Contents

1 General

1.1 General requirements

.1 The requirements of this section shall apply to all sections in Division 22.

.2 Conform to Division 1 General Conditions.

.3 All material, labour, equipment, and services required under this section shall be the full responsibility of the Plumbing Contractor including any material, labour, equipment, and services provided by their subcontractors.

.4 Complete and submit the Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of the tender documents.

1.2 Definitions

.1 “Supply” shall mean supply only.

.2 “Install” shall mean install and connect.

.3 “Provide” shall mean supply, install, and connect.

.4 “Drawings and Specifications” shall mean Contract Documents.

.5 “Authorities” or “Authorities having jurisdiction” shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.

.6 “Work” shall mean all equipment, materials, labour, and permits to provide a complete and operational plumbing system as detailed in the drawings and specifications.

.7 “Owner” shall mean Action Car and Truck.

1.3 Related work

.1 Division 1 – General

.2 Division 23 – HVAC

.3 Division 26 – Electrical

.4 Division 22 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions.

1.4 Intent

.1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.

.2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.

.3 Supply all labour, equipment, and materials necessary to install a complete and operational plumbing system described herein and shown on the drawings.

.4 It is the intent of these drawings and specifications to provide for a plumbing installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.

.5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.

.6 All work must be done by qualified, certified and experienced persons in such line of work. Trade certificates must be available on demand.

.7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.

.8 This Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.

.9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation and finish.

1.5 Codes, bylaws, standards, and regulations

.1 Refer to Section 01 41 00.

.2 The plumbing system shall comply with the latest editions and revisions of applicable codes, bylaws, standards, and regulations including but not limited to:

.1 Ontario Building Code

.2 ASHRAE

.3 Canadian Standards Association

.4 Local Building Bylaws

.5 Ontario Occupational Health and Safety Act

.3 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.

.4 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.

.5 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

1.6 Permits and fees

.1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes.

.2 Coordinate all required inspections and give necessary notice to all authorities.

.3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction for all applicable disciplines.

1.7 Contract breakdown

.1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.

.2 Breakdown shall include but not be limited to:

.1 Mobilization and shop drawing submission
.2 Underground plumbing and drainage
.3 Above ground plumbing and drainage
.4 Plumbing Fixtures
.5 Plumbing Drains
.6 Pumps
.7 Pipe Insulation
.8 Video of Drainage
.9 Testing, Startup & Training
.10 Close-out Submittals – Manuals & Record Drawings

.3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.

1.8 Shop drawings

.1 Refer to 01 33 00.

1.9 Product delivery schedule

.1 Refer to Sections 01 32 00 and 01 65 00.

1.10 Construction meetings

.1 The Plumbing Contractor shall attend all site meetings unless otherwise pre-approved.

.2 Sub-trades shall attend site meetings as requested or as required.

.3 Refer to 01 31 19.

1.11 Record drawings

.1 Refer to Section 01 78 00.

1.12 Reports

.1 Provide the following reports upon completion of work by certified Contractors for review and approval by the Consultant:

.1 Equipment Start-Up Reports

.2 Piping Pressure Test Reports

.3 VFD Startup Reports (where applicable)

.4 Backflow Preventer and Cross Connection Test Reports

.5 Other equipment startup reports and test sheets certified by the manufacturer or a qualified technician

.6 Demonstration and Training Reports/Logs

.7 Water quality test Reports by certified testing agency

.2 All reports shall be dated and signed by the Technician who performed the start-up and/or tests.

1.13 Maintenance manuals

.1 Refer to Section 01 78 00.

1.14 Testing

.1 Refer to Section 22 05 92.

.2 Test and startup all equipment and work.

.3 Fully coordinate all testing and startups with all trades, the Consultant, and authorities having jurisdiction.

.4 Provide adequate notice to all parties.

1.15 Demonstration and training

.1 Refer to Section 01 79 00.

1.16 Substantial completion and performance

.1 Substantial completion and performance shall be determined and awarded by the Consultant.

.2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:

.1 Fire Stopping

.2 System Testing and Startups including report

.3 Maintenance Manuals

.4 Record Drawings

.5 Demonstration and Training

1.17 Warranty

.1 Provide a full parts and labour warranty for the new system from date of substantial completion. Refer to 00 65 36 for details and terms.

.2 Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

2 Products

2.1 Materials

.1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.

.2 Major equipment shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.

.3 The same manufacturer shall be used for types of equipment used in similar applications.

.4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.

.5 Materials shall be stored in original containers.

.6 Submit to the Consultant and the Owner, current MSDS Sheets for any products being used on the job site where they exist.

.7 Remove and dispose of all redundant materials and garbage from site.

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

2.2 Selected products and equivalents

.1 Sections within Division 22 list "Acceptable Manufacturers" which must meet characteristics of the specified equipment and products for each section.

.2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.

.3 Any alternate manufacturers from base specified products and equipment must equal or exceed the quality, finish and performance of those base

specified and/or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions (i.e. electrical changes).

.4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.

.5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 Quality of product

.1 All products provided shall be listed and/or approved by relevant authorities and new, unless otherwise specified.

.2 If products specified are not listed and/or approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

.3 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.4 Product finishes

.1 Shop drawings shall indicate finishes. Use standard finish unless otherwise specified.

.2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

2.5 Access doors

.1 Provide access doors/panels as required for access, adjustment, operation, service, and maintenance.

.2 Minimum size of panels shall be 12" x 18" (300mm x 450mm). Wherever possible 24" x 24" (600mm x 600mm) panels shall be used.

.3 Access doors/panels shall have concealed hinges and screwdriver locking device.

.4 Access doors/covers - flush access door – drywall area

.1 Acudor #DW-5040 Series flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.

.5 Access doors/covers - flush access door - universal

.1 Acudor #UF-5000 Universal Access Doors, 14 GA. (1.7mm) steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.

2.6 Motors

.1 Provide high efficiency motors for plumbing equipment as specified.

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

.3 Motors under 373W, (1/2hp): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.

.4 Motors 373W, (1/2hp) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated.

2.7 Belt drives

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

.3 For motors under 7.5kW (10hp): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5kW (10hp and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.6 Motor slide rail adjustment plates to allow for centre line adjustment.

.7 Provide sheave changes as required for final air balancing.

2.8 Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm (18 gauge) thick sheet metal tops and bottoms.

.3 40mm (1-1/2") diameter holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 106 mm (16 gauge) thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 20 mm (3/4") mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

2.9 Equipment supports

.1 Refer to Section 22 05 29.

.2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of – Structural Steel Section. Submit structural calculations with shop drawings.

.3 Install base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4”) high and 150 mm (6”) larger than equipment dimensions all around.

2.10 Sleeves

.1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.

.2 Schedule 40 steel pipe.

.3 Sleeves with annular fin continuously welded at midpoint:

.1 Through foundation walls.

.2 Where sleeve extends above finished floor.

.3 Through fire rated walls and floors.

.4 Sizes: minimum 6mm (1/4”) clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.

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

.6 Fill voids around pipes:

.1 Caulk between sleeve and pipe in foundation walls and below grade floors with water proof 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 or pipe and ferrous sleeve.

.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+Amdt-Mar-78.

.7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm

clearance all around or to the requirements of the authority having jurisdiction. Seal at all as indicated.

2.11 Fire stopping

.1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.

.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.

.3 Do not use cementious or rigid seals around penetrations for pipe, ductwork, or other plumbing items.

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

.5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.

.6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.

.7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide “fire wrap” blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.

.8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.

.9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.

.10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.

.11 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.

.12 Install material and components in accordance with ULC certification, manufacturer's instructions and local authority.

.13 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.

.14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.

.15 Acceptable Manufacturers:

.1 Fryesleeve Industries Inc.

.2 General Electric Pensiil Firestop Systems

.3 International Protective Coatings Corp.

.4 Rectorseal Corporation (Metacaulk)

.5 Proset Systems

.6 3M

.7 AD Systems

.8 Hilti

.16 Ensure firestop manufacturer representative performs on-site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

2.12 Escutcheons

.1 On pipes and ductwork 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.

2.13 Spare parts

.1 Provide spare parts as specified under this Division.

.2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

2.14 Special tools

.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

3 Execution

3.1 Site examination and preparation

.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.

.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.

.3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

.4 Disconnect and remove all redundant equipment, fixtures, piping and other redundant services throughout area of work.

.5 Maintain vent piping for reuse where possible and remove any redundant.

.6 Coordinate with General Contractor to ensure any combustible material is removed from ceiling plenums.

3.2 Interference and coordination drawings

.1 Refer to Section 01 31 14.

3.3 Separation of services

.1 Contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

.2 All pipes, ductwork and wiring shall be supported from permanent building structure. Use of other services for support is not permitted

3.4 Workplace safety

.1 The workplace must be kept safe at all times.

.2 Conform to all ministries of labour, and health and safety regulations at all times.

.3 Use ladders and proper techniques as approved by the ministry of labour to perform all work.

.4 Cover all holes/openings and provide barriers around hazards, etc. to ensure occupants and workers are not at risk.

.5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner's representative or Consultant or rectify the situation immediately.

.6 Report any hazards or concerns to the Owner's representative immediately.

.7 Conform to Owner's safety requirements and construction regulations.

3.5 Temporary requirements

.1 All temporary requirements to complete plumbing work during construction shall be the responsibility of the Plumbing Contractor except temporary power or water.

3.6 Location of equipment

.1 Approximate distances and dimensions may be obtained by scaling off the drawings. Figured dimensions shall govern over scaled dimensions.

.2 Equipment locations shown on the drawings are approximate. Locations may be revised to suit construction and equipment arrangements provided design intent is not jeopardized and there is no additional cost to the Owner.

3.7 Mounting heights

.1 Mounting height of equipment is from finished floor to equipment unless otherwise specified or indicated. Coordinate with block coursing if applicable.

.2 Where mounting heights are not indicated on the drawings, obtain verification from the Consultant before proceeding.

.3 Install plumbing equipment at the following heights unless otherwise indicated on the architectural drawings. Architectural drawings supersede heights noted below. Confirm all heights prior to installation. Where confirmation or coordination has not been done and changes are required, the Contractor shall cover all costs.

.1 Barrier free wall hung water closets: 400mm(16”) to top of bowl

.2 Urinals: Standard: 432mm(17”) to top of rim

.3 Juvenile: 350mm(14”) to top of rim

.4 Barrier Free: 350mm(14”) to top of rim

.5 Wall hung lavatory: 787mm(31”) to rim

.6 Barrier free wall hung lavatory: 840mm(33”) max to top of rim, 737mm(29”) to underside of rim front

.7 Barrier Free Drinking Fountains: 876mm(34.5”) to spout

.8 Not less than 686mm(27”) under unit

.9 Fire Extinguishers: 1.5m(5’) to top of extinguisher (with or without cabinets)

.10 Double Check Valve Assemblies: 900-1200mm (3’-4’) to centerline

3.8 Excavating and backfilling

.1 Provide all excavating and backfilling inside and to 1.5m outside the building for plumbing pipes, drains and equipment. All backfilling shall be new clean granular ‘A’ fill brought in specifically for the purpose of backfilling to the underside of floor slab. All backfilling shall be compacted at intervals not more than 150 mm (6”) layer to the satisfaction of the Consultant.

.2 Provide excavating and backfilling outside the building with granular 'A' brought in specifically for backfilling to a minimum of 450 mm (18") over the pipe. Backfilling outside building over and above the 450 mm (18") backfill as previously specified herein shall be by the Plumbing Contractor as specified under Division 2. Where backfilling outside the building is not specified under Division 2, the Plumbing Contractor shall provide new clean granular 'A' fill to grade level.

.3 Bottoms of trenches shall be excavated so that the pipe will be supported on a 150 mm (6") compacted bed of clean granular 'A' fill. Provide all necessary pumping to maintain excavation free of water.

.4 Should water be encountered during excavation, the Plumbing Contractor shall provide all labour and material, including all equipment required for dewatering the excavation. After the water has been removed, this Contractor shall install a 300 mm (12") base of compacted 50 mm (2") clear stone covered with filter cloth before installing backfill as detailed and/or as specified.

.5 Be responsible for all weather protection required to install piping and/or equipment to the satisfaction of the Consultant.

.6 Be responsible for providing all clear stone or granular 'A' material suitable for application to replace existing soil not suitable for backfilling above the 450 mm (18") bedding material.

.7 It is the responsibility of the Contractor to review the soils report. Additional work requested due to failure of soil conditions due to Contractor not reviewing report will not be entertained.

3.9 Repairs, cutting and restoration

.1 Scan floors prior to floor cuts.

.2 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.

.3 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

.4 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

.5 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.10 Painting

.1 Refer to other Divisions for Painting unless otherwise specified herein.

.2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

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

.4 Restore to new condition, or replace equipment at discretion of Consultant, finishes which have been damaged too extensively to be merely primed, painted and touched up.

3.11 Concealment

.1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls in finished areas.

.2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit parallel to building lines, tight to roof deck and down columns.

.3 Any redundant risers can remain within existing walls (where walls are scheduled to remain) but services shall be cut and capped within wall so face of wall can be patched and finished smooth.

3.12 Access doors

.1 Provide access doors as required for access, adjustment, operation, service, and maintenance.

3.13 Clearances and accessibility

.1 Install all work for easy access for adjustment, operation, service, and maintenance.

.2 Maintain clearances for all equipment as per local codes and manufacturer's instructions.

.3 Access panels shall be Ecuador or equivalent with concealed hinges and screwdriver locking device.

.4 Provide access panels of adequate size as required to access equipment and components in concealed areas. Do not install access doors in specialty walls or ceilings.

.5 Provide fire rated access doors where installed in fire separations to match rating of separation.

.6 Install all services in exposed areas so that a minimum head clearance of 2200mm (88") is maintained.

3.14 Equipment and system protection

.1 Scan floor prior to color cuts and underground piping installation.

.2 Protect equipment and materials from damage in storage and on site before, during, and after installation until final acceptance.

.3 Protect equipment and system openings from dust and debris with appropriate covers that will withstand through the construction.

.4 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant and the Owner at no expense to the Owner.

3.15 Supports

.1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all equipment, ductwork, piping, and all other work in Division 22.

.2 All supports must be securely mounted to structures.

.3 Refer to Section 22 05 29.

3.16 Fire stopping

.1 Refer to Part 2 herein.

3.17 Cleaning

.1 Clean interior and exterior of all systems including strainers.

.2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

3.18 Owner supplied equipment

.1 Connect to equipment supplied by the Owner and make operable.

3.19 Video recording of underground services

.1 Scope existing underground sanitary through area of work to confirm condition of pipe, routing and inverts prior to start of any new work.

.2 Prior to final acceptance of the drainage work, this Contractor shall retain a qualified Contractor to video tape the sanitary drainage piping and branch piping to ensure it is free from blockages and debris. Clean and flush as necessary. Transfer all video tape information to USB key.

.3 This Contractor shall flush the sanitary system to remove all debris prior to final videotaping of systems.

.4 Provide three (3) copies of USB Key.

.5 Identify video routing on As Built drawings.

3.20 Identification and labeling

.1 All equipment, valves, panels and devices shall be labeled under this Division.

.2 Refer to Section 22 05 53.

3.21 TSSA inspection

.1 Prior to final completion of the project, this Contractor shall make application, arrange, and pay for a TSSA Inspection of all piping systems and equipment installations, including, but not limited to refrigeration, fuel piping, heating plant, and associated equipment installed under the contract.

.2 Provide a copy of the TSSA Reports in the maintenance manuals for each system.

3.22 Demonstration and training

.1 Refer to 1.15 herein.

3.23 Field and deficiencies

.1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.

.2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.

.3 The Contractor shall correct all deficiencies within the work period prior to the next review.

.4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.

.5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

End of section

4 General

4.1 Standards

.1 Construct pressure tanks to ASME Code for Unfired Pressure Vessels.

.2 Comply with Provincial Government Regulations.

4.2 Submittals

.1 Submit with shop drawings for tanks, specifications of tank lining and installation instructions.

4.3 Inspections

.1 Obtain inspection certificates for pressure vessels from Provincial Authorities as required.

4.4 Acceptable manufacturers

.1 Amtrol

.2 Bell & Gossett

.3 Expanflex

.4 Watts

.5 ITT

4.5 Warranty

.1 1 year warranty

5 Products

5.1 Domestic expansion tanks - bladder type

.1 ASME tank, constructed in accordance with Section VIII, Division 1 of the ASME Pressure Vessel Code.

.2 Lead free for potable water service per NSF/ANSI 61

.3 Operation temperature = 93C (200F), working pressure = 10.3bar (150psig).

.4 Pre-charged steel thermal expansion tank with a fixed heavy duty butyl bladder, polypropylene liner material, steel shell and red oxide primer finish.

.5 The tank shall have an NPT stainless steel system connection and a .301" - 32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements.

.6 Pre-charged to 55 psi (Field Adjustable)

.7 Schrader valve with EPDM seat

6 Execution

6.1 Installation

.1 Install as per manufacturer’s recommendations.

.2 Confirm that the air charge is preset or adjusted and correct prior to requesting approval to open water valves.

.3 Follow manufacturer’s recommendations for tank charging and commissioning. Submit report on final pressure.

.4 Adjust charge to suit site operating conditions.

End of section

7 General

7.1 Manufacturer

.1 Provide valves of same manufacturer throughout where possible.

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

7.2 Quality assurance

.1 All valves shall meet all MSS, ANSI and ASME manufacturing standards.

7.3 Submittals

.1 Manufacturer’s data and shop drawings for all valves and accessories including dimensions, pressure ratings, materials, service acceptability.

8 Products

8.1 General

.1 Provide valves of same manufacturer throughout where possible.

.2 All valves shall be acceptable for domestic water use, lead free.

.3 Valves shall be suitable for solder or threaded connections. Provide solder to threaded adapters where applicable.

8.2 Check valves

.1 2 inches (50mm) and smaller: Class 125/200PSI, lead free bronze body and cap, bronze seat, solder or threaded ends. Equal to Kitz #822 and #823.

.2 2.5 inches (63mm) and larger: To Class 150, stainless steel body, hard face seat, 13% chrome, flanged ends. Equal to Kitz #150UOAM.

8.3 Ball valves

.1 600 WOG, lead free brass, two or three piece body, chrome plate ball, full port, teflon seats, blow-out proof stem, threaded or soldered ends, lever handle. Soldered up to 3”, threaded up to 4”.

.2 Acceptable Manufacturers:

.1 Jenkins

.2 NH

.3 Kitz #858 & #859

.4 Red & White (Toyo) 5044A-LF & 5049-LF

.5 MAS #B3-LF and #B4-LF

8.4 Circuit balancing valves (CBV) – domestic water

.1 Provide circuit balancing valve on each domestic recirculation loop designed specifically for use in drinking water applications, NSF/ANSI 61-G rated for commercial hot water service (temperature rated to 180F / 82C) and certified by the NSF with all wetted parts stainless steel.

.2 Lead free construction in compliance with ANS/NSF-372.

.3 Series 300 stainless steel body, nickel plated brass union nut, and tamper-resistant 300 series stainless steel flow cartridge.

.4 Valve shall be suitable for minimum flow of 0.3gpm and maximum flow of 12.0 gpm, and flow rate pre-set accuracy variation of +/- 5% over 95% of the control range.

.5 Valves shall have a full body rating of 400 psi, but is suitable for working pressures with differential control ranges of 2 – 32 psi or 5 – 60 psi differential.

.6 All wetted parts shall comply with NSF/ANSI Standard 372 for minimal lead content.

.7 Compact inline design for tight installations.

.8 Acceptable Manufacturer

.1 Tour & Anderson, Victaulic ICSS, TA Series 76X, RWV 9519AB

8.5 Pressure reducing valves – water

.1 Listed to ASSE 1003 and IAPMO and certified to CSA B356.

.2 Low Pressure (Boiler Make-Up Water)

.1 Adjustable Reduced Pressure Range: 10 to 35psi

.2 Maximum Working Pressure: 200psi (14 bar)

.3 NPT Threaded female union inlet x NPT female outlet

.4 Bronze body construction

.5 SS Integral strainer

.6 High temperature resistant diaphragm

.7 Renewable stainless steel seat

.8 Serviceable in-line

.9 Sealed spring cage, corrosion-resistant adjusting & cage screws for waterworks pit installations

.10 Equal to U5B-LP

.3 High Pressure (Main Water Entrance where indicated)

.1 Pressure reduced from as high as 300psi (20.7 bar) to 50psi (345 kPa) or lower

.2 Sealed spring cage and stainless steel corrosion resistant adjusting cage screws for accessible outdoor or pit installations

.3 Integral stainless steel strainer

.4 Replaceable seat module

.5 Bronze body construction

.6 Serviceable in line

.7 Bypass feature controls thermal expansion pressure

.8 High temperature resistant reinforced diaphragm for hot water

.9 Equal to Watts U5B-Z3

8.6 Vacuum breakers – water

.1 Bronze body, brass trim, composition silicone float disc, full size orifice.

8.7 Relief valves

.1 Provide ASME rated direct spring loaded type, lever operated nonadjustable factory set discharge pressure as indicated.

8.8 Drain valves

.1 Bronze compression stop with ¾” hose threaded.

.2 Brass ball valve with ¾” hose thread.

.3 Provide hose thread connection on valve or piping.

.4 Equal to #868C (Lead Free), KITZ #68AC (Non Lead Free)

8.9 Double check valve assembly - reduced pressure type

.1 Bronze or red brass body, stainless steel springs, composition diaphragm.

.2 Independent acting spring loaded double internal disc valve, three chamber, discharge to atmosphere.

.3 Acceptable Models:

.1 Watts 009 QT

.2 Zurn 975 XL

.3 Febco 825 Y

.4 Combraco 40-200

.4 Non-electronic testing apparatus including gauge, hoses, fittings, accessories, and case. Maximum temperature 104.4°C (220°F), maximum pressure 1034 kPa (150 psi). Equal to Watts TK-9A.

8.10 Strainers

.1 Strainers 50mm (2”) and smaller shall be constructed for 250 psig operating pressure at 406 degrees F and shall have a cast iron threaded body and 20 mesh Type 304 stainless steel screen.

.2 Strainers larger than 50mm (2”) shall be constructed for 125 psig @ 150 degrees F and shall have a cast iron flanged body and a 3/64” perforated Type 304 stainless steel screen up to 75mm (3”) and a 1/8” perforated Type 304 stainless steel screen on 100mm (4”) and larger.

.3 Screen free area shall be minimum three times area of inlet pipe. Provide valved drain and hose connection off strainer bottom.

.4 Strainers 50mm (2”) and smaller shall have straight thread and gasketed caps and plugged blow-off connections.

.5 Strainers larger than 50mm (2”) shall include drain connections complete with ball valve, cap and chain.

.6 Grooved end (where approved): 50mm (2") and larger, 300 PSI (2065 kPa) Y-Type Strainer shall consist of ductile iron body, ASTM A-536, Grade 65-45-12, Type 304 stainless steel perforated metal removable baskets with 1/16" (1,6mm) diameter perforations 2"-3" (DN50-DN75) strainer sizes, 1/8" (3,2mm) diameter perforations 4"- 12" (DN100-DN300) strainer sizes, and 0.156" (4mm) diameter perforations for larger sizes. Victaulic Style 732 and W732.

8.11 Pressure ratings

.1 Unless otherwise indicated, use valves suitable for minimum 860 kPa (125 psi) and 232°C (450°F).

9 Execution

9.1 General

.1 All valves shall be located such that the removal of their bonnets is possible.

.2 Install valves with stems upright or horizontal, not inverted.

.3 All valves shall be installed to allow for ease of access, service and reading of devices from the floor.

9.2 Application

.1 Use ball valves on pressure gauges.

.2 Use plug cocks, globe valves, ball valves, butterfly valves, and metering valves in water systems for throttling service.

9.3 Isolation valves

.1 Isolation valves are to be ball type valves, pipe size as required, but in no case less than 13mm (½") diameter.

.2 For equipment removal purposes. Install valves as close as possible to isolated equipment in order to minimize the amount of water lost during maintenance, replacement or drain down operations.

.3 Isolation drain valves are to be provided with combination air inlet fitting as required to relieve vacuum during draining operations.

.4 Install ball valves where approved for shutoff and isolating service, or to isolate equipment, parts of systems or vertical risers.

.5 Provide drain valves at main shutoff valves, low points of piping and equipment.

9.4 Circuit balancing valves (CBV) – domestic water

.1 The Contractor shall install a CBV on each recirculating loop.

.2 Install CBVs in accordance with manufacturer's instructions including straight pipe run upstream and downstream of CBV.

.3 Valves shall be installed with flow in the direction of the arrow on the valve body.

.4 Label ceiling tile or gypsum board ceilings where CBV is installed above ceiling. Provide access door for access where required.

9.5 Pressure reducing valves

.1 Provide pressure reducing valves where shown or where required. Provide adequately rated shutoff valves.

.2 Install as per manufacturer's recommendations.

.3 Install in vertical position only.

9.6 Relief valves

.1 Provide relief valves at pressure tanks, low pressure side of reducing valves, heating convertors, expansion tanks and where indicated.

.2 Pipe relief valve to nearest floor drain.

.3 System relief valve capacity shall equal make up pressure reducing valve capacity. Equipment relief valve capacity shall exceed input rating of connected equipment.

.4 Where one line vents several relief valves, cross sectional area shall equal sum of individual vent areas.

9.7 Drain valves

.1 Provide ball valves for drains on open systems.

.2 Provide unions downstream of the valve to allow breaking the piping system.

.3 Provide hose thread connection on drain valve and piping.

9.8 Double check valve assembly

.1 Install reduced pressure double check valve assembly to isolate domestic system from hydronic system, where indicated on drawings and as required by code.

.2 Install double check valve assembly at no more than 1.5m (5’) above finished floor and to allow a minimum of 1m (3’) clearance above the device for connection and operation of testing equipment.

.3 Pipe overflow to drain with air gap.

.4 Provide shutoff valves and unions on both sides of double check valve assembly for testing purposes.

9.9 Strainers

.1 Install on the inlet of the main water meter and any large pumps.

End of section

10 General

10.1 Quality assurance

.1 Domestic water pipe supports shall meet the requirements of Ontario Building Code.

10.2 General requirements

.1 Provide hangers and supports to secure equipment in place, prevent vibration, maintain grade and provide for expansion and contraction.

.2 Install supports of strength and rigidity to suit loading without unduly stressing building. Locate adjacent to equipment to prevent undue stresses in piping and equipment.

.3 Select hangers and supports for the service and in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.

.4 Obtain approval prior to drilling for inserts and supports for piping systems.

.5 Obtain approval prior to using percussion type fastenings.

.6 Use of other piping or equipment for hangers and supports is not permitted.

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

10.3 Firestop sealants and collars

.1 Standard method of fire tests of firestop system CAN4-S115-M85.

.2 UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (UL1479).

.3 Seals, assemblies and materials for penetration of fire rated surfaces shall be listed by FM and certified by UL or ULC for the service application.

10.4 Submittals

.1 Firestop materials: Submit service limitations, installation instructions, UL certification and FM listing.

.2 Fire rated penetration seals: Submit dimensional data, service limitations, installation instructions, UL certification and FM listing.

11 Products

11.1 Inserts

.1 Inserts shall be malleable iron case or galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.

.2 Size inserts to suit threaded hanger rods.

11.2 Suspended mechanical equipment

.1 Suspend mechanical equipment from structure with adjustable length steel rods, threaded both ends or continuous threaded, complete with lock nuts on both ends. Provide spreader beams to distribute weight.

.2 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

.3 Provide anchors, bolts and accessories required for mounting and anchoring equipment.

11.3 Pipe hangers and supports

.1 Pipe hangers shall wrap around outside of insulation for all sizes. Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.

.2 Hangers:

.1 Pipe Sizes 13mm (½”) to 38mm (1½”): Adjustable wrought steel ring, or plated strap.

.2 Pipe Sizes 50mm (2”) and over: Adjustable wrought steel clevis.

.3 Hanger Rods: Provide steel hanger rods, threaded both ends or continuous threaded, complete with lock nuts on both ends.

.4 Saddles shall wrap around the outside of the insulation for all piping and be sized accordingly.

.3 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe sizes 150mm (6 “) and over.

.4 Wall Support:

.1 Pipe Sizes to 75mm (3”): Cast iron hook, or fabricated bracket of 1”x1”x¼” angle bar.

.2 Pipe Sizes 100mm (4”) and over: Welded steel bracket and wrought steel clamp.

.5 Vertical Support:

.1 Steel riser clamp.

.6 Floor Support:

.1 Fabricated stand and pipe clamp or saddle.

11.4 Equipment bases and curbs

.1 Equipment bases and curbs shall be provided by the General Contractor. The Mechanical Contractor shall coordinate locations and sizes with the General Contractor.

.2 Provide mounting plates to be formed into pads.

12 Execution

12.1 General

.1 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural bearings do not exist, provide angle or channel iron form nearest structural bearings to support hangers.

12.2 Inserts

.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 100mm (4”) or ducts over 1500mm (60”) wide.

.3 Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

.4 Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab.

.5 Expansion bolt type connections will be approved under certain conditions. Obtain approval from the Consultant. Generally, pipe 50mm (2”) or smaller, and ducts less than 600mm x 300mm (24” x 12”) will be approved, subject to adequate number of support points.

12.3 Suspended mechanical equipment

.1 Suspend mechanical equipment from structure with adjustable length steel rods. Provide spreader beams to distribute weight.

.2 The threaded rod shall be secured to trusses or to steel angle bars spanning the building trusses. The steel spanning bars are to be provided by this Division.

.3 Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

.4 Provide anchor bolts and accessories required for mounting and anchoring equipment.

.5 Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

12.4 Pipe hangers and support

.1 Fasten hangers and supports to building structure or inserts in concrete construction.

.2 Support horizontal metallic piping as follows:

Nominal Pipe Size	Distance Between Supports	Hanger Rod Diameter
13mm (½”)	1.8m (6’)	9.5mm (3/8”)
19 to 38mm (¾” to 1½”)	2.4m (8’)	9.5mm (3/8”)

50 to 63mm (2” to 2½”)	3.0m (10’)	9.5mm (3/8”)
63 to 100mm (3” to 4”)	3.6m (12’)	13mm (½”)
150 to 300mm (6” to 12”)	4.3m (14’)	13mm (½”)
350 to 450mm (14” to 18”)	5.0m (16’)	25mm (1”)

.3 Install hangers to provide minimum 32mm (1¼”) clear space between finished covering and adjacent work.

.4 Place a hanger within 300mm (12“) of each horizontal elbow.

.5 Use hangers which are vertically adjustable 38mm (1½”) minimum after piping is erected.

.6 Support vertical piping at every floor.

.7 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

.8 Where practical, support riser piping independently of connected horizontal piping.

.9 Exposed piping, with less than 2.6m (8½ ft) clearance to floors shall be provided with two times the number of hangers normally required. Spacing shall be equal or adjusted for maximum benefit.

.10 Provide copper plated hangers and supports for copper piping or provide nonferrous packing between hanger or support and piping.

.11 Large capacity piping with vibration potential shall not be suspended from any building structure that will allow transfer of vibrations to the occupied spaces.

12.5 Equipment bases and curbs

.1 All equipment shall be mounted on concrete bases, minimum 100mm (4”) high.

.2 A curb shall be provided around all piping passing through mechanical room floors, minimum 100mm (4”) high.

.3 Equipment bases and curbs shall be provided by the General Contractor. The Mechanical Contractor shall coordinate locations and sizes with the General Contractor.

.4 Provide mounting plates to be formed into pads.

End of section

13 General

13.1 References

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-M89, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

13.2 Product data

.1 Submit product data in accordance with Division 1.

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

13.3 Product literature

.1 Submit product literature in accordance with Division 1.

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

14 Products

14.1 Manufacturer’s equipment nameplates

.1 Metal or plastic lamacoid 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.

14.2 System nameplates

.1 Colours:

.1 Hazardous: red letters, white background

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

.2 Construction:

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

.3 Sizes:

.1 Conform to the following table:

Size	Dimensions mm (“)	No. of Lines mm (“)	Height of Letters mm (“)
1	10 x 50 (3/8” x 2”)	1 (3/64”)	3 (1/8”)
2	15 x 75 (1/2” x 3”)	1 (3/64”)	6 (1/4”)
3	15 x 75 (1/2” x 3”)	2 (5/64”)	3 (1/8”)
4	20 x 100 (3/4” x 4”)	1 (3/64”)	10 (3/8”)
5	20 x 100 (3/4” x 4”)	2 (6/64”)	6 (1/4”)
6	20 x 200 (3/4” x 8”)	1 (3/64”)	10 (3/8”)
7	25 x 125 (1” x 5”)	1 (3/64”)	15 (1/2”)
8	25 x 125 (1” x 5”)	2 (5/64”)	10 (3/8”)
9	32 x 200 (1-1/4” x 8”)	1 (3/64”)	20 (3/4”)

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

.4 Locations:

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

.2 Equipment above ceiling: Use size #1 riveted to ceiling suspension system.

14.3 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 Legend:

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

.3 Arrows showing direction of flow:

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

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

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

.4 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

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

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

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

.2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating suitable for ambient of 100% RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (395 °F).

.6 Colours and Legends:

.1 Where not listed, obtain direction from Consultant.

.2 Colours for legends, arrows:

Background colour	Legend	Arrows
Yellow	White	Black
Green	White	Black
Red	White	Black

14.4 Concrete pads for mechanical equipment

.1 General Contractor to paint tops and sides of all concrete pads for mechanical equipment with two (2) coats of yellow paint.

14.5 Valves, controllers

.1 Brass tags with 15mm (1/2”) 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.

.3 Provide coloured adhesive label indication on ceiling grid to locate valves/equipment above. Label description to match device. Size, colour and description to be pre-approved by Consultant.

14.6 Language

.1 Identification to be in English.

15 Execution

15.1 Timing

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

15.2 Installation

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

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

15.3 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.

15.4 Location of identification on piping systems

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 m (5’-8”) 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 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 Identification to be easily and accurately readable from usual operating areas and from access points. 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.

15.5 Valves

.1 Valves, except at plumbing fixtures or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or close “S” hooks.

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

.3 Number valves in each system consecutively.

End of section

16 General

16.1 Quality assurance

.1 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.

.2 Test procedures shall be in accordance with applicable portions of:

.1 Ontario Building Code

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

.3 American Society of Mechanical Engineers

.4 Ontario Ministry of Health

.5 Local codes and ordinances

.6 Other recognized test codes

.3 Provide additional tests and re-testing as required and requested by the Consultant or Owner.

16.2 Submittals

.1 Obtain certificates of approval and acceptance from authorities having jurisdiction and include in Operating and Maintenance Manuals.

.2 On completion of mechanical installation, provide certification of tests with detailed data as required. Itemize tests as to time performed and personnel responsible. Include a copy of field data in Operating and Maintenance Manuals.

16.3 Liability

.1 During tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration.

17 Products

17.1 Equipment and products

.1 All equipment and products necessary to perform tests shall be covered under this Division at no cost to the Owner.

18 Execution

18.1 Pressure tests

.1 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Consultant.

.2 Provide equipment, materials and labour for tests. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy.

.3 Test equipment and material where specified required by authorities having jurisdiction to demonstrate its proper and safe operation.

.4 Provide four (4) days notice to the Consultant before tests.

.5 Carry out hydraulic tests for eight (8) hours and maintain pressure. Where leakage occurs, repair and retest.

.6 Domestic Water Piping: Test to 1½ times maximum working pressure or 1034 kPa (150 psi) water pressure measured at system low point.

.7 Drainage Systems: Test by filling with water to produce water pressure of 35 kPa (5 psi) minimum and 83 kPa (12 psi) maximum. Check for proper grade and obstruction by ball test, or other approved means.

18.2 Equipment tests

.1 Perform testing of all equipment as per manufacturer’s recommendations and requirements under full operational ranges and submit reports.

.2 Use the services of a qualified Technician and submit report.

18.3 Test reports

.1 Submit all test reports to Consultant as specified herein within one (1) week of each test completion.

.2 Include a copy of all test reports in the manuals.

End of section

19 General

19.1 Work included

.1 Piping Insulation

.2 Adhesives, Tie wires, Tapes

.3 Recovering

19.2 Quality assurance

.1 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site. Trades Qualification certificates must be submitted prior to commencing work and must be on site for inspection.

19.3 Job conditions

.1 Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

19.4 Acceptable manufacturers

.1 Fibreglass Canada

.2 Knauf

.3 Mason

.4 Pittsburg Corning

20 Products

20.1 General

.1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed.

.2 Adhesives, coatings and sealers shall be waterproof.

20.2 Materials

.1 Insulation shall be precovered, preformed insulation complete with foil or kraft all purpose jacket unless otherwise noted.

.2 Insulation shall be 1” thick unless otherwise noted.

.3 Cold Piping: Fine fibrous glass insulation with factory applied vapour barrier jacket, molded to conform to piping, "K" value at 0.24 btu/in/sq ft/deg F/hr.

.4 Hot and Tempered Water Piping: Fine fibrous glass insulation with factory applied general purpose jacket, molded to conform to ping, "K" value at 0.24 btu/in/sq. ft/deg. F/hr.

.5 Condensate Piping: Fine fibrous glass insulation with factory applied vapour barrier jacket, molded to conform to piping, "K" value at 0.24 btu/in/sq ft/deg F/hr.

.6 Roof Drainage: Flexible fibrous glass insulation, "K" value at 0.26 btu/in/sq ft/deg F/hr.

.7 Recovering Jackets in all Exposed Areas (i.e. Mechanical Rooms, etc.): PVC pre-formed.

21 Execution

21.1 Preparation

.1 Do not install covering before piping and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

21.2 Installation

.1 In non fire rated surfaces, ensure insulation is continuous through inside walls. Pack around pipes with fireproof self-supporting insulation material, properly sealed.

.2 Finish insulation neatly at hangers, supports and other protrusions.

.3 Provide recovering jackets on exposed insulation as specified herein.

.4 Coat recovering jacket with two coats of waterproof fire retardant coating.

.5 Do not install and seal vapour proof insulation if ambient air has a high humidity.

.6 Pipe hangers shall wrap around outside of insulation for all sizes. Piping shall be provided with insulation flashing of heavy gauge metal to prevent crushing and hanger sized for exterior of insulation.

21.3 Domestic water piping – hot, cold and tempered

.1 Insulate all new domestic hot, cold and tempered water piping.

.2 Re-insulate all existing domestic hot, cold and tempered water piping with areas of work (washrooms and custodial rooms, and classroom areas at new sinks). The existing insulation shall be removed and replaced.

.3 Insulate valves, unions, flanges, strainers, flexible connections and expansion joints for all cold water systems. Not required for hot or tempered water systems.

.4 Cover elbows, tees and similar fittings with equivalent thickness of insulation material.

21.4 Condensate piping

.1 Insulate all new condensate piping off heat pumps and other mechanical equipment.

.2 Cover elbows, tees and similar fittings with equivalent thickness of insulation material.

21.5 Roof drainage

.1 Insulate all roof hoppers.

.2 Insulate all new roof drainage piping including horizontal *and* vertical piping.

End of section

22 General

22.1 Quality assurance

.1 Water piping shall meet the requirements of the Ontario Building Code and Municipal Codes.

.2 Pipe fittings shall conform to the following standards:

.1 ANSI B36.10, ASTM-197-47 (Materials)

.2 ANSI B16.24, ANSI/ASME B16.15, ANSI B16.8, ANSI/ASME B16.22 (Copper Fittings)

22.2 Reference sections

.1 Section 22 05 01

.2 Section 22 07 19

.3 Section 22 05 29

22.3 Reference standards and codes

.1 Ontario Building Code

.2 ASTM

.3 CSA

.4 ANSI

.5 ULC

.6 Local Codes and Requirements

23 Products

23.1 Domestic water (aboveground)

.1 Domestic water pipe shall be Type “L” hard drawn copper tubing, conforming to ASTM B88.

.2 Fittings shall be wrought copper, solder joint, pressure type. Make soldered joints on copper tubing for potable water using lead free solder and matching flux.

.3 Solder to threaded adapters shall be provided at screwed valves or equipment.

.4 Unions shall be all bronze construction with ground joint and either solder joint or screwed ends as required. Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping.

.5 Provide commercial type water hammer arrestors on all plumbing lines serving fixtures and equipment with quick closing or solenoid valves.

.6 Exposed plumbing brass and metal work shall be heavy chromium plated (including under countertops without cabinets).

.7 Hot, cold and tempered water piping to fixtures shall be flexible copper tube complete with angle type screwdriver stop, reducer, and escutcheon plate.

.8 Provide isolation valves on domestic water piping to each group of fixtures.

23.2 Domestic water (underground)

.1 50mm (2”) and smaller: Copper Type K

.2 100mm (4”) and larger: Listed PVC

23.3 Water hammer arrestors

.1 Refer to 22 42 00.

23.4 Solder

.1 Potable water systems shall be lead free.

23.5 Condensate piping

.1 Type K or L hard copper complete with cast brass or wrought copper drainage fittings with solder joints or

.2 IPEX XFR.

23.6 Aboveground drainage, venting and storm

.1 Pipe up to and including 50mm (2”) for services except Urinals shall be:

.1 Copper DWV pipe complete with cast brass or wrought copper drainage fittings with solder joints, use 50/50 solder and matching flux for copper drain, waste, and vent piping or

.2 Cast iron MJ pipe with MJ fittings and stainless steel clamps. Clamps shall be two-band type.

.2 Pipe up to and including 50mm (2”) for Urinals shall be:

.1 PVC DWV for any piping underground or concealed in walls.

.2 PVC XFR for any piping in pipe chases, ceilings spaces or other open areas.

.3 NOTE: PVC DWV or XFR is not acceptable in any other applications.

.3 Pipe 75mm (3”) and up shall be:

.1 PVC DWV 40 System 15 complete with PVC drainage fittings with solvent weld joints (in concealed areas only, not acceptable in ceilings spaces) or

.2 Cast iron MJ pipe with MJ fittings and stainless steel clamps. Clamps shall be two-band type.

23.7 Drainage system (underground)

.1 Pipe up to and including 75mm (3”) shall be:

.1 ULC certified PVC 40 DWV pipe to CAN/CSA B181.2 complete with PVC DWV fittings to CAN/CSA B181.2 with solvent weld joint.

.2 Pipe 75mm (3”) up to and including 100mm (4”) shall be:

.1 ULC certified PVC 40 DWV pipe to CAN/CSA B181.2 complete with PVC DWV fittings to CAN/CSA B181.2 with solvent weld joint, or

.2 ULC certified PVC SDR 28/35 BDS pipe to CAN/CSA B182.1 complete with PVC BDS fittings to CAN/CSA B182.2 with solvent weld joints.

.3 Pipe 125mm (5”) and up shall be

.1 ULC certified PVC SDR 28/35 sewer pipe to CAN/CSA B182.2 complete with PVC fittings to CAN/CSA B182.2 with ring gasket joints.

23.8 Cleanouts

.1 Refer to Section 22 13 19.

23.9 Plumbing vent stacks

.1 Plumbing vent stacks shall be 18” (457 mm) high, vandal proof, 0.064” (1.6 mm) mill finish 1100-0T alloy aluminum, to CSA B272-93, with aluminum hood and perforated collar, thick pre-molded urethane insulation liner and EPDM Base Seal, bituminous painted deck flange or to match type of roofing system. Equal to Thaler SJ-31, STACK JACK Flashing.

23.10 Firestop sealants and collars

.1 Provide firestop sealants around all pipe penetrations through rated separations.

.2 Provide firestop collars for all combustible pipe penetrations through rated separations (where combustible piping is approved).

.3 Intumescent insert: Flexible, elastomeric strip, two stage expansion, designed to firestop penetrations in fire-rated walls and floors and floor/ceiling assemblies.

.4 Provide a minimum of 15 time free expansion.

.5 Sealants shall not contain water soluble expansion ingredients.

24 Execution

24.1 General

.1 Apply for permit before beginning any work. Have drawings approved for construction by authorities having jurisdiction or local agencies prior to beginning work.

.2 Review all inverts and elevations before beginning any installation.

.3 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural bearings do not exist, provide angle or channel iron form nearest structural bearings to support hangers.

.4 Refer to Section 22 05 29 for Hangers and Supports.

.5 Have entire installation inspected, at various stages where required, to ensure approval at completion of project.

.6 Provide clearance for proper installation of insulation and for access to components including but not limited to valves and drains.

.7 Maintain proper grades on piping for proper drainage and provide valves at all low points.

.8 All sanitary lines shall be sloped minimum 1:50 unless otherwise approved.

.9 All exposed piping to run parallel to walls and in a neat and orderly fashion to maintain headroom. Group piping where possible.

.10 Do not run combustible or non-approved pipe through fire separations or return air ceiling plenums. Use approved materials and methods only.

.11 Provide drain valves at low points where required.

.12 Install piping to allow for expansion and contraction and to eliminate stress on equipment, piping, or connections.

.13 Provide isolation valves or shutoff valves at all equipment.

.14 Provide cleanouts as indicated on drawings and as required by code. Floor cleanouts are not approved in finished floor areas unless otherwise noted. Ensure adequate clearance to all cleanouts.

.15 Provide sleeves for piping passing through floor slab. Caulk around piping and fill entire space between piping and floor slab with approved fire retardant material to maintain required fire rating where necessary.

.16 Provide fire stop sealant at all pipe penetrations through fire separations.

.17 Install reduced pressure double check valve assembly to isolate domestic system from hydronic system, where indicated on drawings and as required by code.

24.2 Grades, routes and installations

.1 All sanitary lines shall be sloped 1:100 unless otherwise specified.

.2 Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space.

.3 Run exposed piping parallel to walls. Group piping wherever practical at common elevations.

.4 Install concealed pipes close to the building structure to keep furrings to a minimum.

24.3 Roof jacks

.1 Provide roof jacks as required, and in compliance with the roofing specifications. Generally, SBS torch down roofing requires aluminum roof jacks. Conventional bituminous roofing accepts lead or aluminum roof jacks.

.2 Flash pipes projecting above finished roof surface with approved material.

24.4 Flashing

.1 Flash all mechanical equipment passes through weather or waterproofed walls and roofs.

.2 Flash floor drains over finished areas by extending flashing 250mm (10”) clear on sides. Fasten flashing to drain clamp device. Use lead sheet or approved nonmetallic waterproofing membrane.

24.5 Sleeves

.1 Provide and set sleeves required for piping.

.2 Set sleeves in position in advance of other work. Provide suitable reinforcing around sleeves.

.3 Extend sleeves through potentially wet floors 50mm above finished floor level. Caulk sleeves full depth and provide floor plate.

.4 Where piping passes through floor, ceiling or wall, close off space between pipe and sleeve with noncombustible insulation or approved non-combustible insulation, fire rated as required to match the rating of the penetrated surface. Provide tight fitting metal caps on both sides.

.5 Install chrome plated escutcheons where piping passes through finished surfaces including millwork.

.6 Size large enough to allow for movement due to expansion and to provide for continuous insulation.

24.6 Firestop sealants and collars

.1 Clean all concrete, masonry and stone penetrations of all contaminants and impurities, concrete form release agents, water repellents, oils, surface dirt and rust, scale, all old sealants and other surface treatments.

.2 Metal surfaces shall be cleaned by wiping them with an oil- free absorbent cloth saturated with solvent such as xylol or toluol. Do not use alcohols.

.3 Do not apply to polycarbonates or to building materials that bleed oils, plasticizers or solvents, or where sealant is not exposed to atmospheric moisture, or to surfaces which have been or will be painted.

.4 Collars are to be installed with steel fasteners or steel expansion anchors. Low melting temperature anchors of lead, plastic or aluminum are not approved.

.5 Installation only when temperatures are between 4°C (40°F) and 37°C (98°F).

24.7 Identification

.1 Identify all piping with type of service and arrows.

.2 Refer to Section 22 05 53.

24.8 Testing

.1 Refer to Section 22 05 92.

24.9 Cleaning

.1 Thoroughly flush domestic water systems upon completion of work.

End of section

25 General

25.1 Submittals

.1 Refer to Section 22 05 00 – General Plumbing Requirements.

.2 Submit certified pump curves with shop drawings showing pump performance characteristics with pump and system operating point plotted. Include NPSH when applicable.

25.2 Quality assurance

.1 Pumps shall be alignment certified.

.2 Ensure pumps operate at specified system fluid temperatures. Operate within 25% of midpoint of published maximum efficiency curve.

25.3 Acceptable manufacturers

.1 Armstrong

.2 Bell & Gossett

26 Products

26.1 General

.1 Statically and dynamically balance rotating parts.

.2 Construction shall permit complete servicing without breaking piping or motor connections.

.3 Pumps shall operate at 1,750 rpm unless specified otherwise.

.4 Pump connections shall be flanged for sizes 63mm (2½”) and over, and grooved or union connections for sizes 50mm (2”) and under.

.5 Units shall be completely factory wired, tested and name-plated before shipment. Pump manufacturer shall be ISO-9001 certified.

.6 Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings. Refer to schedules for unit performance.

27 Execution

27.1 General

.1 Contractor shall install pumps in accordance with manufacturer's guidelines.

.2 Install valves as per detail on drawings.

.3 All electrical wiring and accessories, including power wiring from motor control centers and/or motor starter to driven motor, shall be installed in accordance with the requirements specified by Division 26 and the local electrical authority.

.4 Perform startup to confirm proper operation and rotation.

.5 Remove any temporary strainers after flushing is complete and leave in mechanical room for inspection/confirmation by the Consultant.

End of section

28 General

28.1 General requirements

.1 Provide materials, equipment and labour to install plumbing as required by Provincial and local codes as specified herein.

.2 Provide water and drainage connections to equipment specified in other sections of this specification.

28.2 Quality assurance

.1 Provide new equipment, CSA approved.

28.3 Submittals

.1 Submit shop drawings to the Consultant for review prior to ordering or installation.

.2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.

.3 Fixtures and Cleanouts: Dimensions and installation details

.4 Floor drains: Accessories, dimensions and installation details

.5 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

28.4 Acceptable manufacturers

.1 Watts

.2 Zurn

.3 Ancon

.4 Smith

29 Products

29.1 Cleanouts and cleanout accessories

.1 Sanitary & Storm: Provide caulked or threaded type cleanouts extended to unfinished floor or wall surface. Provide bolted coverplate or threaded cleanouts on vertical rainwater leaders.

.2 Floor cleanout access covers in unfinished areas shall be round with nickel bronze scoriated frames and plates. Wall cleanouts shall be located behind approved access panels.

.3 Provide cleanout inside building at building wall where sanitary and storm services leave the building. Space cleanouts along horizontal drainage lines per OBC requirements.

.4 Floor cleanouts / access covers – adjustable cleanouts

.1 Watts #CO-200-R-34G Cleanout - epoxy coated, cast iron body, 5" (127 mm) round adjustable gasketed nickel bronze top, ABS plug with neoprene gasket, no hub outlet.

.5 Floor cleanouts – stack

.1 Watts #CO-460-RD Cleanout, cast iron body, removable, gasketed, brass plug, round cover, access cover, stainless steel cover, no hub outlet.

.6 Floor cleanouts – round top – one-piece rolled flooring applications

.1 (Note: Confirm all locations with Architectural Drawings and General Contractor) Watts #CO-100-C-RFC-34B Cleanout - epoxy coated, 7" (178 mm) diameter, cast iron body, reversible membrane clamp with anchor flange, 7" (178 mm) round adjustable nickel bronze top with surface membrane clamp, brass tapered threaded plug, no hub outlet.

29.2 Floor drains

.1 Floor drains to be round, nickel bronze.

.2 Floor drains to be suitable for application and environment they are installed.

.3 Funnel floor drains - strainer with funnel - round

.1 Watts #FD-200-EG-7-1 Floor Drain - epoxy coated, cast iron body, 5" (127 mm) diameter nickel bronze, adjustable round strainer, 4" x 9" (102 mm x 229 mm) oval nickel bronze funnel trap primer connection with plug, anchor flange and weepholes, no hub outlet

.4 Floor drains - finished area - adjustable strainer - round

.1 Watts #FD-200-7-5-1 Floor Drain - epoxy coated, cast iron body, trap primer connection with plug, anchor flange and weepholes, no hub outlet Watts -5-1 5" (127 mm) diameter, nickel bronze adjustable round strainer.

.5 Floor hub drains – unfinished area

.1 Watts #FD-200-7-DD-1 Floor Drain - epoxy coated, cast iron body, trap primer connection with plug, anchor flange and weepholes, no hub outlet Watts -DD-1 5" (127 mm) diameter, nickel bronze hub funnel.

.6 Floor drain - finished area – one-piece rolled flooring applications

.1 (Note: Confirm all locations with Architectural Drawings and General Contractor) Watts #FD-100-C-FC7-1-7 Floor Drain - epoxy coated, cast iron body, reversible flashing clamp with primary and secondary weepholes, trap primer connection with plug, no hub outlet. Watts -FC7-1 7" (178 mm) diameter, nickel bronze, adjustable round strainer.

29.3 Trap seal primers

.1 Sioux Chief #695-ES01, surface mount electronic trap primer, single outlet, solenoid valve, vacuum breaker, configurable electronic primer controller, water hammer arrestor, 120VAC power, 1/2" (13mm) inlet and outlet. Provide manifold as required to suit number of traps.

30 Execution

30.1 Installation

.1 Install trap primers for all floor drains and as required by codes. Refer to schedule.

.2 Drainage lines shall grade ¼” per foot unless otherwise noted on drawings.

30.2 Cleanouts and access covers

.1 Unless otherwise noted, floor cleanouts in finished areas are not approved.

.2 Ensure ample clearance at cleanout for rodding of drainage systems.

.3 Provide cleanouts at the base of each stack.

30.3 Floor drains

.1 Provide trap primer connected to intermittent operating cold water service on suitable fixture.

.2 Provide sealed drains where indicated.

.3 Set drain at elevation to allow finished floor to slope to mouth. Coordinate setting elevation with floor finish thickness and General Contractor prior to installation.

.4 Provide flashing of sheet lead or approved nonmetallic membrane where floor drains are located over occupied spaces.

.5 All floor drains and trap primer lines shall be covered, sealed and protected during construction to ensure construction waste or other debris does not fall in. If any drainage problems occur due to floor drains not being covered, the Contractor shall rectify at no cost to the Owner.

30.4 Trap seal primers

.1 Coordinate location of all trap seal primers with site and drawings.

.2 Coordinate 120V power connection with Electrical Contractor.

End of section

31 General

31.1 Quality assurance

.1 Hot Water Tanks shall be CSA certified to the latest edition of ANSI standard Z21.10.3/CSA 4.3.

.2 Water heaters shall comply with regulations under the Energy Efficiency Act and the current ASHRAE Standard 90.1.

31.2 Warranty

.1 Refer to Section 01 78 37.

.2 6-year limited tank warranty.

.3 6-year limited parts warranty.

31.3 Submittals

.1 Shop Drawings:

.1 Refer to Section 22 05 01 – General Mechanical Requirements.

.2 Submit shop drawings to the Consultant for review prior to ordering or installation.

.3 Shop drawings shall include:

.1 Manufacturer and model numbers

.2 Performance data

.3 Construction

.4 Maintenance requirements

.5 Conformance to above reference standards

.4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

.2 Operation and Maintenance Data:

.1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

.2 Operation and maintenance data shall be included in the maintenance manual.

31.4 Acceptable manufacturers

.1 Manufacturers of units whose products are approved in principle, but subject to requirements of drawings and specifications are:

.1 AO Smith

.2 Bradford White

.3 Hubbell

32 Products

32.1 Domestic water heaters

.1 Water heaters shall be commercial grade electric for domestic water use of size and capacity as per schedule on drawings.

.2 Water heaters shall be of voltage and wattage as specified on drawing schedules.

.3 Water heaters shall meet or exceed NRCan energy efficiency standards and standby losses.

.4 Water heaters shall have internal glass coating to protect steel tank from corrosion.

.5 Water heater elements shall be thermostatically controlled for extended life.

.6 Insulation foam shall be CFC free.

.7 Water heater complete with brass drain valve and T&P valve.

.8 UL certified at 300 psi test pressure and 150 psi working pressure.

.9 Anode rod to be magnesium with stainless steel core.

33 Execution

33.1 Installation

.1 Install on new concrete housekeeping pad.

.2 Provide thermometers on inlet and outlet of each heater.

.3 Tank to include automatic reseating pressure and temperature relief valve. Pipe to drain.

End of section

34 General

34.1 Requirements

.1 Plumbing fixtures shall meet the following requirements where applicable:

.1 Ontario Building Code

.2 Local Codes and Requirements including barrier free

34.2 Related Sections

.1 Section 22 05 01

.2 Section 22 13 19

34.3 Codes and standards

.1 CAN 3-B45

.2 CSA B125

34.4 Submittals

.1 Shop Drawings:

.1 Submit shop drawings to the Consultant for review prior to ordering or installation.

.2 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards.

.3 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

.2 Operation and Maintenance Data:

.1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

.2 Operation and maintenance data shall be included in the maintenance manual.

35 Products

35.1 Fixtures

.1 Determine fixture quantity and location from Architectural Drawings. Refer to and provide plumbing fixtures as per schedule.

.2 Refer to Section 22 05 01 for mounting heights. Coordinate with Architectural Drawings and General Contractor prior to installation.

.3 Report any discrepancies of fixtures and mounting heights between Architectural Drawings and Plumbing Drawings/Schedule/Specification to the Consultant.

.4 Plumbing Fixtures shall be approved for intended application.

.5 Fixtures and trim of same type to be of one manufacturer.

.6 Where particular fixture or piece of trim is identified by a manufacturers' catalogue designation this reference is to establish standard and fixture or trim from manufacturers listed below is equally acceptable when conforming to the same level of quality.

.7 Finished surfaces to be clear, smooth and bright, and guaranteed not to haze, discolour or scale.

.8 Visible parts of faucets, escutcheons, wastes, strainers, traps, shower heads, supplies and stops to be chrome plated.

.9 Floor mounted water closets to be fitted with china bolt caps.

.10 Tank water closets to be fitted with bolt on lid.

.11 Swing spouts for sinks shall be sized so spout does not swing beyond sides of bowl. Spouts for sinks shall have stopper to prevent spout from swinging past back of bowl.

.12 Water supply faucet spouts to be fitted with modulators.

.13 Fixtures to be ordered to suit construction schedule.

.14 Acceptable Manufacturers:

.1 Vitreous China (water closets, urinals and lavatories): American Standard, Kohler, Vortens

.2 Wall Carriers: Watts, Zurn

.3 Toilet Seats: Centoco, Bemis, Olsonite

.4 Flush Valves: Commercial Moen, Delta

.5 Faucets: Commercial Moen, Delta

.6 Stainless Steel Sinks: Franke/Kindred, Steel Queen, Elkay

.7 Drinking Fountains (Bottle Filler): Elkay, Oasis

.8 Thermostatic Mixing Valves: Lawler, Haws, Symmons, Powers

.9 Washer box: Precision Plumbing Products, Oatey

35.2 Trim

.1 Provide trim for plumbing fixtures as per schedule.

.2 Trim to be suitable for exposed piping application where applicable.

.3 Acceptable Manufacturers: Cambridge Brass, Delta, Zurn, McGuire

35.3 New plumbing fixture schedule

.1 Refer to schedules on Drawings.

36 Execution

36.1 Installation

.1 Support fixtures level and square and connect with supplies, drains, traps and vents. Provide trap easily accessible for service and cleaning.

.2 Hot water taps to be on left side.

.3 Fixtures on outside walls to have water supplies in insulated chase.

.4 Exposed supply tail pieces, drains and traps on handicapped fixtures are to be insulated and/or covered in conformance with the Ontario Building Code.

.5 Completely remove and reinstall existing fixtures which are indicated to remain and connect to drain, vent, hot and cold water supply piping, to approval of authorities. Provide new seals and “O” rings.

.6 Accurately lay out roughing-in. Offsets will not be accepted.

.7 Provide fixtures complete with necessary trim, including traps, faucets, supplies, stops, strainers and escutcheons. Any exposed trim shall be chrome.

.8 Provide chrome plated rigid or flexible connections with screwdriver stops, reducers, and escutcheons.

.9 Provide trap easily accessible for service and cleaning.

.10 Provide independent threaded check valves on the hot and cold water supply lines to all thermostatic and pressure balancing faucets prior to mixing valves.

.11 Provide hot water recirculation lines within 1200 mm (48 in) of all plumbing fixtures equipped with thermostatic mixing valves.

.12 Seal fixtures and trim to counters using continuous strip of “Plumber’s Dope”.

.13 Install vacuum breakers on plumbing lines where contamination of domestic water may occur. Generally necessary on flush valves and janitor sink trim and shall be integral to fixtures as per schedule.

.14 Install prefabricated shower units with additional support by applying a heavy donut or furrow of wet cement, just prior to unit installation and level unit so that the cement will form a firm support between the floor and the unit.

.15 Provide caulking around mounting face to seal with clear or white silicone.

.16 Thoroughly clean all plumbing fixtures and trim at completion of the project.

36.2 Fixture supports

.1 Install wall mounted fixtures with approved wall carriers, model to suit installation.

.2 Provide plates, brackets, wall carriers, cleats, and supports to rigidly secure fixtures in place.

.3 Fasten wall brackets with bolts attached to double steel supporting plates.

.4 Bolt fixture to wall through cored holes under lavatory wall flange, using chrome plated carriage bolts with integral washers, and expansion shields.

.5 Install extra heavy chair carriers for fixtures not directly supported from floor.

.6 Conceal vertical supports and baseplates in wall construction.

.7 All floor mounted plumbing fixtures (such as water closet bowls, service sinks, mop receptors, and pre-fabricated shower units) to be set in mastic.

36.3 Mounting heights

.1 Refer to Section 22 05 01 and Architectural Drawings/Details for mounting heights. Report any discrepancies.

36.4 Protection

.1 Plumbing fixtures and trim to be covered with plywood, cardboard or heavy paper and kept protected before, during and after installation and until work is completed and accepted.

.2 Clean fixtures and trim immediately prior to building completion.

End of section

37 General

37.1 General requirements

.1 The requirements of this section shall apply to all sections in Division 23.

.2 Conform to Division 1 General Conditions.

.3 All material, labour, equipment, and services required under this section shall be the full responsibility of the Mechanical Contractor including any material, labour, equipment, and services provided by their subcontractors.

.4 Refer to front end tender documents and mechanical specifications for approved sub-trade lists.

37.2 Definitions

.1 “Supply” shall mean supply only.

.2 “Install” shall mean install and connect.

.3 “Provide” shall mean supply, install, and connect.

.4 “Drawings and Specifications” shall mean Contract Documents.

.5 “Authorities” or “Authorities having jurisdiction” shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.

.6 “Work” shall mean all equipment, materials, labour, and permits to provide a complete and operational mechanical system as detailed in the drawings and specifications.

.7 “Owner” shall mean Action Car and Truck.

37.3 Related work

.1 Division 1 – General

.2 Division 22 - Plumbing

.3 Division 26 – Electrical

.4 Division 28 – Communications

.5 Division 23 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions.

37.4 Intent

.1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.

.2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.

.3 Supply all labour, equipment, and materials necessary to install a complete and operational mechanical system described herein and shown on the drawings.

.4 It is the intent of these drawings and specifications to provide for a mechanical installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.

.5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.

.6 All work must be done by qualified, certified and experienced persons in such line of work. Trade certificates must be available on demand.

.7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.

.8 This Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.

.9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation and finish.

37.5 Codes, bylaws, standards, and regulations

.1 The mechanical system shall comply with the latest editions and revisions of applicable codes, bylaws, standards, and regulations including but not limited to:

.1 Ontario Building Code

.2 ASHRAE

.3 SMACNA

.4 NFPA

.5 Canadian Standards Association

.6 Canadian Gas Association

.7 Local Building Bylaws

.8 Ontario Occupational Health and Safety Act

.2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter's regulations base building standards, contract documents, and all authorities having jurisdiction.

.3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to notify the Consultant in writing and obtain clarification prior to proceeding with the work.

.4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

37.6 Permits and fees

.1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes.

.2 Coordinate all required inspections and give necessary notice to all authorities.

.3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction for all applicable disciplines.

37.7 Contract breakdown

.1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.

.2 Breakdown shall include but not be limited to:

- .1 Mobilization and shop drawing submission
- .2 Fans
- .3 Terminal Units
- .4 Grilles, Diffusers and Louvres
- .5 Ductwork
- .6 Duct Insulation
- .7 Controls
- .8 Testing, Startup & Training
- .9 Balancing
- .10 Close-out Submittals – Manuals & As-builts

.3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.

37.8 Shop drawings

.1 Within thirty (30) days of award, the Contractor shall submit shop drawings of all equipment for the project. Partial submittals will not be accepted.

.2 Prior to ordering of products or delivery of any products to job site, submit shop drawings electronically in PDF format to the Consultant for review and comments. Submit sufficiently in advance of construction to allow ample time for review. Size of shop drawings shall be 8.5x11”. 11x17” will be acceptable where appropriate for content and scale.

.3 Submittals shall contain but not be limited to:

- .1 Construction information
- .2 Product data
- .3 Performance data including performance curves
- .4 Acoustical sound power data

.5 Dimensional layout and clearances

.6 Mounting arrangements

.7 Certification of compliance to applicable codes

.8 Operating and Maintenance information

.9 Wiring, single line and schematic diagrams (where applicable)

.4 Clearly mark each sheet of printed submittal material, using arrow, underlining or circling, to show particular sizes, dimensions, wiring diagrams, operating clearances, control diagrams, project identification, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable material. Note on the submittal specified features such as special tank linings, pump seals, materials or painting.

.5 Prior to submission to the Consultant, the General and Mechanical Contractor shall review all shop drawings. By this review the Contractor represents that they have determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so and that they have checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents.

.6 The Contractor’s review of each shop drawing shall be indicated by his approval stamp, date and signature on the front of each page. Drawings will not be considered if not previously checked by the Mechanical Contractor.

.7 Review comments from the Consultant. If shop drawings are modified, confirm changes before proceeding. If shop drawings are not approved, revise and resubmit changes for approval within two (2) weeks.

.8 Review of the shop drawings by the Consultant does not relieve the Contractor or his Supplier of the responsibility to provide the correct and complete equipment, material or installation.

.9 Keep one complete set of shop drawings at the job site during construction.

.10 Include stamped reviewed shop drawings in the Maintenance Manuals.

37.9 Product delivery schedule

.1 Within two (2) weeks from shop drawing review, a schedule must be submitted by the Contractor showing projected delivery dates of all products to meet required construction schedule.

37.10 Construction meetings

.1 The Mechanical Contractor shall attend all site meetings unless otherwise pre-approved.

.2 Sub-trades shall attend site meetings as requested or as required.

37.11 Record drawings

.1 Refer to Section 01 78 00.

37.12 Reports

.1 Provide the following reports upon completion of work by certified Contractors for review and approval by the Consultant:

.1 Equipment Start-Up Reports

.2 Balance Report (Air and Water)

.3 Piping Pressure Test Reports (Gas, Hot Water Heating, Chilled Water), where applicable

.4 TSSA Report (if required)

.5 Other equipment startup reports and test sheets certified by the manufacturer or a qualified technician

.6 Demonstration and Training Reports/Logs

.2 All reports shall be dated and signed by the Technician who performed the start-up and/or tests.

37.13 Maintenance manuals

.1 Refer to Section 01 78 00.

37.14 Testing and Balancing

.1 Refer to Sections 23 05 93 under this Division.

.2 Fully coordinate all testing and startups with all trades, the Consultant, and authorities having jurisdiction.

.3 The Controls Contractor shall be present during HVAC equipment start-ups. Coordinate scheduling with Controls Contractor.

.4 Provide adequate notice to all parties.

37.15 Demonstration and training

.1 Refer to Section 01 79 00.

.2 Refer to Section 23 09 23 for additional training requirements for Controls.

37.16 Substantial completion and performance

.1 Substantial completion and performance shall be determined and awarded by the Consultant.

.2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:

.1 Fire Dampers and Fire Stopping

.2 System Testing and Startups including report

.3 Balancing including report

.4 Maintenance Manuals

.5 Record Drawings

.6 Demonstration and Training

37.17 Warranty

.1 Provide a full parts and labour warranty for the new system from date of substantial completion. Refer to 00 65 36 for details and terms.

.2 Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

38 Products

38.1 Materials

.1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer’s instructions.

.2 Major equipment shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.

.3 The same manufacturer shall be used for types of equipment used in similar applications.

.4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.

.5 Materials shall be stored in original containers.

.6 Submit to the Consultant and the Owner, current MSDS Sheets for any products being used on the job site where they exist.

.7 Remove and dispose of all redundant materials and garbage from site.

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

38.2 Selected products and equivalents

.1 Sections within Division 23 list "Acceptable Manufacturers" which must meet characteristics of the specified equipment and products for each section.

.2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.

.3 Any alternate manufacturers from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified and/or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions (i.e. electrical changes).

.4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.

.5 If item of size indicated is unobtainable, supply next larger size without additional charge.

38.3 Quality of product

.1 All products provided shall be listed and/or approved by relevant authorities and new, unless otherwise specified.

.2 If products specified are not listed and/or approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

.3 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

38.4 Product finishes

.1 Shop drawings shall indicate finishes. Use standard finish unless otherwise specified.

.2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

38.5 Access doors

.1 Provide access doors/panels as required for access, adjustment, operation, service, and maintenance.

.2 Minimum size of panels shall be 12" x 18" (300mm x 450mm). Wherever possible 24" x 24" (600mm x 600mm) panels shall be used.

.3 Access doors/panels shall have concealed hinges and screwdriver locking device.

.4 Access doors/covers - flush access door – drywall area

.1 Acudor #DW-5040 Series flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.

.5 Access doors/covers - flush access door - universal

.1 Acudor #UF-5000 Universal Access Doors, 14 GA. (1.7mm) steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.

38.6 Motors

.1 Provide high efficiency motors for mechanical equipment as specified.

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

.3 Motors under 373W, (1/2hp): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.

.4 Motors 373W, (1/2hp) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated.

38.7 Belt drives

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

.3 For motors under 7.5kW (10hp): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5kW (10hp and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer’s design requirements on prime mover shafts.

.6 Motor slide rail adjustment plates to allow for centre line adjustment.

.7 Provide sheave changes as required for final air balancing.

38.8 Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm (18 gauge) thick sheet metal tops and bottoms.

.3 40mm (1-1/2") diameter holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 106 mm (16 gauge) thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 20 mm (3/4") mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

38.9 Equipment supports

.1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Division 23.

.2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of – Structural Steel Section. Submit structural calculations with shop drawings.

.3 Install base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around.

38.10 Sleeves

.1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.

.2 Schedule 40 steel pipe.

.3 Sleeves with annular fin continuously welded at midpoint:

.1 Through foundation walls.

.2 Where sleeve extends above finished floor.

.3 Through fire rated walls and floors.

.4 Sizes: minimum 6mm (1/4”) clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.

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

.6 Fill voids around pipes:

.1 Caulk between sleeve and pipe in foundation walls and below grade floors with water proof 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 or pipe and ferrous sleeve.

.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+Amdt-Mar-78.

.7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm clearance all around or to the requirements of the authority having jurisdiction. Seal at all as indicated.

38.11 Fire stopping

.1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.

.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.

.3 Do not use cementious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.

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

.5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.

.6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.

.7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide “fire wrap” blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.

.8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.

.9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.

.10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.

.11 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.

.12 Install material and components in accordance with ULC certification, manufacturer’s instructions and local authority.

.13 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.

.14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.

.15 Acceptable Manufacturers:

.1 Fryesleeve Industries Inc.

.2 General Electric Pensiil Firestop Systems

.3 International Protective Coatings Corp.

.4 Rectorseal Corporation (Metacaulk)

.5 Proset Systems

.6 3M

.7 AD Systems

.8 Hilti

.16 Ensure firestop manufacturer representative performs on-site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

38.12 Escutcheons

.1 On pipes and ductwork 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.

38.13 Spare parts

.1 Provide spare parts as specified under this Division.

.2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

38.14 Special tools

.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

39 Execution

39.1 Site examination

.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.

.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.

.3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

39.2 Interference and coordination drawings

.1 Refer to 01 31 14.

39.3 Separation of services

.1 Contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

.2 All pipes, ductwork and wiring shall be supported from permanent building structure. Use of other services for support is not permitted

39.4 Workplace safety

.1 The workplace must be kept safe at all times.

.2 Conform to all ministries of labour, and health and safety regulations at all times.

.3 Use ladders and proper techniques as approved by the ministry of labour to perform all work.

.4 Cover all holes/openings and provide barriers around hazards, etc. to ensure occupants and workers are not at risk.

.5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner’s representative or Consultant or rectify the situation immediately.

.6 Report any hazards or concerns to the Owner’s representative immediately.

.7 Conform to Owner’s safety requirements and construction regulations.

39.5 Temporary requirements

.1 All temporary requirements to complete mechanical work during construction shall be the responsibility of the Mechanical Contractor except temporary power or water.

39.6 Location of equipment

.1 Approximate distances and dimensions may be obtained by scaling off the drawings. Figured dimensions shall govern over scaled dimensions.

.2 Equipment locations shown on the drawings are approximate. Locations may be revised to suit construction and equipment arrangements provided design intent is not jeopardized and there is no additional cost to the Owner.

39.7 Mounting heights

.1 Mounting height of equipment is from finished floor to equipment unless otherwise specified or indicated. Coordinate with block coursing if applicable.

.2 Where mounting heights are not indicated on the drawings, obtain verification from the Consultant before proceeding.

39.8 Repairs, cutting and restoration

.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.

.2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

.4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

39.9 Painting

.1 Refer to other Divisions for Painting unless otherwise specified herein.

.2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

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

.4 Restore to new condition, or replace equipment at discretion of Consultant, finishes which have been damaged too extensively to be merely primed, painted and touched up.

39.10 Concealment

.1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls in finished areas.

.2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit parallel to building lines, tight to roof deck and down columns.

39.11 Access doors

.1 Provide access doors as required for access, adjustment, operation, service, and maintenance.

39.12 Clearances and accessibility

.1 Install all work for easy access for adjustment, operation, service, and maintenance.

.2 Maintain clearances for all equipment as per local codes and manufacturer’s instructions.

.3 Access panels shall be Acudor or equivalent with concealed hinges and screwdriver locking device.

.4 Provide access panels of adequate size as required to access equipment and components in concealed areas. Do not install access doors in specialty walls or ceilings.

.5 Provide fire rated access doors where installed in fire separations to match rating of separation.

.6 Install all services in exposed areas so that a minimum head clearance of 2200mm (88”) is maintained.

39.13 Equipment and system protection

.1 Protect equipment and materials from damage in storage and on site before, during, and after installation until final acceptance.

.2 Protect equipment and system openings from dust and debris with appropriate covers that will withstand through the construction.

.3 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant and the Owner at no expense to the Owner.

39.14 Supports

.1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all equipment, ductwork, piping, and all other work in Division 23.

.2 All supports must be securely mounted to structures.

.3 Refer to Section 22 05 29.

39.15 Fire stopping

.1 Refer to Part 2 herein.

39.16 Cleaning

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units prior to turn over to Owner.

.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.

39.17 Owner supplied equipment

.1 Connect to equipment supplied by the Owner and make operable.

39.18 Identification and labeling

.1 All equipment, valves, panels and devices shall be labeled under this Division.

39.19 TSSA inspection

.1 Where applicable, prior to final completion of the project, this Contractor shall make application, arrange, and pay for a TSSA Inspection of all piping systems and equipment installations, including, but not limited to refrigeration, fuel piping, heating plant, and associated equipment installed under the contract.

.2 Provide a copy of the TSSA Report in the maintenance manuals for each system.

39.20 Demonstration and training

.1 Refer to 1.15 herein.

39.21 Field review and deficiencies

.1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.

.2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.

.3 The Contractor shall correct all deficiencies within the work period prior to the next review.

.4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor’s expense.

.5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

End of section

40 General

40.1 Work included

.1 Review location of all balancing valves on drawings for air and water systems prior to construction and submit recommendations for additional balancing dampers or balancing valves to perform complete system balancing.

.2 Test, balance and adjust all new air and water systems and equipment and submit reports.

.3 Allow for a minimum of one (1) return visit for any adjustments and/or to work with the Contractor to investigate any issues.

40.2 Scope of work

.1 Review design drawings and general function of each system including associated equipment, control sequences and operation cycles. Confirm listing of flow and terminal measurements to be performed.

.2 Confirm balancing valve and damper locations are adequate for system balancing. Recommend additional locations to Contractor and Consultant if required to complete system balancing.

.3 Outline procedures for taking test measurements to establish compliance with requirements. Specify type of instrument to be used, method of instrument application and correct factors.

.4 Test, balance and adjust updated air and water systems upon completion of the work. Use approved report format as approved by the Consultant to record all results. Submit sample to Consultant for approval prior to balancing.

.5 Contact Consultant during or immediately following balancing procedures to discuss any concerns or issues prior to issuing any reports.

.6 Submit one (1) copy of the Balance Report to the Consultant for review.

.7 Make adjustments as directed by the Consultant. Include for a minimum of one (1) return visit for any adjustments and/or to work with the Contractor to investigate any issues.

.8 Revise report and resubmit to the Consultant for review.

.9 Upon acceptance of the report, participate in Commissioning process. Demonstrate a minimum of 30% of readings and submit on separate test forms.

40.3 Balance reports

.1 Use a format acceptable to the Consultant for Reports.

.2 Submit one (1) copy of the report to the Consultant for review within one (1) week from balance completion and prior to inclusion into Maintenance Manuals. Include any comments or concerns from system balancing on report.

.3 Reports shall include equipment data, design data and balance results in metric and imperial units.

.4 Report shall include but not be limited to:

.1 Balancing Company

.2 Balancing Agent who performed the work

.3 Date the balancing was performed

.4 Date of report

.5 Tools and apparatus used for testing including calibration information

.6 System description

.7 Equipment manufacturer, model, arrangement, size, performance, fan size (if applicable), motor size, voltage and amperage

.8 Design and actual air flows (supply air, return air, outside air)

.9 Design and actual water flows

.10 Setting of balancing valves

.11 Design and actual pressure drops (air and water)

.12 Electrical characteristics

.13 Design and actual motor FLA, RPM

.14 Comments or concerns on findings

40.4 Acceptable balancing agencies

.1 Obtain the services of a NEBB or CAABC accredited Balancing Agent for all balancing work described herein.

.2 All equipment and products necessary to perform tests shall be provided and covered by the Balancing Agent.

40.5 Maintenance manual materials

.1 Provide copies of the reports to the Contractor for inclusion in the manuals.

41 Execution

41.1 General

.1 Coordinate with system installers to confirm location of all balancing dampers and balancing valves. Balance dampers and valves required in addition to those shown on the drawing must be coordinated prior to installation.

.2 Balance to maximum measured flow deviation from specified values of 10% at terminal device and 5% at equipment.

.3 Mark settings on valves, splitters, dampers and other adjustment devices.

.4 Include any required site investigation and system balancing based on any system deficiencies as noted herein.

.5 Contact Consultant during or immediately following balancing procedures to discuss any concerns or issues prior to issuing any reports.

.6 At final inspection, recheck and prove random selections of data recorded in report at discretion and direction of the Consultant.

.7 Participate in Commissioning.

41.2 Instrument test ports

.1 Ports shall be supplied and installed by the mechanical contractor prior to installation of external insulation. The balancing contractor shall assist the mechanical contractor to mark the spacing for the instrument ports on the ductwork after installation of the ductwork and notify the commissioning team of the number of ports

41.3 Air system procedure

.1 Adjust air handling and distribution systems to provide required or design supply and return air quantities.

.2 Make air quantity measurements in ducts by pitot tube traverse of entire cross-sectional area of duct.

.3 Measure air quantities at air inlet and outlet.

.4 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Affect volume control by duct internal devices, such as dampers and splitters.

.5 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.6 Provide system schematic with required and actual air quantities at each outlet or inlet.

41.4 Water system procedure – hydronic systems

.1 Adjust water systems to provide required or design quantities.

.2 Use calibrated venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

.3 Adjust systems to provide specified pressure drops and flow through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

.4 Effect system balance with automatic control valves fully open to heat transfer elements.

.5 Effect adjustment of water distribution systems by means of balancing cocks, valves and fittings. Do not use service or shutoff valves for balancing unless indexed for balance point.

.6 Where pump capacity available is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

41.5 Reports

.1 Submit written reports for all balancing in a format pre-approved by the Consultant as per Scope of Work above.

.2 Submit one (1) copy of the Balance Report to the Consultant for review.

.3 Make adjustments as directed by the Consultant. Include for a minimum of one (1) return site visit as noted herein.

.4 Revise report and resubmit to the Consultant for review.

.5 Fan Test Reports

.1 Report air flow; air pressure at inlet and discharge; fan speed; motor current; motor voltage; manufacturer; model; fan wheel size.

.2 For fans with power greater than 250 watts, plot design and actual pressure and flow on manufacturer's or drafted fan performance curve.

.6 Pump Test Reports.

.1 Report designed water flow; water pressure at inlet and discharge; pump speed; motor current; motor voltage; manufacturer; model; impeller size.

.2 For pumps with power greater than 250 watts, plot design and actual pressure and flow on manufacturer's or drafted pump performance curve.

.7 Upon acceptance of the report, provide copies of final report for maintenance manuals.

41.6 Commissioning

.1 Participate in Commissioning. Demonstrate a minimum of 30% of readings and submit on separate test forms.

End of section

42 General

42.1 Work included

.1 Duct thermal insulation

.2 Duct acoustic insulation

.3 Insulation for Exterior and Waterproof Applications

.4 Recovering

42.2 Quality assurance

.1 All workers engaged in the application of insulation shall be journeymen, or indentured apprentices working under a journeyman who is on the site.

42.3 Job conditions

.1 Deliver material to job site in original nonbroken factory packaging, labeled with manufacturer's density and thickness.

.2 Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

43 Products

43.1 General

.1 Adhesives, Insulation, Coatings, Sealers and Recovering Jackets shall have composite fire and smoke hazard ratings not exceeding 25 for flame spread and 50 for smoke developed.

.2 Adhesives, coatings and sealers shall be waterproof.

43.2 Thermal duct insulation

.1 Insulation shall be pre-covered, preformed insulation complete with foil or kraft all purpose jacket unless otherwise noted.

.2 Supply duct insulation shall be:

.1 Minimum 25mm (1”) thick

.2 R-6 in unconditioned spaces (non-ceiling plenum areas including Mechanical Room)

.3 R-12 in attic spaces

.4 R-1.9 in indirectly conditioned spaces (including ceiling plenum areas)

.3 Outside air and exhaust air duct insulation shall be:

.1 Minimum 25mm (1”) thick

.2 R-6

.4 Exposed Rectangular Ducts: Rigid fibrous glass insulation with factory applied reinforced aluminum foil vapour barrier.

.5 Round Ducts and Concealed Rectangular Ducts: Flexible fibrous glass insulation with factory applied reinforced aluminum foil vapour barrier.

.6 Recovering Jackets (Interior): ULC listed "Thermo Canvas", treated cotton fabric.

.7 Acceptable Manufacturers:

.1 Fibreglass Canada

.2 Knauf

.3 Mason

43.3 Acoustic duct insulation

.1 Fiberglass insulation with "K" value at 0.26 btu/in/sq ft /deg F/hr absolute roughness of exposed surface not to exceed 0.033 mm coated to prevent fibre erosion at air velocities up to 400 fpm.

.2 All substrate material to be non-darkened, contrasting colour from liner layer.

.3 Use 25mm (1”) thick insulation unless otherwise noted.

43.4 Insulation for exterior and waterproof applications

.1 Insulation: 3.0 PCF density, 50mm (2”) thick rigid fiberglass insulation board with factory applied fsk facing. Equal to Knauf insulation board with ecose technology.

.2 Jacket: Weather proof flexible jacket equal to Alumaguard 60.

44 Execution

44.1 Preparation

.1 Do not install covering before ductwork and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

44.2 Installation - general

.1 In non fire rated surfaces, ensure insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material properly sealed.

.2 Finish insulation neatly at hangers, supports and other protrusions.

.3 Locate insulation or cover seams in least visible locations.

44.3 Thermal duct insulation

.1 Provide thermal insulation on:

.1 All outside air and exhaust air ductwork between Energy Recovery Air Handling Unit and exterior wall louvres including louvre plenums.

.2 ALL supply air ductwork whether it is installed in a plenum or not in a plenum. Refer to R-values under Part 2.

.3 Outside air intakes and plenums in all areas.

.4 Exhaust air ductwork within 2.4m (8’) of insulated surface penetration (i.e. exterior wall or roof).

.2 Exposed Rectangular Ducts: Secure rigid insulation with 50% coverage of adhesive and 12 gauge galvanized impale anchor tabs on 400mm (16”) centres. Seal joints with 100mm (4”) wide foil tape.

.3 Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 150mm (6”) wide strips on 400mm (16”) centres. Provide 16 gauge annealed tie wire, or polypropylene twine, spiral wound or half hitched at 100mm (4”) centres for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks with 100mm (4”) foil tape.

44.4 Acoustic duct insulation

.1 Apply to interior of:

.1 First 3m (10’) of supply AND return ducts on inlet and discharge of Energy Recover Air Handling Unit and Rooftop Units.

.2 First 1.5m (5’) of supply AND return ducts on inlet and discharge of any other air handling equipment.

.3 Transfer ducts and elbows.

.4 As indicated on drawings.

.2 Secure to ductwork with adhesive using 50% coverage and 12 gauge impale anchor tabs on 400mm (16”) centres. Cut off excess fastener length and cover with brush coat of sealer.

.3 Shop fabrication cuts shall be coated with JM’s SuperSeal Duct Butter and Edge Treatment products.

.4 Seal all cut and exposed ends.

.5 Acoustically lined ductwork to have 2” (50mm) nosing all around on leading edge. In addition, at fan discharge where air velocity exceeds 1500 fpm, acoustic lining to have wire meshing on first 10’ (3m) of run.

44.5 Canvas recovering jacket

.1 Provide recovering jackets on exposed insulation throughout including but not limited to Mechanical Rooms.

.2 Coat recovering jacket with two coats of waterproof fire retardant coating.

44.6 Insulation for exterior and waterproof applications

.1 Provide insulation for waterproof applications complete with jacketing on ductwork exterior to building (i.e RT-101).

End of section

45 General

45.1 Work Included

.1 Commissioning shall be carried out by a Third Party Commissioning Agent retained by the Contractor under this contract.

.2 Commissioning Agent shall hold a currently valid certificate from one of the following organizations:

.1 ASHRAE

.2 Association of Energy Engineers (AEE)

.3 Building Commissioning Association (BCA)

.3 The Contractor shall provide assistance throughout the commissioning process as needed.

46 Products

46.1 Equipment and products

.1 All equipment and products necessary to complete the commissioning shall be covered by the Agent and this Division at no cost to the Owner.

47 Execution

47.1 Commissioning

.1 Third Party Commissioning Plan shall be prepared by the Commissioning Agent and submitted to the Consultant for review at the start of the project.

.2 A copy of all HVAC Shop Drawings shall be forwarded to the Commissioning Agent after review

.3 All equipment and systems shall be started, tested and reports submitted and accepted prior to start of commissioning.

.4 System tests shall include, but not be limited to:

.1 Update HVAC Systems including existing Roof Top Units.

.2 Exhaust Fans

.3 Control Systems for HVAC

.4 Natural Gas piping revisions (if applicable)

.5 The Contractor shall submit all checklists included within the prepared Third Party Commissioning Plan.

.6 The Balancing Agent shall demonstrate a minimum of 30% of TAB readings and record.

47.2 Demonstration and Training

.1 Provide assistance during Demonstration and Training as detailed within Third Party Commissioning Plan and Section 01 79 00.

.2 Complete and accepted maintenance manuals and record drawings shall be submitted and available for use during the demonstration and training.

End of section

48 General

48.1 Reference standards

.1 Ontario Building Code

.2 ASHRAE

.3 SMACNA

.4 NFPA 90A – Air Conditioning and Ventilation Systems

.5 ULC

.6 CSA

.7 Local Codes and Requirements

48.2 Submittals

.1 Submit shop drawings showing location, ratings, sizes of all fire dampers.

.2 One copy of all stamped reviewed shop drawings plus operation and maintenance data shall be included in the maintenance manual.

49 Products

49.1 General

.1 All required accessories shall conform to ASHRAE and SMACNA standards and recommendations.

49.2 Fire dampers

.1 Provide fire dampers in ducts penetrating fire rated walls, floors, or ceiling as indicated on the drawings.

.2 Fire dampers shall be UL STD 555 to 1-1/2 hour fire ratings.

.3 Fire dampers shall be equipped for vertical or horizontal suitable for application.

.4 Frame: 4-7/8”, 20 gauge galvanized steel channel.

.5 Blades: 24 gauge galvanized steel blades, curtain type, recessed out of air stream.

.6 Fusible link: 165°F.

.7 Provide duct access doors to service fire dampers for those air transfer openings mounted with ducts.

.8 Floor fire dampers not accessible from above must have factory installed rings for unlocking from the underside.

.9 Acceptable Manufacturers

.1 Ruskin – Series IBD2 Style B

.2 Nailor Industries – 0120 Type B

.3 National Controlled Air (NCA) – FD – 80 Type B

.4 Tamco

.5 Price

49.3 Balancing dampers

.1 Multi-blade damper: Galvanized steel minimum 16 gauge, provide with quadrants or adjustment rods and lock screw.

.2 Single blade damper: Galvanized steel minimum 18 gauge, provide with quadrants and lock screw.

.3 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration. Size on basis of straight air volume proportioning.

.4 Fabricate single blade dampers for duct sizes to maximum 250mm x 750mm (10” x 30”).

.5 Fabricate multi-blade dampers of opposed blade pattern with maximum blade sizes 300mm (12”) to 1.8m (6’). Assemble centre and edge crimped blades in prime coated or galvanized channel frame with approved type hardware.

.6 Include for the supply and installation of twelve (12) extra balance dampers in installed ductwork pending balance results and comments.

.7 Duct splitter dampers are to measure 1.25 times the controlled opening size. Damper push rods to be 1/4" with secure locking device. Splitter dampers over 16” (400mm) in depth to have 2 push rods.

49.4 Turning vanes

.1 Factory or shop fabricated double thickness to SMACNA standards.

.2 Acceptable Manufacturers:

.1 Duro Dyne

.2 Ductmate

49.5 Automatic dampers

.1 Damper frames and blades shall not be less than 12 gauge, 0.081" (2.1mm) extruded aluminium. Channel frame to be 4" (101.6mm) deep.

.2 Blades to be single unit, internally reinforced and connected to frame with a 7/16" hexagon rod. Internal hollows to be insulated with 7/8" thick polyurethane foam with T factor of 5.0 per inch. Blades shall be thermally broken. All fresh air intake dampers to be complete with insulated frame and blade.

.3 Blade and frame seals to be extruded synthetic rubber secured in an integral slot within the blade extrusion.

.4 Frame shall be insulated with polystyrene, R factor of 5.0 per inch.

.5 Bearings to be comprised of Celcon inner bearing fixed onto a hexagon rod rotating within a Polycarbonate outer bearing inserted into frame, resulting in no metal to metal contact.

.6 Linkage hardware to be out of air stream and constructed of aluminium and corrosion resistant zinc plated steel, equipped with cup-point trunnion screw for slip-proof grip.

.7 Dampers shall be suitable for operating in temperatures ranging between -40°F (-40°C) and 165°F (731°C).

.8 Leakage shall not exceed 0.6% of the rated air flow at 10" WG differential static pressure across the damper.

.9 This Contractor shall provide all 120-24V transformers as required.

.10 Acceptable Manufacturers:

.1 Tamco 9000

.2 Ruskin

.3 Nailor.

49.6 Damper actuators

.1 Damper actuators shall be supplied with the unit by the unit manufacturer or by Controls Contractor under Section 23 09 23 as indicated in the equipment schedules, equipment specifications and controls details.

49.7 Access doors

.1 Provide access doors in ductwork to allow cleaning in the bottom of all duct risers, next to outside air intakes and outlets, at each fire damper and plenum and equipment casings to facilitate maintenance and cleaning of all components.

.2 Construct access doors from double thickness 20 gauge galvanized steel sheets or aluminium in equal strength where required, 25mm apart, with necessary reinforcing inside for rigidity. Fill the 25mm space with glass fibre insulation.

.3 Make doors airtight with a continuous rubber gasket.

.4 Access Doors shall have minimum two hinges and one sash lock for sizes up to 250mm (10”), and two hinges and two compression latches for sizes up to 600mm (24”).

.5 Acceptable Manufacturers

.1 Price

.2 Nailor

.3 Titus

49.8 Flexible connections

.1 Flexible Connections shall be Duro Dyne heavy glass, ULC listed, non-combustible, waterproof fabric, double coated with neoprene and shall be 150 mm minimum width, 0.81mm thick, density of 1.3 kg/m^2. Temperature rating shall be -40C (-40F) to +90C (+194F).

.2 Flexible connectors shall be attached to 24 gauge metal strips minimum 75mm (3”) wide.

.3 Acceptable Manufacturers:

.1 Duro Dyne

.2 Mercer Rubber Co.

49.9 Test ports

.1 Test ports shall be equal to Duro Dyne TH-1, IP-2, IP-4 to suit application complete with screw in cap, neoprene gasket, insulating plug, and extensions for insulated ductwork.

.2 Acceptable Manufacturers:

.1 Duro Dyne

.2 Ductmate

50 Execution

50.1 Installation

.1 Provide access doors of adequate size to service, maintain, or inspect within duct stream where required. Locations include but are not limited to automatic dampers, fire dampers, and filters. Coordinate installation with General Contractor.

.2 Install flexible connections where rigid duct connects to equipment that is susceptible to vibration and as indicated on drawings.

.3 Install instrument test ports to allow Pitot tube insertion with cam-action handle.

50.2 Fire dampers

.1 Confirm rating of devices with ratings of surfaces or separations.

.2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction.

.3 Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.4 Provide duct access doors to service fire dampers for those air transfer openings mounted with ducts.

.5 Provide fire stop flaps on air outlets penetrating fire rated membranes or surfaces.

50.3 Balancing dampers

.1 Provide balancing dampers, whether shown or required, at points on supply, return and exhaust systems, where branches are taken from larger ducts, for proper air balancing.

.2 Review balance damper locations with the Balancing Contractor prior to installation. Additional costs to add balance dampers for proper balancing after installation will not be accepted.

.3 Include for the supply and installation of twelve (12) extra balance dampers in the already installed ductwork pending balance results and comments.

50.4 Turning vanes

.1 Install in conformance with SMACNA standards.

.2 Install in all square elbows and short radius elbows for supply and return air ductwork.

50.5 Automatic dampers

.1 Install opposed blade automatic control dampers as indicated on drawings.

.2 Opposed Blade Dampers: Use for shut off service, modulating service without companion dampers, throttling services.

.3 Parallel Blade Dampers: Use for mixing or relief service, variable position service with companion dampers.

.4 Coordinate installation of operator and controls with Controls Contractor where applicable.

.5 Damper actuators shall be supplied by Controls Contractor under Section 15900 as indicated in the equipment schedules, equipment specifications and controls details.

50.6 Access doors

.1 Access doors shall be complete with two (2) locking latches.

50.7 Flexible connections

.1 Provide flexible connections on inlet and outlet duct connections of air handling units or other equipment likely to be affected by, or to cause vibration or noise to be transmitted through ductwork.

.2 Install in accordance with SMACNA.

End of section

51 General

51.1 Reference standards

.1 Ontario Building Code

.2 SMACNA

.3 NFPA 90A – Air Conditioning and Ventilation Systems

.4 ASTM A653

.5 ULC

.6 Local Codes and Requirements

51.2 Related Sections

.1 Section 23 05 01

.2 Section 23 07 13

.3 Section 23 23 00

52 Products

52.1 General

.1 Provide ductwork as recommended and specified in the latest revision of the Sheet Metal and Air Conditioning Contractors National Association incorporated (SMACNA).

52.2 Ductwork

.1 Galvanized steel with Z90 designation zinc coating lock forming quality to ASTM A525M.

.2 Round:

.1 Factory fabricated, spiral wound, with matching fittings and specials. Longitudinal seam type is not acceptable.

.2 Transverse joints up to 900mm (36”): slip type with tape and sealants.

.3 Transverse joints over 900mm (36”): Ductmate or Exanno Nexas Duct System.

.3 Comply with NFPA standards for exhaust ductwork and hoods which are used in applications resulting in airborne grease entrainment. 18 gauge stainless steel continuous welded. Refer to drawings for details and specifications.

.4 All exposed ductwork in finished areas shall be spiral unless otherwise indicated.

52.3 Duct construction

.1 All new supply air ductwork from air handling unit fan discharge to first VAV / VVT component or first reheat coil shall be constructed to SMACNA 750 PA (3: wg) duct construction class. All other supply air ductwork upstream of VAV / VVT components or reheat coils shall be constructed to SMACNA 500 Pa (2” wg) duct construction class. For all other constant volume systems, all supply air ductwork installed in mechanical rooms shall be constructed to SMACNA 500 Pa (2” wg) duct construction class.

.2 All new supply air ductwork downstream of VAV / VVT components or reheat coils shall be constructed to SMACNA 250 Pa (1” wg) duct construction class.

.3 All new return air ductwork and all exhaust air ductwork installed in mechanical rooms shall be constructed to SMACNA 500 Pa (2” wg) duct construction class. All other return air ductwork and exhaust air ductwork shall be constructed to 250 Pa (1” wg) duct construction class.

.4 Tie rods shall not be used in lieu of external duct reinforcement except where specifically mandated by SMACNA duct construction standards.

.5 Duct tapers to be at 14 degrees maximum (1:4 ratio) for all systems with air velocities less than 1500fpm and 8 degrees (1:7 ratio) for velocities 1500 fpm and greater.

.6 This Section shall provide a schedule of proposed duct construction, meeting SMACNA standards, to be used on the project. Schedule shall include panel width, gauge, transverse connector, reinforcement, longitudinal seam, sealing class and sealing compound. Submit schedule prior to performing any duct fabrication/installation.

52.4 Fittings

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius and or short radius with double thickness turning vanes Centreline radius: 105 times width of duct.

.2 Round: in exposed areas one-piece smooth radius, 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400mm (16”): with double thickness turning vanes.

.2 Over 400mm (16”): with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with 45° entry on branch.

.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 Diffuser connection to main:

.1 High efficiency takeoffs complete with rectangular duct opening and 45° slope body. Takeoffs shall be furnished complete with balancing damper and locking quadrant.

.2 Contractor shall notify Consultant if height of takeoff is required to be reduced to suit ceiling clearances and obtain approval from the same prior to installing or fabricating.

.3 Takeoffs shall be equal to SMC H.E.T.O. or fabricated on site.

.6 Transitions:

.1 Diverging: 20° maximum included angle.

.2 Converging: 30° maximum included angle.

.7 Offsets:

.1 Full short radiused elbows.

.8 Obstruction deflectors: maintain full cross-sectional area.

52.5 Firestopping

.1 40mm x 40mm x 3mm (1-1/2” x 1-1/2” x 14ga) retaining angles all around duct, on both sides of fire separation.

.2 Firestopping material and installation must not distort duct.

.3 All ductwork passing through partition walls shall be firestopped.

52.6 Fasteners

.1 Fasteners shall be sheet metal screws, rivets, and bolts.

52.7 Flexible ductwork

.1 Listed in accordance with ULC-S110 and classified Class 1.

.2 Flame spread rating not more than 25. Smoke developed rating not more than 50.

.3 Semi-rigid and lightweight air duct, manufactured using a dead soft aluminum strip which is spirally wound and mechanically joined together to form an air tight and leak-proof three ply mechanical seam. Self-supporting and corrosive resistant that provides excellent strength and rigidity.

.4 Provide insulated or uninsulated as noted.

.5 Performance - Uninsulated:

.1 Material: Aluminum

.2 Maximum rated velocity: 5500 fpm

.3 Maximum positive pressure: 2.5 kPa (10 in.wc.)

.4 Maximum negative pressure: 3.0 kPa (12 in.wc.)

.5 Temperature Range : -51C to 315C (-60F to 600F)

.6 Bend Radius : 1.5 times diameter

.7 Available sizes : 50mm to 610mm (2 inches to 24 inches)

.6 Performance - Insulated:

.1 Core material: Aluminum

.2 Thermal Resistance: Available in R4.2, R6, R8

.3 Maximum rated velocity: 4000 fpm

.4 Maximum positive pressure: 3.0 kPa (12 in.wc.)

.5 Maximum negative pressure: 0.25 kPa (1 in.wc.)

.6 Temperature Range : -40C to 121C (-40F to 250F)

.7 Bend Radius : 1.5 times diameter

.8 Available sizes : 100mm to 500mm (4 inches to 20 inches)

.7 Acceptable Manufacturers:

.1 Uninsulated: Flexmaster Triple Lock T/L Aluminum Flexible Ducting

.2 Insulated: Flexmaster Triple Lock T/L Aluminum Thermal Flexible Ducting

52.8 Hangers and supports

.1 Refer to Section 23 05 29.

52.9 Duct sealer

.1 Duct Sealer to be ULC classified for surface burning characteristics and be water based.

.2 Duct Sealer shall be Duro-Dyne DWN, grey, water-based for medium and high pressure duct systems, non-flammable (wet state), fire retardant (dry state).

.3 Duct Sealer shall be clear silicone type on all exposed ductwork or duct sealer shall be applied to inside of fittings to ensure clean look.

52.10 Turning vanes

.1 Turning vanes shall be of steel construction with prime coat finish and complete with supports and fastenings.

.2 Turning vanes shall be double wall with correct airfoil pattern.

52.11 Instrument test ports

.1 Instrument port covers shall be Duro-Dyne IP-1 for bare ducts and IP-2 for insulated ducts.

53 Execution

53.1 Rigid ductwork

.1 Coordinate with other trades prior to installing ductwork.

.2 All ductwork and fittings shall be installed in accordance with SMACNA and ASHRAE standards.

.3 Duct tapers to be at 14 degrees maximum (1:4 ratio) for all systems with air velocities less than 1500fpm and 8 degrees (1:7 ratio) for velocities 1500 fpm and greater.

.4 Ductwork shall be properly constructed, braced, connected and jointed. Suspend with hangers to SMACNA Standards. Refer to Section 23 05 29.

.5 Do not suspend hangers including wires and rods from the steel roof deck nor from other mechanical or electrical components. Support hangers from structural bearings such as beam, top chords of steel joists or structural concrete slabs. Where structural bearings do not exist, provide angle or channel iron form nearest structural bearings to support hangers.

.6 Use of “S and drive” or equivalent slip joint method, or Ductmate flange joint method is permissible. Fabricate and install in accordance with SMACNA reinforcement standards. Leave smooth finish on edges and interior of duct runs. Install internal ends of slip joints in direction of flow.

.7 Ducts and joints shall be tight and rigid so as not to leak, rattle, or vibrate.

.8 Install ductwork to allow adequate space for normal operation and maintenance of equipment nearby.

.9 Where possible, radiused duct elbows with radiused splitter vanes are preferable over square elbows with turning vanes. Where square duct elbows are necessary, turning vanes to be double thickness airfoil type installed in every slot on the vane rail.

.10 Direct size duct spin-ons are not acceptable. Conical spin-on or square-to-round fittings shall be provided.

.11 Where ducts pass through walls, seal around ducts with noncombustible material.

.12 All openings through wall must be sleeved and lined as specified. Openings shall be 50mm (2”) larger all around than duct or piping and filled with fireproof Rockwool type insulation complete with fire retardant sealant both sides.

.13 All open ductwork, not being worked on, must be completely covered during construction phase until all sanding, plastering, painting, and finishing is complete.

.14 Inspect and test ductwork prior to any required painting or insulation for air leakage at joints and connections under normal operating conditions. Air leakage tests shall be performed as specified herein.

.15 Paint ductwork visible through registers, grilles and diffusers flat black.

.16 Under no conditions are pipes, rods or wires allowed to penetrate ducts.

.17 Commercial kitchen exhaust duct shall be welded, sloped and with access doors in conformance with NFPA 96.

53.2 Flexible ductwork

.1 Install in accordance with SMACNA.

.2 Maximum length shall be 1.8m (6'). Minimum 12" (300mm) straight vertical duct run to be provided at all diffusers.

.3 Provide support at centre of flexible duct.

53.3 Duct sealing

.1 Seal all ductwork with duct sealer as specified herein. Ducts constructed to SMACNA 500Pa (2") duct construction class and under shall be sealed to SMACNA Standard Section 1.6 and 1.7, Class C. Ducts constructed to SMACNA 750Pa (3") duct construction class shall be sealed to SMACNA Standard Section 1.6 and 1.7, Class B. Duct sealer shall be applied behind fittings for all exposed ductwork in finished areas.

.2 The sealer shall be stored at room temperature for at least 24 hours prior to use. Surfaces shall be clean, dry and free from oil, grease, and any other foreign material.

.3 Clean fittings to a depth of four inches with a solvent, exercising safe practices as recommended by the manufacturer.

.4 Stir sealer thoroughly before application.

.5 Use a brush, cartridge guns or spatula to apply the sealer to male section of spiral duct or to both fittings of rectangular duct. Join joints while sealer is wet (within approximately 15 minutes) and secure with sheet metal

screws applied as close as possible (1/2” or less). Apply sealer to outside of assembly with a 2” wide band of sealer, thoroughly covering joint head and sheet metal screws. Allow sealer to set (approximately 72 hours) before pressure testing. Do not thin.

.6 The Consultant shall inspect the duct sealing prior to any insulation being installed. Provide minimum four (4) working days’ notice.

53.4 Instrument test ports

.1 Ports shall be supplied and installed by the mechanical contractor prior to installation of external insulation.

.2 With the assistance of the balancing contractor, the contractor will mark the spacing for the instrument ports on the ductwork after installation of the ductwork and notify the commissioning team of the number of ports.

53.5 Duct leakage tests

.1 All new, revised and upgraded systems (Rooftop Air Handling Systems) shall be pressure tested for leakage.

.2 Tests shall be performed in accordance with SMACNA procedures including supply air, return air, outside air and exhaust air. Calibrated orifices shall be used to measure all leakage airflow rates. All ductwork shall be pressure tested at minimum 500 Pa (2”WG). For any system, total leakage at the test pressure shall not exceed 5% of respective fan design air flow rate. For constant volume (CV) systems, test all supply air ductwork from air handler to air terminals including fire dampers but excluding air terminals. For return and exhaust air ducts, blank grilles or open ducts and test duct from fan inlet to most remote inlet including fire dampers, access doors and silencers. Repair all leaks and repeat test. Pressurize with small blower. Test system as a whole, or in parts, provided that all ductwork is accessible for inspection at the time of test.

.3 Tests shall be performed before ducts are insulated or enclosed. Submit notice of all tests in ample time to allow the Consultant or their representative to be present when the tests are conducted. All tests shall be witnessed by the Consultant and the Owner’s third party commissioning agent or they shall be repeated.

.4 Any components of the systems which might be damaged during the tests shall be removed before the tests and reinstalled after the tests.

.5 Provide all test holes (including prefabricated insulated capped test hole fittings), dampers, access facilities, etc. as required for air balancing and make any changes required for the final balancing results. Cooperate with the Balancing Contractor to ensure satisfactory completion of his work. Provide test holes prior to application of thermal insulation.

.6 Submit report of air tests to Consultant and include in maintenance manuals.

53.6 Painting

.1 All exposed ductwork in finished areas shall be painted. Coordinate colour with Owner.

53.7 Cleaning (prior to start-up)

.1 Keep ductwork and duct liners clear from dust and debris during construction.

.2 Prior to starting HVAC equipment, inspect and clean all equipment, and ductwork on the inside and outside to ensure that they are completely free from dust and debris.

.3 Install clean filters in all units.

End of section

54 General

54.1 Quality assurance

.1 Conform to AMCA Bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal.

.2 Wheels will be balanced in accordance with AMCA Standard 204-96.

.3 Polyphase, squirrel cage, single speed NEMA/EEMAC Design A or B induction motors, between 1 hp and 200 hp whether in packaged equipment or not, shall comply with the current requirements of the Ontario Hydro Efficiency Standards Regulation, and specifically, CSA C390- 93 Energy Efficiency Test Methods for Three Phase Induction Motors.

54.2 Related Sections

.1 Section 23 05 01

.2 Section 23 05 93

54.3 Submittals

.1 Shop Drawings:

.1 Refer to Section 01 33 00

.2 Submit shop drawings to the Consultant for review prior to ordering or installation.

.3 Fan shop drawings shall include:

.1 Manufacturer and model numbers

.2 Performance data

.3 Fan curves and sound data, with fan and system operating point plotted on curves

.4 Calculations and technical data to support drive selection

.5 Fan details, isolation and details

.6 Cabinet construction, gauge, access doors, fasteners

.7 Maintenance requirements

.8 Conformance to above reference standards

.4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

.2 Operation and Maintenance Data:

.1 Provide operation and maintenance literature indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

.2 Operation and maintenance data shall be included in the maintenance manual.

54.4 Job conditions

.1 Do not operate fans for any purpose, temporary or permanent until ductwork is clean, filters in place, bearings lubricated and fan has been run under close supervision.

54.5 Acceptable manufacturers

.1 Manufacturers of exhaust fans whose products are approved in principle, but subject to requirements of drawings and specifications are:

.1 Cook

.2 Greenheck

.3 Penn

.4 Carnes

.5 Broan

.6 Nutone

.7 Zonex

.2 Alternatives: Equivalent fan selections shall not decrease motor power, increase noise level, increase tip speed by more than 10% or increase inlet air velocity by more than 20% from that specified.

55 Products

55.1 General

.1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.2 Provide balanced variable sheaves.

.3 Fans shall be capable of accommodating static pressure variations of +10% with no objectionable operating characteristics.

.4 Unless otherwise noted, include all motors and drive combinations with electrical characteristics as detailed elsewhere.

.5 Fan hubs and sheaves shall be keyed to shafts for fans over ¾ hp. Use of flat ground surface and set screws are not approved.

.6 Select variable and adjustable pitch sheaves unless otherwise specified, so that required rpm is obtained with sheaves set at mid-position, and approximate speed adjustment of 25%.

.7 Rate drive as recommended by manufacturer, but minimum 1.5 times power rating of the motor. Submit calculations and technical data with shop drawings, to support drive selection.

.8 Fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.

55.2 Cabinet fans

.1 Fans shall be of the centrifugal, direct driven, in-line type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.

.2 Cabinet shall be heavy gauge metal with galvanized or baked enamel finish.

.3 Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.

.4 The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.

.5 Motors shall be variable speed heavy duty ball bearing type. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance.

.6 Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum catalogued operating speed.

.7 Accessories:

.1 NEMA 1 pre-wired disconnect switch.

.2 Multi-blade, rattle free, backdraft damper with felt lined blade edges.

.3 Time delay off switch where indicated.

.4 Controls as indicated on drawing schedule.

.8 Spare Parts

.1 Supply one (1) complete set of spare belts for any belt driven fans.

55.3 Ceiling mounted fans

.1 Ceiling mounted fans shall be low sone type equal to manufacturer and model as per schedule and shall not exceed sone value as indicated.

55.4 Kitchen exhaust fans

.1 Where noted, provide kitchen hood as per schedule on drawings.

.2 Fans shall be ULC762 listed.

.3 Motors shall be CSA approved.

.4 Accessories:

.1 Roofcurb

.2 Fan mounted pre-wired disconnect

.3 Welded drain coupling

.4 Grease terminator

.5 Clean out port

.6 Pre-wired fan speed controller

56 Execution

56.1 General

.1 Install as per manufacturer's instructions.

.2 Install fans as shown, with resilient or spring mountings and fan restraining snubbers and flexible electrical leads. Refer to 23 05 47.

.3 Align shafts, belt drive and motor, adjust belt tension, ensure all set screws are tight, and check motor rotation before start-up.

.4 Protect motors and fans during construction and rotate fans, by hand, every month between delivery and acceptance of building.

.5 Install fans with flexible connections on inlet ductwork and on discharge ductwork in accordance with Section 23 33 00.

.6 Adjust variable pitch fan/motor sheaves during balancing to achieve specified air quantities.

56.2 Cabinet fans

.1 Install in conformance with manufacturer's requirements and recommendations.

.2 Provide U-Channel, 3/8" rod and vibration isolation for mounting.

.3 Provide guard on any exposed fan inlet or outlet.

.4 Provide belt guards on belt driven fans.

.5 Supply and install sheaves as necessary for final air balancing for belt driven fans.

56.3 Kitchen hood fans (where applicable)

.1 Install and maintain clearances as per manufacturer's instructions and NFPA 96.

End of section

57 General

57.1 Requirements

.1 Air outlets shall meet the following standards and requirements:

.1 ASHRAE

.2 AMCA

.3 Local Codes and Requirements

.2 Air flow tests and sound levels shall be made in accordance with ASHRAE standards.

.3 Manufacturers shall certify performance and application.

57.2 Related Sections

.1 Section 23 05 01

.2 Section 23 31 00

57.3 Submittals

.1 Shop Drawings:

.1 Refer for Section 01 33 00.

.2 Submit shop drawings to the Consultant for review prior to ordering or installation.

.3 Shop drawings shall include manufacturer, model numbers, performance data, and indicate conformance to above reference standards. Louver shop drawings shall include free area, pressure drop and water carry over data.

.4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

.2 Operation and Maintenance Data:

.1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

.2 Operation and maintenance data shall be included in the maintenance manual.

58 Products

58.1 General

.1 Air flow tests and sound levels shall be made in accordance with ASHRAE standards.

.2 Manufacturers shall certify performance and application.

.3 All supply grilles shall be adjustable with double deflection.

58.2 Grilles and diffusers

.1 Provide grilles, registers and diffusers of the types as shown on the drawings.

.2 Provide vertical throw type as noted based on ceiling heights.

.3 Construction shall be heavy duty, with 14 gauge steel blades and heavy duty steel support bars and frame unless otherwise noted.

.4 Grilles shall be complete with steel volume damper of the opposed blade type for balancing purposes as noted.

.5 Supply diffusers mounted in t-bar shall not contain integral balance dampers. Balance dampers must be installed in branch duct runs to diffusers (unless specifically noted otherwise).

.6 Provide ULC fire stop flaps/linkages and fire blankets where indicated.

.7 Provide chains on all diffusers in exposed ceiling areas and where diffusers are susceptible to heavy contact.

.8 Acceptable Manufacturers:

.1 Price

.2 Nailor

.3 Titus

.4 Metal Aire

.5 Kreuger

58.3 Louvres

.1 Louvres shall be licensed to bear the AMCA seal and certified by the manufacturer for outdoor use.

.2 Louvres shall be sized as noted on drawings and model selected to prevent moisture carry-over (896 fpm for base specified Ventex 2435 or 638 fpm for base specified Ventex 2425).

.3 Frame shall be 0.081" (2.06 mm) extruded aluminium, alloy 6063-T5.

.4 Blades shall be 0.081" (2.06 mm) extruded aluminium, alloy 6063-T5, at an angle of 35° on 3.5” (89mm) centres. Louver assembly shall have blades contained within a single frame.

.5 Louvre components including heads, jambs, sills and mullions shall be factory assembled.

.6 All materials shall be factory finished after assembly with Polyester Powder Coat, standard mill finish unless otherwise indicated.

.7 Louvres shall be complete with 19 gauge galvanized birdscreen with ½” x ½” openings.

.8 Submit all performance data with shop drawings for free area, pressure drop and water carry over.

.9 Acceptable Manufacturers:

.1 Ventex

.2 Tamco

.3 Price

.4 Ruskin

59 Execution

59.1 Grilles and diffusers

.1 Confirm location, type of mounting and size of all outlets with site conditions prior to ordering and installing.

.2 Provide flanged connection off ductwork for mounting of grilles.

.3 Position vertical throw diffusers and deflection of grilles to achieve best air flow in area. Adjust to suit Balancing Contractor and Engineer’s requirements.

.4 Provide birdscreen on all open ended return air ducts unless otherwise noted.

59.2 Louvres

.1 Confirm location and size of all louvres with General Contractor prior to ordering and installing.

.2 Provide 16 gauge galvanized sheet metal sleeve through wall opening where required.

.3 All louvres shall be equipped with birdscreen.

.4 Provide caulking at all louvres using non-shrink Mono caulking to match building colour.

End of section

60 GENERAL

60.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for wet pipe fire protection and sprinkler systems for heated areas.

60.2 RELATED SECTIONS

.1 Section 22 05 00 – Common Work Results for Plumbing.

60.3 REFERENCES

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

.2 ANSI/NFPA 13, Installation of Sprinkler Systems.

.3 ANSI/NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances.

.4 ANSI/NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.6 Safety Data Sheets (SDS).

.7 Underwriter's Laboratories of Canada (ULC)

.8 CAN4 S543, Standard for Internal Lug Quick Connect Couplings for Fire Hose.

60.4 SAMPLES

.1 Submit samples of following:

.1 Each type of sprinkler head.

.2 Signs.

60.5 DESIGN REQUIREMENTS

.1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by

hydraulic calculations for uniform distribution of water over design area. Occupancy hazard shall be as required by NFPA 13.

.2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.

.3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.

.4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

.5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

.6 Location of Sprinkler Heads:

.1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.

.2 Uniformly space sprinklers on branch.

.7 Water Distribution:

.1 Make distribution uniform throughout the area in which sprinkler heads will open.

.2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density required in NFPA 13.

.8 Density of Application of Water:

.1 Size pipe to provide specified density when system is discharging specified total maximum required flow.

.2 Application to horizontal surfaces below sprinklers shall be lpm per m² as required for NFPA 13.

.9 Sprinkler Discharge Area:

.1 Area: hydraulically most remote m² area as defined in NFPA 13.

.10 Outside Hose Allowances:

.1 Include allowance in hydraulic calculations of lpm for outside hose streams per NFPA.

.11 Friction Losses:

.1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.

.12 Water Supply:

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

.13 Show the following in the drawings submitted to the Owner for approval.

.1 Show the layout and size of all piping and equipment from the point of connection to the water supply, to the sprinkler cross mains. The contract drawings must include a detailed sprinkler riser diagram. Water velocity in the piping should not exceed 6 m/s.

.2 Show location and size of service mains, interior feed mains, control valves, sprinkler risers, drain lines, sectional valves and inspector's test valves and switches on the drawings.

.3 Specify waterflow data including hydrant flow results, including location where the hydrant flow test was conducted, the location and size of existing mains and new water supply lines that will serve the sprinkler system (including all supervisory valves), and the location and size of all risers.

.4 Highlight or clearly indicate the area(s) to be protected by sprinklers on the drawings.

.5 Specify waterflow requirements including the design density, design area, the hose stream demand (including location of the hose stream demand), the duration of supply, and sprinkler spacing and area of coverage in this section.

.6 Show the location of the backflow preventer (including provisions for a drain and access for maintenance) where the potable water supply system is at risk of contamination by the sprinkler system on the drawings.

.7 Show all provisions necessary for forward flow testing of the backflow preventer at system demand, as required by NFPA 13 on the drawings. Indicate location of all components and required items, including test ports, for pressure measurements both upstream and downstream of the backflow preventer, a drain to the building exterior, and appropriate permanent means of disposing of the large quantity of water that will be involved in the initial test and subsequent annual tests.

.8 Highlight all concealed spaces on the drawings that require sprinkler protection, such as spaces above suspended ceilings that are built of combustible material or that can contain combustible materials, such as storage, and communication cabling that is not fire-rated.

.9 Provide details on the drawings of pipe restraints for underground piping. This includes details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.

60.6 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.1 Shop drawings: submit drawings stamped and signed by designer registered and acceptable to the authority having jurisdiction.

.2 Indicate:

.1 Materials.

.2 Finishes.

.3 Method of anchorage

.4 Number of anchors.

.5 Supports.

.6 Reinforcement.

.7 Assembly details.

.8 Accessories.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Test reports:

.1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Instructions: submit manufacturer's installation instructions.

.2 Manufacturer's Field Reports: manufacturer's field reports specified.

.4 Closeout Submittals:

.1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.

.2 Manufacturer's Catalog Data, including specific model, type, and size for:

.1 Pipe and fittings.

.2 Alarm valves.

.3 Valves, including gate, check, and globe.

.4 Water motor alarms.

.5 Sprinkler heads.

.6 Pipe hangers and supports.

.7 Pressure or flow switch.

.8 Fire department connections.

.9 Excess pressure pump.

.10 Mechanical couplings.

.3 Drawings:

.1 Sprinkler heads and piping system layout.

.1 Prepare 760 mm by 1050 mm detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".

.2 Show data essential for proper installation of each system.

.3 Show details, plan view, elevations, and sections of systems supply and piping.

.4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.

.2 Electrical wiring diagrams.

.4 Design Data:

.1 Calculations of sprinkler system design.

.2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.

.5 Field Test Reports:

.1 Preliminary tests on piping system.

.6 Records:

.1 As-built drawings of each system.

.1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.

.2 Submit 760 mm by 1050 mm drawings on reproducible Mylar film with title block similar to full size contract drawings.

.7 Operation and Maintenance Manuals:

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

.2 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for aboveground and underground piping and other documentation for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 13.

60.7 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: certified journeyperson in wet sprinkler systems with 5 years documented experience approved by manufacturer.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

60.8 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

60.9 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Storage and Protection:

.1 Store materials indoors in dry location.

.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

61 PRODUCTS

61.1 ABOVE GROUND PIPING SYSTEMS

.1 Provide fittings for changes in direction of piping and for connections.

.1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.

.2 Perform welding in shop; field welding will not be permitted.

.3 Conceal piping in areas with suspended ceiling.

61.2 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous: to ANSI/NFPA 13.

.2 Copper tube: to ANSI/NFPA 13.

.2 Fittings and joints to ANSI/NFPA 13:

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

.2 Copper tube: screwed, soldered, brazed.

.3 Provide welded, threaded, grooved-end type fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.

.4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.

.5 Rubber gasketted grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.

.6 Fittings: ULC approved for use in wet pipe sprinkler systems.

.7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.

.8 Side outlet tees using rubber gasketted fittings are not permitted.

.9 Sprinkler pipe and fittings: metal.

.3 Valves:

.1 ULC listed for fire protection service.

.2 Gate valves: open by counterclockwise rotation.

.3 Provide rising stem OS & Y valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.

.4 Check valves: flanged clear opening swing-check type with flanged inspection and access cover plate for sizes 100 mm and larger.

.5 Provide gate valve in piping protecting elevator hoistways, machine rooms, and machinery spaces.

.6 Provide ball or butterfly valves for zone control.

.4 Pipe hangers:

.1 ULC listed for fire protection services in accordance with NFPA.

.5 Riser manifold assembly

.1 Provide floor control assembly in accordance with NFPA 13 consisting of supervised control valve, pressure gauge, flow switch, sight glass, test valve, drain valve and corrosion resistant orifice equal to smallest sprinkler orifice in the system.

.2 Provide as alternative to the above a riser manifold assembly with flow switch, pressure gauge with isolating valve, test/drain valve with orifice and sight glass.

61.3 SPRINKLER HEADS

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

.2 Sprinkler Head Type:

.1 Type A: upright bronze.

.2 Type B: pendant chrome glass bulb type.

.3 Type B: pendant chrome glass bulb type - Semi-recessed.

.4 Type C: recessed polished satin chrome glass bulb type with ring and cup.

.5 Type D: concealed glass bulb with cover to match ceiling finish.

.6 Type E: side wall polished satin chrome glass bulb type.

.3 Provide nominal 12 mm orifice sprinkler heads.

.1 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.

.2 Provide polished stainless steel ceiling plates or chromium-plated finish on copper alloy ceiling plates, and chromium-plated pendent sprinklers below suspended ceilings.

.3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.

.4 Provide sprinkler heads as required.

.5 Deflector: not more than 75 mm below suspended ceilings.

.6 Ceiling plates: not more than 25 mm deep.

.7 Ceiling cups: not permitted.

61.4 ALARM CHECK VALVE

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

.2 Provide variable pressure type alarm valve complete with retarding chamber, alarm test valve, alarm shutoff valve, drain valve, pressure gages, accessories, and appurtenances for proper operation of system.

61.5 WATER MOTOR ALARMS

.1 Provide alarms approved weatherproof and guarded type, to sound locally on flow of water in each corresponding sprinkler system.

.2 Mount alarms on outside of outer walls of each building at location as directed.

.3 Provide separate drain piping directly to exterior of building.

61.6 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 Pressure or flow switch type:

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

.2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.

.3 Connect into building fire alarm system.

.4 Connection of switch: Section 28 31 01 - Fire Alarm Systems.

.5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.

.4 Pressure alarm switch:

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

61.7 WATER GONG

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

61.8 FIRE DEPARTMENT CONNECTION

.1 Provide connections approximately 1.5 m above finish grade, location as indicated.

.2 To ANSI/NFPA 13 and ULC S543 listed, Siamese type.

.3 Polished bronze chrome plated recessed or exposed of approved two-way type with plug, chain, and identifying fire department connection escutcheon plate.

.4 Thread specifications: compatible with local fire department.

61.9 EXCESS PRESSURE PUMP

.1 Provide pumps on each sprinkler piping riser.

.2 Pumps:

.1 Pumps: positive displacement, gear type rated at 1.0 lpm, integrally mounted with motor.

.2 Double acting displacement type, open cylinder design, direct drive, ULC listed, complete with relief valve.

.3 Pump and motor unit:

.1 Approved for automatic wet pipe fire extinguishing sprinkler systems; complete with pilot light panel, differential motor control switch, high pressure switch, and low pressure switch.

.2 NEMA Class B squirrel cage induction 1725 rpm, continuous duty, drip proof, ball bearing, maximum temperature rise 50 degrees C, 0.25 kW, 120/1/60.

.3 Capacity: 7.6 L/min.

.4 Provide electrical power supply connections for pump and pilot light panel at supply side of building service panel.

.5 Provide separate fused safety-type switch with locked lever for each connection.

.6 Provide pressure pump sensing piping in supply piping upstream of fire pump.

.7 Pump operation switch: to operate excess pressure pump with pressure differential of 103 kPa.

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

61.10 PRESSURE GAUGES

.1 ULC listed and to Section 23 05 19.13 - Thermometers and Pressure Gauges - Piping Systems.

.2 Maximum limit of not less than twice normal working pressure at point where installed.

61.11 BURIED WATER PIPING SYSTEM

.1 Pipe and Fittings:

.1 Provide outside-coated, cement-mortar lined, ductile-iron pipe, and fittings, in accordance with NFPA 24, for piping under building and outside of building walls.

.2 Anchor joints in accordance with NFPA 24.

.3 Provide concrete thrust block at elbow where pipe turns up toward the floor, and restrain pipe riser with steel rods from elbow to flange above floor.

.4 Minimum pipe size: 150 mm.

.5 Minimum depth of cover: 1.5 metres at finish grade.

.6 Piping beyond 1.5 metres outside of building walls: provided by Civil.

.2 Ductile Iron Pipes:

.1 Class 200, Type: cement-mortar lined.

.3 Fittings for Ductile Cast Iron Pipes:

.1 Type mechanical joint, and flange.

.2 Fittings: painted with tar epoxy resin paint.

.4 Exterior Coating for Ductile Iron Pipes and Fittings:

.1 Type for exposed pipe.

.2 Type for submerged pipe.

.5 Rubber Gasket for Pipe Connection:

.6 Bolt and Nut for Flange:

.1 Galvanized Hexagon Head bolts and Hexagon nuts.

.7 Valves:

.1 In accordance with NFPA 24.

.2 Gate valves: ULC listed and opened by counterclockwise rotation.

.8 Post Indicator Valves:

.1 Provide with operating nut located about 1.5 m above finish grade.

.2 Gate valves for use with indicator post, ULC listed.

.3 Indicator posts: ULC listed.

.4 Provide each indicator post with one (1) coat of primer and two coats of red enamel paint.

.9 Valve Boxes:

.1 Except where indicator posts are provided, for each buried valve, provide cast-iron, ductile-iron, plastic valve box of suitable size.

.2 Plastic boxes: constructed of acrylonitrile butadiene styrene (ABS) inorganic fiber-reinforced black polyolefin.

.3 Provide cast-iron, ductile-iron, plastic cover for valve box with word English wording for "WATER" cast on cover.

.4 Minimum box shaft diameter: 133 mm.

.5 Coat cast-iron ductile-iron boxes with bituminous paint applied to minimum dry-film thickness of 10 mil.

.10 Buried Utility Warning and Identification Tape:

.1 Provide detectable aluminum foil plastic backed tape detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping detectable by electronic detection instrument.

.2 Provide tape in rolls, 76 mm minimum width, colour coded in accordance with local utility, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length.

.3 Warning and identification: to read "CAUTION BURIED WATER PIPING BELOW".

.4 Use permanent code and letter colouring unaffected by moisture and other substances contained in trench backfill material.

61.12 PIPE SLEEVES

.1 Provide pipe sleeves where piping passes through walls, floors, and roofs.

.2 Secure sleeves in position and location during construction.

.3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.

.4 Provide 12 mm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.

.1 Firmly pack space with mineral wool insulation.

.2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.

.3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.

.5 Sleeves in masonry and concrete walls, floors, and roofs:

.1 Provide hot-dip galvanized steel, ductile-iron, cast-iron sleeves.

.2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

.6 Sleeves in other than masonry and concrete walls, floors, and roofs:

.1 Provide 0.61 mm thick galvanized steel sheet.

61.13 ESCUTCHEON PLATES

.1 Provide one piece or split hinge type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.

.2 Provide polished stainless steel plates chromium-plated finish on copper alloy plates in finished spaces.

.3 Provide paint finish on metal plates in unfinished spaces.

61.14 INSPECTOR'S TEST CONNECTION

.1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3.0 m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.

.2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.

.3 Provide discharge orifice of same size as corresponding sprinkler orifice.

61.15 SIGNS

.1 Attach properly lettered English and approved metal signs to each valve and alarm device to ANSI/NFPA 13.

.2 Permanently fix hydraulic design data nameplates to riser of each system.

61.16 ANTIFREEZE

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

61.17 SPARE PARTS CABINET

.1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

62 EXECUTION

62.1 MANUFACTURER'S INSTRUCTIONS

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

62.2 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with ANSI/NFPA 13 and ANSI/NFPA 25.

62.3 PIPE INSTALLATION

.1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.4 Inspect piping before placing into position.

62.4 ELECTRICAL CONNECTIONS

.1 Coordinate electrical work associated with this section under Section 26 05 00 - Common Work Results – Electrical and electrical contractor.

.2 Coordinate fire alarm system under Division 28.

.3 Coordinate control and fire alarm wiring, including connections to fire alarm systems, in accordance with Canadian Electrical Code and electrical contractor.

.4 Wiring in rigid metal conduit or intermediate metal conduit by electrical contractor.

62.5 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

.1 Notify Contracting Officer in writing at least 15 days prior to connection date.

.2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.

.3 Bolt sleeves around main piping.

.4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.

.5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

62.6 BURIED PIPING SYSTEM

.1 Bury tape with printed side up at depth of 300 mm below the top surface of earth or top surface of subgrade under pavements.

62.7 FIELD PAINTING

.1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.

.2 Apply coatings to clean, dry surfaces, using clean brushes.

.3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.

.4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 mil, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 mil.

.5 Shield sprinkler heads with protective covering while painting is in progress.

.6 Upon completion of painting, remove protective covering from sprinkler heads.

.7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.

.8 Provide primed surfaces with following:

.1 Piping in Finished Areas:

.1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.

.2 Provide valves and operating accessories with one (1) coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.

.3 Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.

.2 Piping in Unfinished Areas:

.1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.

.2 Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6.0 m intervals.

62.8 FIELD QUALITY CONTROL

.1 Site Test, Inspection:

.1 Perform test to determine compliance with specified requirements in presence of Owner.

.2 Test, inspect, and approve piping before covering or concealing.

.3 Preliminary Tests:

.1 Hydrostatically test each system at 1400 kPa for a two (2) hour period with no leakage or reduction in pressure.

.2 Flush piping with potable water in accordance with NFPA 13.

.3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.

.4 Test alarms and other devices.

.5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.

.4 Formal Tests and Inspections:

.1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.

.2 Submit written request for formal inspection at least fifteen (15) working days prior to inspection date.

.3 Repeat required tests as directed.

.4 Correct defects and make additional tests until systems comply with contract requirements.

.5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.

.6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.3 Site Tests:

.1 Field test each fire pump, driver and controllers in accordance with ANSI/NFPA 20. Testing shall include:

.1 Verification of proper installation, system initiation, adjustment and fine tuning.

.2 Verification of the sequence of operations and alarm systems.

.2 Testing to be witnessed by authority having jurisdiction.

.3 Develop, with Owner assistance, detailed instructions for O & M of this installation.

62.9 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION