delta 55T1513, 8" (200mm) deck mount, spray with spring loaded stainless steel hose auto shut-off, hooded

lever, quick snap hose installation, supplies with angle stops.

.22 LT: Laundry tub, single tub with legs, strainer with plug, chrome plated faucet, shut-off valves, supplies, trap and drain piece.

.23 Hot water tank pan, all aluminum construction, .032" (0.81mm) thick, rolled exposed edges. A 1" (25mm) dia. drain connection.

.24 Where water supply temperature to handicapped accessible lavatories and kitchen sinks exceeds 109°F (43°C) supply and install insulation on the complete exposed drain, hot water, and cold water, piping under the lavatory.

.1 Insulation kits shall be an integral skin white antibacterial/fungal polyurethane foam product equal to Skal Gard by TCI Products, or Prowrap by McGuire.

PART 3 EXECUTION

3.1 Installation

.1 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

.2 Wall-hung fixtures: measured from finished floor.

.3 Physically handicapped: to comply with most stringent of either NBCC or CAN/CSA B651.

.4 Provide approved type mixing valves on KS, LAV fixtures as required. 120°F (49°C) max.

3.2 Adjusting

.1 Conform to water conservation requirements specified this section and as per the OBC.

.2 Adjustments.

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.3 Checks.

.1 Aerators: operation, cleanliness.

.2 Vacuum breakers, backflow preventers: operation under all conditions.

.3 Wash fountains: operation of flow-actuating devices.

.4 Thermostatic controls.

.1 Verify temperature settings, operation of control, limit and safety controls.

.5 Fixture pipe sizes unless indicated, NPS (DN):

Fixture	DCW	DHW	SAN
WC, tank type	1/2 (15)		3 (75)
WC, flush valve	1 (25)		3 (75
U	3/4 (20)		2 (50)
Lav	1/2 (15)	1/2 (15)	1 (25)
Bath	1/2 (15)	1/2 (15)	1-1/2 (40)
Shower	1/2 (15)	1/2 (15)	1-1/2 (40)
Kitchen Sink	1/2 (15)	1/2 (15)	1-1/2 (40)
Janitor sink	1/2 (15)	1/2 (15)	2 (50)
NFWH	3/4 (20)		
Hose Bibb	3/4 (20)		
Floor Drain			3 (75
Funnel Floor Drain			3 (75)
Hub drain			3 (75)
Washer/Dryer	1/2 (15)	1/2 (15)	2 (50)
Dish Washer		1/2 (15)	1-1/4 (32)

.1 Provide trap seal for all floor drains.

.2 All domestic clothes washers shall have dedicated sanitary and vent stacks.

.3 Make all connections for all equipment and fixtures supplied by others. (Kitchen equipment, laundry room equipment and other specialty plumbing fixtures.)

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END.

PART 1 GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

1.1 References

.1 Underwriters' Laboratories of Canada (ULC)

.1 ULC S636-08, Standard for Type BH Gas Venting Systems.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Clearly indicate following:

.1 Methods of sealing sections.

.2 Methods of expansion.

.3 Details of thimbles.

.4 Bases/Foundations.

.5 Supports.

.6 Guy details.

.7 Rain caps.

.8 Insulation.

1.3 Closeout

.1 Submittals

.1 Submit operation and maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

1.4 Certifications

.1 Catalogued or published ratings shall be those obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 Type ‘B’ Gas Vent

.1 ULC labelled, 550˚F (288˚C) rating maximum, atmospheric gas vent only.

.2 Sectional, prefabricated, double wall with 13mm air space. Aluminum inner wall. Galvanized steel outer wall. Mated fittings and couplings.

2.2 Accessories

.1 Cleanouts: bolted, gasketted type, full size of breeching, as indicated.

.2 Barometric dampers: 70% of full size of breeching area.

.3 Hangers and supports: in accordance with recommendations of Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA).

.4 Listed rain cap.

.5 Expansion sleeves with heat resistant caulking, held in place as indicated.

PART 3 EXECUTION

3.1 Installation - General

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

.2 Suspend breeching at 5' (1.5m) centres and at each joint.

.3 Support chimneys at bottom, roof and intermediate levels as indicated. Where chimneys or vents are more than 4' (1.2m) high supply and install guide wire systems.

.4 Install thimbles where penetrating roof, wall, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.

.5 Install flashings on chimneys penetrating roofs, as indicated and required.

.6 Install rain caps, access doors and cleanouts, as indicated and required.

.7 All venting arrangements shall comply with boilers/gas fired equipment manufacturers instructions and requirements.

.8 Install residential dryer(s) venting as per manufacturer's instructions and as per relevant Codes and Standards. Size of vents will be determined from the manufacturer's instructions. Domestic dryer vent: to Class 1 as per CAN/ULC S110.

.9 All combustion air supply air ducts and pipes shall be insulated.

END.

PART 1 GENERAL

1.1 References

.1 NEMA MG1, Part 30.

.2 NEMA MG1, Part 31.

.3 IEEE-519 (most recent edition).

.4 CSA 22.2 (most recent edition).

.5 UL508C.

1.2 Scope

.1 Provide Variable Frequency Drive (VFD) for each:

.1 Cooling tower.

.2 Heating circulating pump.

.3 Chilled water circulating pump.

.4 Heat pump loop circulator.

.5 Domestic cold water booster pump.

.2 Provide on-site commissioning of the VFD by factory trained service personnel. Adequate time must be allowed to thoroughly and safely start, program, and test run the VFD with the building management system. A separate site visit shall be provided for training of operation and maintenance personnel.

1.3 Submittals

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Approval submittals shall include the following and approvals must be received prior to delivery of any goods:

.1 A detailed description of all components in the VFD package, including line and load reactor impedance ratings

and or filter design type, VFD current, HP, and voltage rating.

.2 A list of any exceptions to this specification.

.3 Harmonic specification compliance calculations.

.4 Schematic wiring diagram showing all VFD package component connections and all serial, digital and analog inputs and outputs to be connected to the control system.

.5 Mechanical dimensional drawings with mounting details.

.3 On completion of the installation, the supplier shall provide the following:

.1 Full commissioning report documenting all programmable settings, AC input voltage, DC Bus voltage, current draw at maximum speed, and a description of ambient conditions.

.2 One operator's manual for each VFD installed.

.3 One 8.5" x 14" (216mm x 356mm) legal size (wiring diagram for each VFD installed.

1.4 General Design Characteristics

.1 The VFD shall be of the Pulse Width Modulated (PWM) voltage source type, utilizing fixed diode bridge input rectification and Insulated Gate Bipolar Transistor (IGBT) / Intelligent Power Module (IPM) technology.

1.5 Timing

.1 Commissioning to commence only after satisfactory completion of start-up, verification of performance and 30 day test period as specified above.

.2 Commissioning of occupancy, weather, and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied, except as follows:

.3 The VFD shall be dual rated for variable torque applications, with the continuous duty output current on the nameplate. The overload rating shall be 125% for 60 seconds. The VFD shall be selected such that the continuous duty current rating shall be

equal to or greater than the connected motor full load current rating.

.4 All VFDs shall be factory CSA/CUL certified.

.5 All packaged drive systems shall be CSA certified.

.6 The VFD shall have a minimum displacement power factor of 0.96 or higher at all output frequencies.

.7 The VFD and all options must be supplied in a single NEMA 1 enclosure. The enclosure may be of a Wall or Floor mount design, depending on the rating.

.8 Warranty of the VFD System shall be for 18 months from the date of start-up or 12 months from date of delivery, which ever is sooner. The warranty shall include all parts and repair labour.

PART 2 PRODUCTS

2.1 Standard VFD Design Features

.1 Microprocessor Logic: The VFD shall include a 32 bit microprocessor, Digital Signal Processor and a digital keypad.

.2 Digital Inputs: The VFD shall include a minimum of five (5) digital inputs programmable for function.

.3 Analog Inputs: The VFD shall accept an analog speed reference input signal of 0-5 VDC, 0-10 VDC, and/or 4-20 ma.

.4 Digital Outputs: The VFD shall include two (2) digital outputs each programmable for drive run, frequency arrival (at set speed) or over torque.

.5 Analog Output: The VFD shall provide an analog output signal (0-10 VDC, @ 1ma) proportional to the output frequency or output current.

.6 Alarm Relay Outputs: The VFD shall provide an alarm relay which activates during a fault condition. The relay contacts shall include a set of normally open/normally closed contacts.

.7 Auto Restart: The VFD shall have the capability to automatically restart the motor after an interruption in input power.

.8 Critical Frequency Rejection: The VFD shall provide a minimum of three(3) selectable jump frequency points used to avoid critical resonance of the mechanical system. Frequency bandwidth for each jump frequency shall be programmable from 0 to +/- 9.9 Hz.

.9 DC Injection Braking: The VFD DC braking control shall be capable of automatic initiation prior to all start commands to stop a "wind-milling" fan motor before issuing a run command. The duration and amplitude of this setting is to be programmable through the operator interface.

.10 Acceleration/Deceleration Control: The VFD shall provide independent programmable settings for accel/decel time (0-999 seconds). The VFD shall include a setting to allow the motor to coast to a stop.

.11 Carrier Frequency: The carrier frequency shall be programmable from 3 kHZ up to a maximum of 16 kHz.

.12 Energy Savings:

.1 The VFD shall be programmable for variable torque V/F curves to optimize energy consumption.

.2 The VFD shall include an Automatic Energy Savings feature to further reduce energy consumption by minimizing the current demand of the motor for a given load, automatically.

.13 Automatic Voltage Regulation: The VFD shall maintain the rated starting torque independent of the input voltage tolerance of +/-10%.

.14 Power Loss Ride-though: The VFD shall have a ride-through capability during an intermittent loss of power for up to 15 mSec.

.15 Min/Max Speed: Minimum and maximum speed settings shall be adjustable from 0 - 100%.

.16 Safety Interlocks: Terminals to be provide for connection of safety interlocks such as Fire-stat and Freeze-stat. These interlocks shall shutdown operation in either the Drive or Bypass (if supplied) operating modes.

.17 Door Mounted Operator Controls/Indicators: The basic operator controls shall consist of the following:

.1 Hand – Off – Auto Selector Switch.

.2 Indicating Lights for:

.1 Power On.

.2 Run.

.3 Fault.

.4 External Fault.

.5 At Set Speed.

.6 Hand Mode.

.7 Auto Mode.

.3 Drive Keypad for setting parameters, control and viewing of Speed, Current, and Alarms.

2.2 Output Ratings

.1 The VFD shall operate within the following rated values:

.1 Output Frequency Range: 0.1 to 400 Hz.

.2 Frequency Accuracy: +/- 0.01% with respect to digital input setting.

.3 Overload Rating: VT – 125% for 60 seconds.

2.3 Input Power

.1 Voltage:

.1 3 phase (3 wire) 575 V +/- 10%.

.2 3 phase (3 wire) 200-230 +/- 10%.

.2 Frequency: 60 Hz +/-5%.

2.4 Environmental Ratings

.1 The VFD shall operate within the following parameters without the need for derating:

.1 Temperature: 14 to 104°F (-10 to 40°C).

.2 Humidity: 20 - 90% RH non-condensing.

.3 Altitude: up to 3280' (1,000m).

.4 Vibration of 0.2g or less.

2.5 Protective Features

.1 The VFD shall be designed to include the following protective functions and displays for maintainability:

.1 All control circuits (5, 12, & 24 VDC) shall be physically and electrically isolated from the power circuit voltages to ensure safety to maintenance personnel.

.2 Instantaneous Overcurrent Protection: The output of the VFD shall automatically be turned off if the operating current exceeds the specified level.

.3 Motor Overload Protection: The VFD shall include electronic thermal overload protection with provision for automatic reduction of the overload limit at reduced operating speed. The output of the VFD shall be disabled if the motor's thermal rating is exceeded.

.4 External Trip: The VFD shall have the capability to accept an external trip input and the input shall be programmable for either N/O or N/C operation.

.5 Phase Loss Protection: Phase loss detection shall be provided to prevent single phasing of the VFD input.

.6 Unattended Start Protection: The VFD shall include a user selectable function to prevent an automatic restart after an interruption in input power.

.7 Over Voltage Protection: The output of the VFD shall be automatically cut off if the DC Bus voltage exceeds the specified level due to regenerative energy from the motor.

.8 Ground Fault Protection: The VFD shall have the capability to sense current imbalance during motor start-up for protection of the power circuit in the event of a ground fault.

.9 Software Lock: The VFD shall include a software function which prevents changes to the user defined settings.

.10 Power Module Protection: The IPM shall incorporate thermal and short circuit protection circuits.

.11 CPU or EEPROM Error: VFD shall automatically be turned off in the event of an error in the CPU or EEPROM.

.12 Option board communication error: VFD will automatically be turned off in the event of an option board error.

2.6 Input & Output Filtering

.1 All VFD packages shall be furnished with the following protective devices as a minimum:

.1 5% impedance harmonically compensated Line reactors rated to carry 150% total RMS current continuously. Drive shall be connected to Inverter Duty (MG1 Part 31) motors only.

2.7 Option Features

.1 Non-Fused Input Disconnect:

.1 Provide a Non-Fused Input Disconnect. The Non-Fused disconnect shall be integrally mounted and wired with the VFD in the drive enclosure and be provided with a door interlock mechanism to prevent unauthorized entry with power on. In addition, the disconnect must have provision for padlocking in the "Off" position.

.2 Overload Relay:

.1 Provide a separately mounted overload relay for each motor in a multi-motor application.

.3 Weather-Proof Enclosure:

.1 Provide VFD and all accessories in a weather-proof, ventilated enclosure suitable for rooftop mounting. Rooftop enclosure to include a thermostatically controlled

space heater for control of condensation. Contractor to mount the enclosure out of direct sunlight.

.4 Serial Communication (Johnson Metasys N2):

.1 Provide a Serial Communication interface to each VFD via a RS485 port for Interface to a Johnson Metasys N2 network.

2.8 Harmonics/IEEE-519-1992 Compliance

.1 All VFD installations must meet IEEE-519-1992 harmonic guidelines for control of harmonics. Calculations to demonstrate compliance must be supplied with shop drawings.

2.9 Acceptable Products

.1 Cooling tower: Hitachi.

.2 Pumps: ABB.

PART 3 EXECUTION

3.1 Installation

.1 Supply and install VFD for each pump, fan etc. as required.

.2 Pump VFD controls shall be based on a differential pressure controller.

.3 Differential pressure controller shall measure pressure differential:

.1 Between supply - return mains.

.2 Between supply - return piping of the most remote riser.

3.2 Start-up and Commissioning Services

.1 The manufacturer shall provide start-up and commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer site.

.2 Start-up services shall include checking for verification of proper operation and installation of the VFD, its options and its interface wiring to the building automation system. Included in this service shall be as a minimum:

.1 Verification of contractor wire terminations and conduit runs to and from the VFD.

.2 Minimum eight hours of customer operator training on the operation and service diagnostics at the time of commissioning.

.3 Measurement for verification of proper operation of the following:

.1 Motor voltage and frequency. Verification of proper motor operation.

.2 Control input for proper building automation system interface and control calibration.

.3 Calibration check for the following set-points:

.1 Minimum speed.

.2 Maximum speed.

.3 Acceleration and deceleration rates.

.3 Commissioning agent to verify the programming of the VFD and to provide a written copy of the settings to the Engineer.

.4 Commissioning agent to lock out critical frequencies throughout the operating curve of the equipment as identified and required by the Engineer. The agent shall record amperages at six (minimum) different frequencies from minimum to maximum speed.

3.3 Site Examination

.1 The contractor is to verify that the jobsite conditions for installation meet the factory recommended and code required conditions for the VFD installation prior to start-up. These shall include as a minimum:

.1 Clearance spacing.

.2 Compliance with environmental ratings of the VFD system.

.3 Separate conduit installation of the input wiring, the motor wiring, and control wiring. At no time does any of this wiring run in parallel with each other.

.4 All power and control wiring is complete.

.5 VFD to be programmed such that minimum flow is maintained through chillers during pump alternation.

.6 Ensure VFD is programmed or re-programmed as required to maintain correct pump rotation.

.2 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD system shall not be operated while the unit is covered.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15072 - Vibration Isolation

.2 Section 15073 - Seismic Restraint

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate following: fan curves showing point of operation, motor drive, bearings, filters, coils, plus all performance data.

1.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

1.4 Extra Materials

.1 Provide maintenance materials in accordance with Section 15014 - Closeout Submittals.

.2 Spare filters: In addition to filters to be installed immediately prior to acceptance by Engineer, supply 1 complete set of filters for each filter unit or filter bank.

.3 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

.4 Provide maintenance materials in accordance with Section 15014 - Closeout Submittals.

1.5 References

.1 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1

PART 2 PRODUCTS

2.1 Horizontal/ Vertical Direct Drive Hydronic Fan Coil

.1 Factory assembled components to form unit s supplying air at designed conditions, as indicated.

.2 Horizontal/vertical as indicated, having air tight modular components, consisting of casing, fan section with motor and drive, filter section, heating coil, cooling coil, control valves.

.3 Units shall have remote mounted multi-speed selector switch, all wiring for the speed control by Division 15.

.4 Units shall have acoustically insulated return air plenums ± 24" (600mm) long.

2.2 Casings

.1 Provide G60 galvanized steel casing. Insulate with 3/4" (19mm) dual-density neoprene coated glass fibre. Discharge shall be equipped with duct collar. Side panel shall be removable for access. Filter shall be 1" (25mm) throwaway type. Steel parts, where not galvanized, to be painted over with corrosion resistant paint to CGSB 1-GP-181M.

.2 Coil connections and condensate drain shall be stubbed out of unit.

2.3 Drain Pans

.1 Construction: Continuous galvanized steel, insulated with closed cell insulation and sealed with mastic. Rounded corners.

.2 Drain connection: In bottom at low point.

.3 Installation: Slope without sag minimum 1% to ensure no standing water at any time or at any point.

.4 Connect condensate drains to dedicated condensate riser or to the nearest sanitary or storm drains as per Plumbing Code.

2.4 Fans

.1 Centrifugal fans: Selected to operate in stable part of performance curve at all times and services self aligning bearings. Provide internally externally mounted motor.

.2 Direct drive units shall have DWDI forward curved fans. Motors shall be three speed permanent split capacitor type with resilient mount, sleeve bearings, oilers and internal thermal overload protection.

.3 Maximum: Sound power levels, as indicated.

.4 Fan motor shall be high efficiency type.

2.5 Vibration Isolation

.1 Spring isolators and as indicated.

2.6 Filter Box

.1 Exterior to unit in filter grille or filter rack as indicated.

.2 Provide blank-off plates and gaskets to prevent air bypass.

.3 Filters: to Section 15861 - Filters and Filter Gauges.

2.7 Coils

.1 Capacity: as indicated scheduled on drawings.

.2 Ratings: ARI certified.

.3 Fan coils shall have aluminum fin, copper tube coils with manual air vents.

.4 Units shall have 2-way control valves for heating and chilled water.

2.8 Residential Unit List

.1 See motor list.

.2 All units to have factory 2-way control valves, air vents and all controls, two pipe or four pipe as indicated on drawings.

2.9 Thermostats

.1 A 24 volt, heat/cool, seven (7) day programmable/four (4) time periods per day, digital display, non-volatile memory, set point limiting. Fan Coil Unit speed shall be selectable from thermostat, minimum three (3) speeds, fan-on-auto-off, automatic changeover, and aquastat. Provide all necessary relays for N.O./N.C. valve operation.

.2 Install Aquastat on the riser.

2.10 Transformers

.1 Provide control transformer. All control wiring by Division 15. Power connection by Division 16.

2.11 Disconnect Switch

.1 Unit shall be included with built-in disconnect switch. Power wiring by Division 16.

PART 3 EXECUTION

3.1 Installation

.1 Install units in accordance with manufacturer's instructions and as indicated.

.2 Ensure adequate clearance for: Servicing and maintenance.

.3 Check units for excessive vibration.

.4 Flush and clean the systems as described in the general instructions.

.5 Install CBVs on heating/chilled water supplies and set the flows as indicated.

.6 Supply access panels for installation by others. Panels shall allow for unit and filter servicing. Panels shall have acoustical insulation.

.7 All control valves shall be installed for easy servicing.

.8 Install flexible duct connections at fan coil unit inlet and supply openings.

.9 Install vibration isolators.

3.2 Drip Pans

.1 Install deep seal P-traps and trap seal primer on drip lines. Depth of water seal to be 1.5 times static pressure at this point.

.2 Connect condensate drains to the nearest suitable drain or condensate riser via trap.

.3 Condensate drains/risers shall be indirectly connected to the building sanitary system via trap.

END.

PART 1 GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Submit product data sheets for unit heaters. Include:

.1 Product characteristics.

.2 Performance criteria.

.3 Mounting methods.

.4 Physical size.

.5 Heating rating, voltage, phase.

.6 Cabinet material thicknesses.

.7 Limitations.

.8 Colour and finish.

.3 Manufacturer's instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate:

.1 Equipment, capacity and piping connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.3 Closeout Submittals

.1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 Cabinet Unit Heaters

.1 Acceptable manufacturers as indicated.

.2 Cabinet: type as indicated, 0.062" (1.6mm) thick steel with rounded exposed corners and edges, removable panels, glass fibre insulation and integral air outlet and inlet.

.3 Finish with factory applied primer coat.

.4 Special cabinets, and front panels: as indicated.

.5 Coils: aluminum fins mechanically bonded to copper tubes. Hydrostatically tested to 145psi (1 MPa).

.6 Fans: centrifugal statically and dynamically balanced, direct driven, sleeve bearings, resilient mounted.

.7 Motor: Multi-speed, tapped wound permanent split capacitor type with sleeve bearings, built-in thermal overload protection and resilient rubber isolation mounting.

.8 Filters: Removable 1" (25mm) thick permanent washable type.

.9 Capacity: As indicated.

.10 Control:

.1 Control thermostat: integral electric or remote as indicated, rating to suit cabinet unit heater, set point locking device, concealed adjustment. (Control wiring by Division 16 for remote thermostat).

.11 Factory install disconnect switch.

.12 Line voltage thermostat for fan cycling c/w lockable cover.

2.2 Horizontal Unit Heaters

.1 Acceptable manufacturers as indicated.

.2 Casing: 1.6mm thick cold rolled steel, gloss enamel finish, with threaded connections for hanger rods.

.3 Coils: Seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing. Hydrostatically test to 145psi (1 MPa).

.4 Fan: Direct drive propeller type, factory balanced, with anti-corrosive finish and fan guard.

.5 Motor: Speed as indicated continuous duty, built-in overload protection, and resilient motor supports.

.6 Air outlet: Adjustable louvres.

.7 Thermostat: Electric, line voltage, integral or remote, locking cover, set point locking device, (control wiring by Division 16 for remote thermostat).

.8 Factory installed disconnect switch.

.9 Line voltage thermostat to control fan c/w cycling. Lockable cover.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Provide double swing pipe joints as required.

.3 Check final location with Engineer if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

.4 Hot water units: for each unit, install valves as indicated. Install drain valve at low point. Install manual air vent at high point. Install a circuit balancing valve and set to water flow as indicated, install ball valve on return pipe.

.5 Clean finned tubes and comb straight.

.6 Provide supplementary suspension steel as required.

.7 Install thermostats in locations indicated.

.8 Before acceptance, set discharge patterns and fan speeds to suit requirements.

END.

PART 1 GENERAL

1.1 General

.1 Supply and install materials and design technology for snow melting systems and slab heat systems.

.2 Contractor shall submit complete shop drawings including the loops layout, information for all components, control, wiring diagrams and calculations.

1.2 References

.1 DIN 4726, Plastics piping systems for warm water surface heating systems and radiator connecting systems.

.2 ASTM:

.1 F876, Standard Specification for Crosslinked Polyethylene (PEX) Tubing

.2 F877, Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold Water Distribution Systems

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

.1 ASHRAE 90.1

PART 2 PRODUCTS

2.1 Pipe

.1 Pipe embedded in concrete or stapled to underside of slab shall be Type 'A', cross-linked polyethylene (hePEX-PLUS 3 polymer layers of oxygen diffusion barrier manufactured to ASTM F876 standard) piping for areas requiring heating rated at 180°F (82°C) maximum working temperature and up to 100 psi (690kPa) working pressure in accordance with ASTM standard F876 and F877. Loop lay-out to be in accordance with manufacturer’s submitted design.

.2 The pipe shall be manufactured by the "Engel Method". The pipe shall have a 2-layer oxygen diffusion barrier capable of

limiting oxygen diffusion through the pipe to no greater than 5 x 10^{-6} oz/ft^3 (0.005 gram/m^3) day at 40°F (4°C) to DIN 4726.

.3 Pipe shall have 100% thermal memory when heated to 266°F (130°C).

.4 The minimum bend radius for cold bending of the pipe shall not be less than eight (8) times the outside diameter. Bends with a radius less than stated will require the use of a bend support by the pipe manufacturer.

2.2 Fittings & Manifolds

.1 Tubing fittings shall be manufactured of dezincification resistant brass. Fittings shall be supplied by the pipe manufacturer. The pipe fitting shall consist of a barbed insert, a serrated compression ring, and a nut capable of connecting to the manifold.

.2 Manifolds shall be of cast bronze construction and shall have integral loop balancing, and loop control valves. Supply and return manifolds shall be able to vent air from the system and shall be provided with support brackets. Manifolds shall be isolated from supply and return piping with valves that are suitable for isolation and balancing.

.3 Provide thermometers and pressure gauges as shown on the drawings and where required.

2.3 System Components

.1 Piping: Acceptable material - Type 'A'.

.2 Heat exchanger: Acceptable material - brazed plate type.

.3 System pumps: Acceptable material - see pump schedule for primary/secondary.

.4 Air eliminator: Acceptable material - SPIROVENT.

.5 Expansion tank: As selected by system manufacturer.

.6 Ethylene glycol fill at 50% concentration.

2.4 System Design

.1 Manufacturer to provide heating system loop lay-out and control components package design. System installation to be supervised and start-up by local representative.

2.5 System Control

.1 The heating system control shall form part of the complete conditioning package:

.1 Automatic valves.

.2 Solid state snow-ice reset controllers pre-wired in NEMA panels.

.3 Snow-ice and slab sensors.

.4 Glycol temperature sensors.

.2 The heating system control shall be capable of shutting down the system when outdoor air temperature is above 40°F (4.4°C).

.1 In the case of a heat tracing system, this condition is met when the conditions of the protected fluid will prevent freezing.

.2 In the case of a slab/pavement heating system, the heating system control shall be capable of shutting down the system when the pavement/slab temperatures are above 50°F (10°C), or when no snow/ice accumulation will occur during shutdown when outdoor air temperature is above 40°F (4.4°C).

2.6 Warranties

.1 All in-slab hePEX piping to be installed under manufacturer authorized supervision in order to qualify for manufacturer's 24 year warranty.

PART 3 EXECUTION

3.1 Installation

.1 Contractor must pressure test for 24 hours all in slab piping with air to manufacturer’s recommendations prior slab concrete pour.

.2 24V wiring and start-up of control package shall be done by system manufacturer.

.3 Maintain proper clearances to permit service and maintenance.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 15950 - Testing, Adjusting and Balancing (TAB) of Mechanical System.

1.2 References

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

.2 National Fire Protection Agency (NFPA).

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate following:

.1 Sealants.

.2 Tape.

.3 Proprietary Joints.

1.4 Certification of Ratings

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 Seal Classification

.1 Classification as follows:

Maximum Pressure, psi (Pa)	SMACNA Seal Class
0.072 (500)	B
0.036 (250)	B
0.018 (125)	C

.2 Seal classification:

.1 Class A: Longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: Longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.

.3 Class C: Transverse joints and connections made air tight with gaskets sealant tape or combination thereof. Longitudinal seams unsealed.

2.2 Sealant

.1 Sealant: Oil resistant, polymer type flame resistant duct sealant. Temperature range of -508°F (-300°C) to 1706°F (930°C).

2.3 Tape

.1 Tape: Aluminum type adhesive, Alumagrip 701 or equal.

2.4 Duct Leakage

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.5 Fittings

.1 Fabrication: To SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius, short radius with single thickness turning vanes in tight areas only.

.2 Round: five piece.

.3 Mitred elbows, rectangular:

.1 To 16" (400mm): with single thickness turning vanes.

.2 Over 16" (400mm): with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with radius on branch 1.5 times width of duct (commercial), 45° entry on branch (residential).

.2 Round main and branch: Enter main duct at 45° with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20° maximum included angle.

.2 Converging: 30° maximum included angle.

.6 Offsets:

.1 Full radiused elbows.

.7 Obstruction deflectors: Maintain full cross-sectional area. Maximum included angles: as for transitions.

2.6 Firestopping

.1 Retaining angles around duct, on both sides of fire separation.

.2 Firestopping material and installation must not distort duct.

2.7 Galvanized Steel

.1 Thickness, fabrication and reinforcement: to ASHRAE SMACNA.

.2 Joints: to ASHRAE and SMACNA.

2.8 Hangers and Supports

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 20" (500mm).

.2 Hanger configuration: to ASHRAE and SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods.

Duct Size, inches (mm)	**Angle Size, inches (mm)**	**Rod Size, inches (mm)**
to 30 (750)	1 x 1 x 1/8 (25 x 25 x 3)	1/4 (6)
over 30 (750) to 42 (1050)	1-9/16 x 1-9/16 x 1/8 (40 x 40 x 3)	1/4 (6)
over 42 (1050) to 60 (1500)	1-9/16 x 1-9/16 x 1/8 (40 x 40 x 3)	3/8 (10)
over 60 (1500) to 84 (2100)	2 x 2 x 1/8 (50 x 50 x 3)	3/8 (10)
over 84 (2100) to 96 (2400)	2 x 2 x 3/16 (50 x 50 x 5)	3/8 (10)
over 96 (2400)	2 x 2 x 1/4 (50 x 50 x 6)	3/8 (10)

.4 Upper hanger attachments:

.1 For concrete: Manufactured concrete inserts.

.2 For steel joist: Manufactured joist clamp.

.3 For steel beams: Manufactured beam clamps.

PART 3 EXECUTION

3.1 General

.1 Do work in accordance with NFPA, ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Support risers in accordance with ASHRAE and SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 Hangers

.1 Strap hangers: Install in accordance with SMACNA.

.2 Angle hangers: Complete with locking nuts and washers.

.3 Hanger spacing:

Duct Size, inches (mm)	**Spacing, inches (mm)**
to 60 (1500)	120 (3000)
over 60 (1500)	100 (2500)

3.3 Kitchen Exhaust

.1 Systems:

.1 Install to NFPA 96 and as indicated.

3.4 Dishwasher:

.1 Exhaust Duct

.1 Duct shall be stainless steel or aluminum, water tight joints.

3.5 Sealing and Taping

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and re-coat with minimum of one coat of sealant to manufacturers recommendations.

.3 All bathroom, dryer and range hood exhaust ducts shall be galvanized spiral, sized as indicated and all sealed with adhesive aluminum duct tape. Range hood - 5" (125mm) dia. Bathroom/dryer exhaust - 4" (100mm) dia.

3.6 Leakage Tests

.1 Do leakage tests in sections.

.2 Make trial leakage tests as instructed to demonstrate workmanship.

.3 Complete test before insulation or concealment.

Z:\specification\2014 SPEC\14-021 Southway\Mechanical\2015-##-## Issued for Pricing\MECHANICAL ISSUED FOR PRICING MAY 29 2015\15811 Ductwork - Low Pressure Metallic to 500Pa.doc

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

1.2 References

.1 National Fire Protection Association (NFPA.)

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.3 Underwriter's Laboratories of Canada (ULC).

1.3 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate the following:

.1 Thermal properties.

.2 Friction loss.

.3 Acoustical loss.

.4 Leakage.

.5 Fire rating.

1.4 Certification of Ratings

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 Samples

.1 Submit samples with product data of different types of flexible duct being used in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

PART 2 PRODUCTS

2.1 General

.1 Factory fabricated to CAN/ULC S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 Metallic - Uninsulated

.1 Type 1: spiral wound flexible aluminum.

.2 Performance:

.1 Factory tested to 0.36psi (2.5kPa) without leakage.

.2 Maximum relative pressure drop coefficient: 3.

2.3 Metallic - Insulated

.1 Type 2: spiral wound flexible aluminum with factory applied, 1.5" (37mm) thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket.

.2 Performance:

.1 Factory tested to 0.36psi (2.5 kPa) without leakage.

.2 Maximum relative pressure drop coefficient: 3.

PART 3 EXECUTION

3.1 Duct Installation

.1 Install in accordance with: SMACNA.

.2 Maximum length to be 36" (900mm) for final connections of terminal units (grilles, diffusers).

.3 No flexible ducts shall be used in bathroom, dryer and range hood exhaust systems.

END.

PART 1 GENERAL

1.1 Related Sections

.1 Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Section 01355 - Waste Management and Disposal.

1.2 References

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

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible (most recent edition).

1.3 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

1.4 Certification of Ratings

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 General

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

2.2 Flexible Connections

.1 Frame: galvanized sheet metal frame mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at -40°F (-40°C) to 194°F (90°C), density of 0.081 lb/ft^3 (1.3 kg/m^2).

.3 Suitable for interior or exterior use as indicated.

2.3 Access Doors in Ducts

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.02" (0.6mm) thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.02" (0.6mm) thick complete with sheet metal angle frame and 1" (25mm) thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 12" x 12" (300mm x 300mm): two sash locks.

.2 Greater than 12" to 18" (301mm to 450mm): four sash locks complete with safety chain.

.3 Greater than 18" to 40" (451mm to 1000mm): piano hinge and minimum two sash locks.

.4 Greater than 40" (1000mm): piano hinge and two handles operable from both sides.

.5 Hold open devices.

2.4 Turning Vanes

.1 Factory or shop fabricated single thickness to 12" (300mm), double thickness, to recommendations of SMACNA and as indicated.

2.5 Instrument Test

.1 0.063" (1.6mm) thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 1.10" (28mm) minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 Spin-In Collars

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

2.7 Escutcheons

.1 Conical galvanized sheet metal escutcheons one gauge thicker than duct, one piece, tight fitting on duct.

PART 3 EXECUTION

3.1 Installation

.1 Flexible connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air handling units and fans. Shall be exterior grade where applicable.

.2 Inlets and outlets of exhaust and supply air fans.

.3 Supply and return air duct connections of all air handling systems (roof top units, make-up air units, fan coils, heat pumps etc.)

.4 As indicated.

.2 Length of connection: 4" (100mm).

.3 Minimum distance between metal parts when system in operation: 3" (75mm).

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access doors and viewing panels:

.1 Size:

.1 24" x 24" (600mm x 600mm) for person size entry.

.2 12" x 12" (300mm x 300mm) for servicing entry.

.3 6" x 6" (150mm x 150mm) for viewing.

.4 As indicated.

.2 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 Elsewhere as indicated.

.3 Instrument test ports.

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations.

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub-main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Engineer.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

.5 Escutcheons:

.1 Install on all exposed ducts, rectangular or round, at penetrations of walls, ceilings or floors.

.2 If fire damper is present then make large enough to cover damper and associated angles. Shall not compromise functioning of fire damper.

END.

PART 1 GENERAL

1.1 References

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible (most recent edition).

1.2 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate the following: size, type, operator type.

PART 2 PRODUCTS

2.1 General

.1 Manufacture to SMACNA standards.

2.2 Splitter Dampers

.1 Of same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Double thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: Piano hinge.

.6 Folded leading edge.

2.3 Single Blade Dampers

.1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside bronze end bearings.

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

2.4 Multi-Bladed Dampers

.1 Factory manufactured of material compatible with duct.

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

.3 Maximum blade height: 4" (100mm).

.4 Bearings: Pin in bronze bushings.

.5 Linkage: Shaft extension with locking quadrant.

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

PART 3 EXECUTION

3.1 Installation

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 All dampers to be vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Install balancing opposed blade dampers at all grilles, diffusers, duct branches, and where indicated.

.8 Install balancing dampers at duct run-outs in case of:

.1 Exposed duct systems.

.2 Suspended T bar ceilings.

.9 Install balancing/volume dampers at grilles and diffusers in case of suspended drywall ceilings.

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END.

PART 1 GENERAL

1.1 References

.1 ASTM A525M-90, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

1.2 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

PART 2 PRODUCTS

2.1 Multi-Leaf Dampers

.1 Parallel or opposed blade type as indicated.

.2 Dampers shall be 4" (100mm) deep. Blades shall be 0.063" (1.6mm) thick, thermally broken with high density Polyurethane non-CFC injected foam insulation. Frame shall be 0.081" (2.1mm) thick, thermally broken with polystyrene insulation. Axles shall be 0.375" (9.5mm) thick, Aluminum square bar. Blade and Jamb seals shall be neoprene. Air leakage through a 36" x 36" (900mm x 900mm) damper shall not exceed 3 CFM/ft^2 (16 LPS/m^2) against 4" water gauge (1 kPa) static pressure at standard air (as per AMCA testing). Operating temperature range shall be -40° to 180°F (-40° to 82°C).

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: Plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with RSI 0.88.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

.6 Acceptable material: Alumavent, Tamco, Price or approved equal.

PART 3 EXECUTION

3.1 Installation

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper.

.5 Motorized dampers shall be installed at all louvres and grilles facing the outside wall.

.6 Motorized dampers shall be installed on all roof or exterior wall mounted exhaust fans.

.7 All motorized dampers installed outside or subject to the weather elements shall be of water/weather proof type.

END.

PART 1 GENERAL

1.1 References

.1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA) NFPA-90A.

.2 Underwriters Laboratories of Canada (ULC).

.3 Ontario Building Code Section 3.1.8.7.

1.2 Product Data

.1 Submit product data in accordance with Section 15012 - Submittal Procedures.

.2 Indicate the following:

.1 Fire dampers, dynamic and static.

.2 Fire stop flaps.

.3 Operators.

.4 Fusible links.

.5 Design details of break-away joints.

1.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

1.4 Extra Materials

.1 Provide maintenance materials in accordance with Section 15014 - Closeout Submittals.

.2 Provide following:

.1 Six (6) fusible links of each type.

1.5 Certification of Ratings

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to Codes and Standards.

PART 2 PRODUCTS

2.1 Fire Dampers

.1 Fire dampers: arrangement Type B, listed and bear label of ULC, meet requirements of authorities having jurisdiction. Fire damper assemblies to be fire tested in accordance with CAN4-S112. All fire dampers shall be dynamic type. Static fire dampers may be used in unducted transfer wall openings.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.3 Top hinged: offset, round or square; multi-blade hinged sized to maintain full duct cross section.

.4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.5 1.6" x 1.6" x 0.12" (40mm x 40mm x 3mm) retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.6 Fire stop flaps-ULC listed, sizes to match the grilles and diffusers dimensions.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Install access door adjacent to each damper. See Section 15820 - Duct Accessories.

.5 Coordinate with installer of firestopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

.8 Fire dampers shall be installed in all fans, ducts, grilles, transfer openings in walls of:

.1 Mechanical and electrical rooms.

.2 Corridors.

.3 Garbage and storage rooms.

.4 Other service rooms.

.5 Locker rooms.

.6 Laundry rooms.

.7 Janitor's rooms.

.8 Commercial kitchens.

.9 Fire Control centres.

.9 Fire dampers shall be installed in all ducts penetrating floor/ceiling rated assemblies.

.10 Provide mock-up for review by AHJ and Engineer prior to full scale work.

.11 Where desired ceiling heights cannot be maintained by type B dampers which are same size as ducts then provide dampers of same cross sectional area and reduced height with transitions to duct.

.12 All supply and return air grilles and supply air diffusers shall have fire stop flaps when installed in drywall or suspended ceilings forming the fire rated assembly. Add fire blanket on the top side of diffusers.

.13 Static fire dampers can be used in transfer openings.

.14 Dynamic fire dampers shall be used in all forced air systems (ducts, fans, etc.).

Z:\specification\2014 SPEC\14-021 Southway\Mechanical\2015-##-## Issued for Pricing\MECHANICAL ISSUED FOR PRICING MAY 29 2015\15823 Dampers - Fire and Smoke.doc

END.

PART 1 GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 01001 1.15 - Submittals.

.2 Product data to include fan curves and sound rating data.

1.2 Operation and Maintenance Data

.1 Provide maintenance data for incorporation into manual specified in Section 01001 1.15 - Submittals.

PART 2 PRODUCTS

2.1 Fans General

.1 Capacity, total static pressure, revolutions per minute, power, model, size and sound power levels: as indicated.

.2 Sound ratings: Comply with AMA (Air Moving and Conditioning Association) 301-76 tested to AMA 300-67. Unit shall bear AMA certified sound rating seal.

.3 Fans: Statically and dynamically balanced, constructed in conformity with AMA 99-83.

.4 Ratings: Based on tests performed in accordance with AMA 210-74, and ASHRAE 51-85.

.5 Motors: Sizes as specified.

.6 Factory primed before assembly in colour standard to manufacturer.

.7 Scroll drains: Where indicated.

2.2 Inline Fans

.1 Fan shall be duct mounted, belt driven centrifugal square inline.

.2 Fan shall bear the AMCA certified ratings seal for sound and air performance.

.3 Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gaskets. Pivoting motor plate shall utilize threaded L-bolt design. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

.4 Wheel: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

.5 Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.

.6 Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty re-greasable ball type in a pillow block cast iron housing.

.7 Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

2.3 Prop Fans, Circulating Fans

.1 Transfer fans shall be a wall mounted, direct driven, propeller exhaust fan.

.2 Circulating fans shall be wall or ceiling mount.

.3 Fan shall bear the AMCA certified ratings seal for sound and air performance.

.4 Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor shall be mounted on a 12 gauge steel wire guard. The wire guard shall be bolted to a minimum 14 gauge wall panel with continuously welded corners and an integral venturi. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

.5 All steel fan components shall have an electrostatically applied, baked polyester powder coating.

.6 Propeller shall have aluminum blades riveted to a painted steel hub. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans. Propelled fans shall have the following options:

.1 Rear guard.

.2 Wall mounting sleeve guard.

.3 Wall mounting sleeve.

.4 Wall shutter/motorized damper.

.5 Front guard.

.6 Wall grille as indicated on plans.

.7 Motor: Motor shall be 115V/1Ph. open drip proof type with permanently lubricated sealed bearings.

.8 Transfer and circulating fans shall be on all the time.

2.4 Cabinet Fans

.1 Similar to inline fans but with grille on bottom face of fan housing suitable for ceiling mount.

2.5 Roof/Wall Supply/Exhaust Fans

.1 See specifications on mechanical drawings.

.2 Fans shall be direct driven or belt driven as indicated and specified.

.3 Fans shall be installed on roof curbs or wall flanges to suit.

.4 All fans shall be installed with motorized dampers, screens and insulated roof curbs.

.5 Kitchen exhaust fans shall be UL 762 certified.

.6 Dishwasher exhaust fans shall be belt driven, motor out of stream.

PART 3 EXECUTION

3.1 Fan Installation

.1 Install fans as indicated, complete with resilient mounting type as indicated and flexible electrical leads.

.2 Install fans with 100mm flexible connection on inlet and on discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25mm flex between ductwork and fan during running.

.3 Install fan restraining snubbers. Flexible connections shall not be in tension during running.

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

.5 All propeller fans installed on the outside walls shall have:

.1 Louvre and screen.

.2 Motorized damper.

.3 Wall sleeve.

.4 Wall box.

.5 Guard.

.6 Fire damper in fire separations.

.6 All propeller fans installed in walls indoor shall have:

.1 Grille and screen.

.2 Fire damper.

.3 Sleeve and wall box.

.4 Backdraft damper.

.5 Guard.

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END.

PART 1 GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

1.2 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

1.3 Extra Materials

.1 Provide maintenance materials in accordance with Section 15014 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.4 Certification of Ratings

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.5 References

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

.1 AMCA standard 301

.2 AMCA standard 300

.2 National Fire Protection Association:

.1 NFPA-96

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

.1 ASHRAE 90.1

PART 2 PRODUCTS

2.1 Fans General

.1 Sound ratings to comply with AMCA 301, tested to AMCA 300.

.2 Maximum loudness: 2.5 sones.

.3 Fans with motors greater than 0.75HP shall have automatic controls.

.1 Controls will be capable of shutting off fans when not required, unless fans are intended to operate continuously.

2.2 Washroom Exhaust Fans

.1 BEF: Ceiling cabinet type, Reversomatic [ECM motor type], 120V/1Ph., insulate 72" (1800mm) of 4" (100mm) diameter rigid duct from wallbox with 1" (25mm) thick thermal insulation c/w vapour barrier, max 2.5 sones rating.

.2 Wall box: Factory supplied single, double or triple insulated wall box as indicated. c/w neoprene backdraft damper (BDD), screen and extruded aluminum grille, neck sizes 5" (125mm) diameter or as indicated, finish as per Architect’s requirements.

.3 BDD to be Reversomatic ‘RD’ series or equal.

2.3 Dryer Booster Fan (DBF)

.1 DBF: Cabinet type, Reversomatic [ECM motor type], 120V/1Ph., isolating switch by Division 16, Reversomatic LT180 lint trap, [current sensor control provided by Division 15, installed and wired by Division 16. Current sensor to be rated for 1-50 amps input and have a 5 minute time delay to switch off DBF. Greystone CS-425-HC or equal. Install on hot wire.] Insulate 72" (1800mm) of 4" (100mm) diameter rigid duct from wallbox

with 1" (25mm) thick thermal insulation c/w vapour barrier. Provide fabricated mitred duct elbow at wallbox in tight quarters.

.2 Wall box and BDD similar to washroom exhaust fan Section above.

.3 AMP sensors shall be suitable for "Energy Star" appliances, high sensitive.

2.4 Range Hood

.1 RH: 30" (750mm) wide range hood, Broan Allure 2, multi-speed, 120V/1Ph. Insulate 72" (1800mm) of 5" (125mm) diameter rigid duct from wallbox with 1" (25mm) thick thermal insulation c/w vapour barrier.

.2 Wall box and BDD similar to washroom fan section above.

.3 Hood to be c/w filters, lights.

2.5 Kitchen Hoods, commercial type

.1 Kitchen exhaust hoods shall be supplied by others and installed by Division 15.

.2 All installation shall comply with NFPA-96.

.3 Kitchen hoods shall be constructed to UL710, ULC-S-646 and NFPA-96.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with manufacturer's recommendations.

.2 Install single, double or triple wall boxes as indicated, insulated and vapour barrier attached to the exterior wall vapour barrier (see architectural details).

.3 Where wall boxes are installed in curtain wall assemblies provide a transitional duct piece insulated and sealed. Make final connections to the wall louvres supplied and installed by the wall installer.

.4 Curtain wall extruded aluminum louvres shall be provided by Division 15 and handed over to the wall/window supplier for installation. Final wall box connections by Division 15.

.5 Install longitudinal seam exhaust ducts with seam not between 4 and 8 o’clock positions. Apply aluminum tape to all seams and joints.

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END.

PART 1 GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate the following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

1.2 Certification of Ratings

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.3 References

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

.1 ANSI/NFPA 96 (most recent edition), Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

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

.1 ASTM E90 (most recent edition), Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.4 Society of Automotive Engineers (SAE)

PART 2 PRODUCTS

2.1 Gooseneck Hoods

.1 Thickness: to ASHRAE and SMACNA.

.1 Kitchen: to ANSI/NFPA 96.

.2 Fabrication: to ASHRAE and SMACNA.

.1 Kitchen: to ANSI/NFPA 96.

.3 Joints: to ASHRAE and SMACNA

.4 Supports: as indicated.

.5 Complete with integral birdscreen of 1/8" (3.2mm) diameter aluminum wire. Use 1/2" (12mm) mesh.

.6 Provide [backdraft] [motorized damper] at roof line except in kitchen ducts.

.7 Provide 2" MERV 8 filter on all intakes unless indicated.

2.2 Fixed Louvres - Aluminum

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 48" (1.2m).

.4 Frame, head, sill and jamb: 4" (100mm) one piece extruded aluminum, minimum 1/8" (3.2mm) thick.

.5 Mullions: hidden, at 48" (1.2m) maximum centres.

.6 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Bird screen/Insect screen.

.8 Finish: factory applied custom to Architect’s approval: clear anodized aluminum, "Alumite #17 Clear" Architectural Class II

Anodic Coating in accordance with Aluminum Association Specification AA-M12C22A31, minimum 0.017" (0.43 mm) thickness.

.9 All louvres at the outside walls shall have a motorized damper supplied and installed by Division 15 and wired by Division 16.

.10 See Section 15832 - Domestic Fans, Range Hoods and Kitchen Fans for extruded aluminum louvres as part of wall box assemblies.

.11 Provide 2" MERV 8 filter on all intakes unless indicated.

2.3 Adjustable Louvres - Aluminum

.1 Adjustable (motorized) louvers shall be the drainable blade type with a frame depth of 4" (100mm). Frames and blades shall be 20 gauge galvanized aluminum. Blades shall be located on a 45 degree blade angle and shall have blade seals. Screens shall consist of 1/2" (12mm) 19 gauge galvanized aluminum, with an extruded frame, mounted to the louver interior, and be removable for cleaning.

.2 Bearings shall be permanently lubricated oilite bronze, press fit into frame. Axles shall be 1/2" diameter plated steel. Linkages shall be plates steel, concealed in jamb. Jambs to be c/w seals.

.3 Louvers shall be finished as selected by the architect.

.4 Actuator shall be provided by this contractor and wired by Division 16.

.5 Provide 2" MERV 8 filter on all intakes unless indicated.

PART 3 EXECUTION

3.1 Installation

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as indicated.

.3 Anchor securely into opening. Seal with caulking all around to ensure weather tightness.

.4 Decorative louvre dimensions and number of sections shall be determined from architectural elevations.

.5 Louvre finishes and colour shall be determined by the Architect.

END.

PART 1 GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

.2 Indicate the following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.6 Colour

.7 Mounting style.

1.2 Manufactured Items

.1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

1.3 Certification of Ratings

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 General

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames where set into plaster or gypsum board at all locations and as specified.

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: standard as directed by Engineer.

.5 Acceptable material: E.H. Price, Titus or approved equivalent.

2.2 Supply Grilles and Registers

.1 General: with opposed blade dampers.

.2 Type SA: steel 1" (25mm) border, double deflection with airfoil shape, horizontal face and vertical rear bars. Finish: white or as indicated. Grilles in exposed duct systems to have aluminum finish, E.H. Price B15 or equal.

Flow, CFM (LPS)	**Size, inches (mm)**
to 150 (70)	8 x 6 (200 x 150)
to 250 (120)	12 x 8 (250 x 200)
to 350 (165)	14 x 8 (350 x 200)
to 500 (235)*	18 x 18 (450 x 450)*

*Intended for corridor make-up air.

.3 Type SB: for garage transfer openings, steel 1" border, single deflection, horizontal bars. Finish: prime coat.

.4 Sizes as indicated.

.5 NC level: maximum 20.

2.3 Return and Exhaust Grilles and Registers

.1 General: with opposed blade dampers as indicated.

.2 Type RA: steel, 3/4" (19mm) border, single 45º deflection, horizontal face bars. Finish: white or as indicated. Grilles in exposed duct systems to have aluminum finish, E.H. Price B15 or equal.

.3 Type RB: steel, 3/4" (19mm) border, single 45º deflection, vertical face bars. Finish: white or as indicated. Grilles in exposed duct systems to have aluminum finish, E.H. Price B15 or equal.

.4 Type RC: aluminum, 3/4" (19mm) border, 1" x 1" (25mm x 25mm) egg crate type face bars, no damper. Finish: white or as indicated. Grilles in exposed duct systems to have aluminum finish, E.H. Price B15 or equal.

.5 Type RD: heavy duty, steel, 3/4" (19mm) border, single 45º deflection, horizontal face bars. Finish: white or as indicated. Grilles in exposed duct systems to have aluminum finish, E.H. Price B15 or equal. Model: E.H. Price 90.

.6 Type G: fans and or transfer openings in parking garage same as type RB. Provide 1" filter on intake into room.

.7 Sizes: as indicated.

.8 NC level: maximum 20.

2.4 Diffusers

.1 General: Volume control dampers.

.2 Type DA: steel, square type, 4-cone, having adjustable fixed pattern, lay-in and or surface mounted. Finish: white. Model: E.H. Price SCD. 24" x 24" (600mm x 600mm) or 12" x 12" (300mm x 300mm) as indicated, neck size as indicated.

.3 Type DB: steel, square rectangular multi-pattern lay-in and or surface mounted. Finish: white. Model: E.H. Price SMD. Panel size: 24" x 24" (600mm x 600mm), pattern sizes as indicated.

.4 Type DC: Similar to type DA but round.

.5 Type DD: linear slot diffuser, aluminum, E.H. Price SDS or approved equal.

.1 To 100 CFM (47 LPS): SDS 100, 2 slot, 50 CFM/ft (77LPS/m), NC18,

.2 To 250 CFM (118 LPS): SDS 100, 4 slot, 100 CFM/ft (155LPS/m), NC23.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with manufacturers instructions.

.2 Install with flat head oval head, steel cadmium plated screws in countersunk holes where fastenings are visible, same colour as frame.

.3 Bolt grilles, registers and diffusers in heavy traffic common areas and rooms.

.4 Provide all necessary duct transitions to all grilles and diffusers as required.

.5 All supply and exhaust grilles shall have balancing dampers where directly attached to ducts or plenums.

.6 Each supply air grille in suites shall have a manually operated volume damper.

.7 Adjust bars on single or double deflection grilles to 22º spread.

Z:\specification\2014 SPEC\14-021 Southway\Mechanical\2015-##-## Issued for Pricing\MECHANICAL ISSUED FOR PRICING MAY 29 2015\15852 Grilles, Registers and Diffusers.doc

END.

PART 1 GENERAL

1.1 References

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

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 52.1 (most recent edition), Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).

.3 Canadian General Standards Board (CGSB)

.4 Underwriters' Laboratories of Canada

1.2 Shop Drawings and Product Data

.1 Submit shop drawing and product data in accordance with Section 15012 - Shop Drawings, Product Data, Samples and Mock-Ups.

1.3 Closeout Submittals

.1 Provide maintenance data for incorporation into manual specified in Section 15014 - Closeout Submittals.

1.4 Maintenance Materials

.1 Provide maintenance materials in accordance with Section 15014 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

1.5 Extra Materials

.1 Spare filters: in addition to filters to be installed immediately prior to acceptance by Engineer, supply (1) complete set of filters for each filter unit or filter bank in accordance with Section 15014 - Closeout Submittals.

PART 2 PRODUCTS

2.1 General

.1 Media: suitable for air at 100% RH and air temperatures between -40°F (-40°C) and 122°F (50°C).

.2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.

.3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

2.2 Accessories

.1 Holding frames: permanent "T" section or channel section construction of same material as casing/hood, 0.063" (1.6mm) thick, except where specified otherwise.

.2 Seals: to ensure leakproof operation.

.3 Blank-off plates: as required, to fit all openings and of same material as holding frames.

.4 Access and servicing: through doors/panels on each side, from upstream/downstream.

2.3 Fibrous Glass Panel Filters

.1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.

.2 Holding frame: 1.2mm minimum thick galvanized steel with 3mm diam hinged wire mesh screen.

.3 Performance: minimum average synthetic dust weight arrestance 70%.

.4 Fire rated: to ULC -S111.

.5 Nominal thickness: 2" (50mm).

2.4 Filter Gauges - Dial Type

.1 Diaphragm actuated, direct reading.

.2 Range: zero (0) to two (2) times initial pressure.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

.2 Install Merv 13 filters and 30% prefilters on all:

.1 Fresh air make-up units.

.1 Maximum pressure drop: 0.25 inches water (62Pa) static pressure.

.3 Install 2" (50mm) thick pleated extended surface filters, throw away type, Merv 8, equal to AAF Perfect Pleat M8.

.1 Initial resistance pressure drop = .16 inches water (40Pa) at 300 FPM (1.5 m/s)

.2 Install on all roof top HVAC systems.

.4 Install 1" (25mm) thick AAF filter AM air 300x, throw away type, Merv-6.

.1 Initial resistance o.2 inches water (50Pa) at 300 FPM (1.5m/s)

.2 Install on all:

.1 Suite fan coil units.

.2 Common areas fan coil units.

.3 Air handlers, H.V.A.C. units.

3.2 Replacement Media

.1 Replace all media with new upon acceptance.

.2 Filter media to be new and clean, as indicated by pressure gauge, at time of acceptance.

3.3 Filter Gauges

.1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.

.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

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END.

PART 1 GENERAL

1.1 Summary

.1 Testing, Adjusting and Balancing (TAB) means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.

1.2 Qualifications of TAB Personnel

.1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Engineer within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

1.3 Purpose of TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 Submittals

.1 Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

.2 Submit in accordance with Section 15014 Closeout Submittals.

1.5 Exceptions

.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.6 Co-ordination

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 References

.1 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.3 Associated Air Balance Council (AABC).

.1 National Standards for Total System Balance (most recent edition).

.4 National Environmental Balancing Bureau (NEBB)

.1 Procedural Standards for TAB Environmental Systems

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Pre-TAB Review

.1 Review contract documents before project construction is started and confirm in writing to Engineer adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Engineer in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

3.2 Start-up

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 15.

3.3 Operation of Systems During TAB

.1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

3.4 Start of TAB

.1 Notify Engineer seven (7) days prior to start of TAB.

.2 Start TAB only when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, caulking.

.5 All pressure, leakage, other tests specified elsewhere Division 15.

.6 All provisions for TAB installed and operational.

.7 Start-up, verification for proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 All outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

3.5 Application Tolerances

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: +/-5 %.

.2 Hydronic systems: +/-5 %.

3.6 Accuracy Tolerances

.1 Measured values to be accurate to within +/- 2 % of actual values.

3.7 Instruments

.1 Prior to TAB, submit to Engineer list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

3.8 Preliminary TAB Report

.1 Submit for checking and approval of Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

3.9 TAB Report

.1 Format to be in accordance with referenced standard.

.2 TAB report to show all results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit six (6) copies of TAB Report to Engineer for verification and approval, in English in D-ring binders, complete with index tabs.

3.10 Verification

.1 All reported results subject to verification by Engineer.

.2 Provide manpower and instrumentation to verify up to 30 % of all reported results.

.3 Number and location of verified results to be at discretion of Engineer.

.4 Bear costs to repeat TAB as required to satisfaction of Engineer.

3.11 Settings

.1 After TAB is completed to satisfaction of Engineer, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.

.2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

3.12 Completion of TAB

.1 TAB to be considered complete only when final TAB Report received and approved by Engineer.

3.13 Air Systems

.1 Standard: TAB to be to most stringent of this section or TAB standards of SMACNA and ASHRAE.

.2 Do TAB of all systems, equipment, components, controls specified Division 15.

.3 Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB.

.4 Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

.5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls:

.1 Air velocity

.2 Static pressure

.3 Flow rate

.4 Pressure drop (or loss)

.5 Temperatures:

.1 Dry bulb (DBT)

.2 Wet bulb (WBT) or % relative humidity (%RH)

.3 Dewpoint (DPT)

.6 Duct cross-sectional area

.7 Equipment:

.1 RPM

.2 Electrical power

.3 Voltage

.4 Noise

.5 Vibration.

.6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of each damper, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At each controller, controlled device.

.7 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, run-out (or grille, register or diffuser).

3.14 Hydronic Systems

.1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, glycol systems.

.2 Standard: TAB to be to most stringent of this section or TAB standards of AABC and NEBB.

.3 Do TAB of all systems, equipment, components, controls specified Division 15.

.4 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.

.5 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC or NEBB.

.6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls:

.1 Flow rate

.2 Static pressure,

.3 Pressure drop (or loss)

.4 Temperature

.5 Specific gravity

.6 Density

.7 Equipment:

.1 RPM

.2 Electrical power

.3 Voltage

.4 Noise

.5 Vibration.

.7 Locations of equipment measurement: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of each heat exchanger (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.

.2 At each controller, controlled device.

.8 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of each primary and secondary loop (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.

3.15 Other Systems

.1 Plumbing systems:

.1 Standard:

.2 TAB procedures:

.1 Flush valves: adjust to suit project pressure conditions.

.2 Pressure booster systems: test for capacity and pressures under all conditions and at all times.

.3 Controlled flow roof drain systems: adjust weirs to suit actual roof conditions, slopes, areas drained.

3.16 Other TAB Requirements

.1 General requirements applicable to all work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

.2 Building pressure conditions:

.1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions during winter/summer conditions at all times.

.3 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish specified air pressure differentials, with all systems in all possible combinations of normal operating modes.

.4 Measurement of noise and vibration from equipment specified in Division 15.

3.17 Post-Occupancy TAB

.1 Measure DBT, WBT (or %RH), air velocity, air flow patterns, noise criteria (NC) levels, in occupied zone of following areas: Both parking garages, locker areas, ground floor lobby, ground floor exercise, one suite on each floor chosen at engineer's discretion, make up air unit, stair and elevator pressurization fans.

.2 Participate in systems checks twice during Warranty Period - #1 approximately three (3) months after acceptance and #2 within one (1) month of termination of Warranty Period.

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END.

PART 1 GENERAL

1.1 Summary

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.1 Control Description Logic (CDL) for each system.

.2 Input/Output Point Summary Tables for each system.

.3 System Diagrams consisting of the following; System architectural diagram, Control Design Schematic for each system, System flow diagram for each system.

1.2 Sequencing

.1 Sequencing of operations for systems as follows:

.1 Heating Pumps

.1 Manual sequencing and changeover.

.2 Boiler

.1 Tekmar controller stages boilers

.2 Internal boiler logic controls internal staging.

.3 Make-up Air Unit

.1 Provide time clock, by Division 15, and set schedule as advised during Testing, Adjusting and Balancing (TAB).

.4 Unit Heater

.1 Provide line voltage or low voltage as indicated heating thermostat behind lockable metal cover. Set to 65ºF (18ºC).

.5 Fan Coil Unit

.1 Suites: Provide low voltage one stage cool, one heat, thermostat, fan coil unit (FCU) speed selectable from thermostat and automatic changeover.

.2 Setpoints

.1 Suites:

.1 Heating: 72°F (22°C)

.2 Cooling: 75°F (24°C)

.2 Common Areas:

.1 Heating: 72°F (22°C)

.2 Cooling: 75°F (24°C)

.3 Make up air:

.1 Heating: 70°F (21°C)

.2 Cooling: 75°F (24°C)

.4 Vestibules:

.1 Heating: 72°F (22°C)

.2 Cooling: 75°F (24°C)

.5 Other service rooms and corridors:

.1 Heating: 65°F (18°C)

.2 Cooling: 80°F (27°C)

.6 Other common rooms and corridors:

.1 Heating: 72°F (22°C)

.2 Cooling: 75°F (24°C)

.7 Heating water supply: 180°F (82°C).

.8 Heating water return: 160°F (71°C).

Z:\specification\2014 SPEC\14-021 Southway\Mechanical\2015-##-## Issued for Pricing\MECHANICAL ISSUED FOR PRICING MAY 29 2015\15960 Sequence of Operation.doc

END.