

Part 1 CODES AND STANDARDS

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

1.2 SCOPE OF WORK

- .1 Work to include all labour, material and equipment required for installing, testing and commissioning of mechanical systems as detailed in other sections of Divisions 21 to 23.
- .2 All mechanical work to be bid as a single complete sub-contract even though work of various mechanical trades has been subdivided.
- .3 It is the responsibility of the general mechanical contractor to co-ordinate the work among the various mechanical sub-trades to ensure complete functioning systems.

1.3 EXISTING CONDITIONS

- .1 Examine site, existing adjacent buildings and local conditions affecting work under this contract. Examine Structural, Architectural, Mechanical and Electrical and all other Contract drawings to ensure work can be performed without changes to the building as shown on drawings. No allowance will be made later for necessary changes, unless notification of interferences have been brought to the Consultant's attention, in writing, prior to closing of tenders.

1.4 SITE SERVICE INFORMATION

- .1 Location, routing and depth of existing mechanical services shown on drawings including sanitary sewers, water mains and other utilities are based on recorded information and are approximate only. Contractor and his sub-trades shall verify exact location at jobsite.
- .2 Obtain Owner approval before commissioning systems and putting into service.

1.5 PERMITS AND REGULATIONS

- .1 Obtain all permits and pay all fees for performing the work.
- .2 Review drawings with authorities having jurisdiction to ensure compliance with all applicable codes and bylaws.

1.6 EXECUTION OF WORK

- .1 Install work in advance of concrete pouring or similar work. Provide and set pipe sleeves and equipment anchors as required.
- .2 Install concealed pipes and ducts neatly, close to building structure so furring is minimum size. Pipes, ducts and equipment installed improperly, to be removed and replaced without cost to Owner.

- .3 Protect and maintain work until building has been completed and accepted. Protect work against damage during installation. Cover with tarpaulins if necessary. Repair all damage to floor and wall surfaces resulting from carrying out work, without expense to Owner.
- .4 During welding or soldering ensure structure is protected against fire by shielding, using fire-rated sheets or galvanized iron sheets. Contractor shall provide trained persons armed with suitable type extinguishers, to watch for and extinguish sparks, etc.
- .5 Co-ordinate work with other sections to avoid conflict and ensure proper installation of all equipment. Review all contract drawings.
- .6 On completion of work, remove tools, surplus and waste material and leave work in clean, perfect condition.

1.7 WARRANTY

- .1 Warranty satisfactory operation of all work and apparatus installed under this contract. Replace, at no expense to Owner, all items which fail or prove defective within a period of one year after final acceptance of complete contract by Owner, provided such failure is not due to improper usage by Owner. Make good all damage to building incurred as a result of failure or repair of mechanical work.
- .2 No certification given, payment made, partial or entire use of equipment by Owner, shall be construed as acceptance of defective work or acceptance of improper materials. Make good at once, without cost to the Owner all such defective work or materials and consequence resulting there from, within one year of final acceptance date.
- .3 This general guarantee shall not act as a waiver for any specified guarantee and/or warranty of greater length of time noted elsewhere in these documents.

1.8 ENGINEERING INSPECTIONS

- .1 Contractor's work will be inspected periodically by Owner, and/or Consultant or their representatives, solely for purpose of determining general quality of work, and not for any other purpose. Inspection and directives given to Contractor does not relieve Contractor and his agents and employees of their responsibility to erect and install work in all its parts in a safe and workmanlike manner, and in accordance with plans and specifications, nor impose upon Owner, and/or Consultant or their representatives, any responsibility to supervise or oversee erection or installation of any work.

1.9 PIPE WELDING REGULATIONS

- .1 Welding to be performed by welder holding current welder's certificate from Provincial Department of Labour.
- .2 Pipe fabrication shall conform to the American National Standard, ASME Code for B31.1 – Power Piping and B31.9 – Building Services Piping Code.
- .3 Welding procedure qualifications shall be in accordance paragraph 127.1.1 of ANSI B31.1 (refer to Section IX of the ASME Boiler and Pressure Vessel Code).

- .4 Pressure and leak tests shall conform to paragraph 137 of ANSI B31.1.
- .5 Welding safety requirements shall be in accordance with ANSI Z49.1, Safety in Welding and Cutting.
- .6 The testing of welding procedures, welders and welding operators shall conform to the requirements of Section IX of the ASME Boiler and Pressure Vessel Code.
- .7 Fabricated piping dimensional tolerances and bends shall conform to the "Pipe Fabrication Institute Standard ES3".
- .8 Erected pipelines may have a dimensional tolerance of 15 mm. Greater deviations from drawings are only permissible with written approval from the Consultant.
- .9 Piping supports, hangers, spacers, etc. shall be as indicated and in conformance with ANSI B31, Part 5.

1.10 MECHANICAL SHOP DRAWINGS

- .1 Submit for review no more than six sets of detailed shop drawings for all mechanical equipment noted in other sections of Divisions 21 to 23.

Alternately the Contractor may elect to submit shop drawings in PDF file format provided all requirements of this clause are met.

- .2 Check shop drawings for conformity to plans and specifications before submission.
- .3 Each drawing shall bear Divisions 21 to 23 stamp with Firm's name, date of review and shall be initialled by the responsible officer of Divisions 21 to 23. Include name of project, equipment supplier and clause number equipment is specified under.
- .4 Clearly show division of responsibility. No item, equipment or description of work shall be indicated to be supplied or work to be done "by Other's or by Purchaser". Any item, equipment or description of work shown on shop drawings shall form part of the contract, unless specifically noted to contrary.
- .5 Take full responsibility for securing and verifying field dimensions. In case where fabrication must proceed prior to field dimensions being available, check all shop drawings and approve for dimensions only. In this case guarantee that dimensions will be worked to and ensure that other sub-trades are aware of these dimensions and shall comply with them.
- .6 Review by Consultant shall be mutually understood to refer to general design only. If errors in detailed dimensions or interference with work are noticed, attention of Contractor will be called to such error or interferences, but Consultant's review of drawings will not relieve Contractor from responsibility for said error or interferences, or from necessity of furnishing such work, and materials as may be required for completion of work as called for in Contract Documents.

1.11 MECHANICAL SUB-TRADES

- .1 State in tender, names of all sub-trades to be used in mechanical work.

- .2 Contractor to have minimum five years experience in field of mechanical contracting and to have successfully performed work of similar nature and approximate size to that indicated in specifications and on drawings. Sub-trades shall employ, on this project, foremen or supervisory personnel who have had similar experience to that required by the Contractor.

1.12 OPERATING AND MAINTENANCE MANUALS

- .1 Provide operation and maintenance data for incorporation into O&M manuals.
- .2 Draft operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.
- .3 Operation data to include:
 - .1 Control schematics for each system.
 - .2 Description of each system and its controls for control systems not provided by the Owner's control contractor.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
- .4 Maintenance data shall include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, and tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified elsewhere.
- .6 Approvals:
 - .1 Submit (1) copy of draft Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless so directed by Consultant.
 - .2 Bind data in 3 ring binder with indexed tabs, table of contents, and contact personnel for repair and maintenance. Make changes as required and resubmit (3) final copies and a compact disc including a PDF file of the bound O&M manual.

1.13 DRAWINGS

- .1 Drawings are diagrammatic only and do not show all details. Information involving accurate measurements of building to be taken from Architectural Drawings and/or at the building. Make without additional expense to Owner, all necessary changes or additions to runs to accommodate structure conditions. Locations of pipes, ducts and other equipment to be altered without charge to Owner, provided change is made before installation and does not necessitate additional materials and that Consultant ratifies all such changes and recorded on Record Set of Drawings.

- .2 Drawings and specifications to be considered as an integral part of Contract Documents. Neither drawings nor specifications to be used alone. Misinterpretation of requirements of plans or specifications shall not relieve Contractor of responsibility of properly completing work to approval of Consultant.
- .3 It is the mechanical general contractor's responsibility to ensure that all subcontractors and suppliers are aware of and conform to all contract requirements indicated on both the drawings and specifications.
- .4 As work progresses, and before installing piping, ductwork, fixtures and equipment interfering with interior treatment and use of building, consult Consultant for comments. This applies to all levels and proper grading of piping. If Contractor fails to perform above checking and fails to inform Consultant of such interference, Contractor to bear all subsequent expense to make good the installation.
- .5 Drawings indicate general location and route to be followed by pipes and ducts. Where required piping is not shown on plans or only shown diagrammatically, install in such a way as to conserve headroom and interfere as little as possible with free use or space through which they pass.
- .6 Refer to Architectural Drawings for roof construction details. These shall relate to roof supports, piping penetrating roofs, etc. as indicated on the mechanical drawings.

1.14 MATERIALS – EQUALS AND ALTERNATES

- .1 Acceptable manufacturers of specified materials and equipment are named in this specification for the purpose of establishing the standard of materials and workmanship to which Contractor shall adhere. The tender price shall be based on the use of materials and equipment as specified.
- .2 Materials of same general type are to be from the same manufacture (eg: all air supply units shall be same manufacturer). The Contractor shall ensure that all sub-trades provide products of same manufacturer.
- .3 Equipment listed as "equal" in specifications or submitted as alternate by Contractor must meet all space requirements, specified capacities and must have equipment characteristics of specified equipment as interpreted by Consultant. Install equipment in strict accordance with manufacturer's published recommendations. Any variations to installation, additional work required or additional equipment required to meet the specified and designed drawing of the "equal" equipment that is not required for the specified product shall be the responsibility of the contractor and/or supplier.
- .4 Equipment and material shown on drawings and not specified herein, or specified herein and not shown on drawings, shall be included in this Contract as though both shown and specified

1.15 EQUIPMENT INSTALLATION

- .1 Unions or flanges: provide for ease of maintenance and disassembly.
- .2 Space for servicing, disassembly and removal of equipment and components: provided as recommended by manufacturer or as indicated.

- .3 Equipment drains/Relief Valves: pipe to floor drains, minimum drain size NPS 1 complete with tees and cleanouts for easy cleaning.

1.16 PROTECTION OF OPENINGS

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

1.17 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.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 10 mm high and 100 mm larger than equipment dimensions all around. Form concrete around existing housekeeping pad to meet requirements listed.
- .4 Provide any necessary, anchor bolts, anchor sleeves, fire-stop sleeves, etc not supplied by equipment suppliers as necessary for a complete installation.

1.18 TESTS

- .1 Give 24 hours written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by Consultant.
- .3 Conduct tests in presence of Consultant.
- .4 Bear costs including retesting and making good.
- .5 Piping:
 - .1 General: maintain test pressure, 448 kPa [65 psi], without loss for 4 hours unless otherwise specified.
 - .2 Test natural gas system to CAN1-B149.1-M86 and requirements of authorities having jurisdiction.
 - .3 Test drainage, waste and vent piping to National Building Code and authorities having jurisdiction.
 - .4 Test fire systems in accordance with authorities having jurisdiction and as specified elsewhere.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests isolate all equipment or other parts, which are not designed to withstand test pressures or test medium.

1.19 DIELECTRIC UNIONS

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

- .2 Where pipes of dissimilar metals are joined.
- .2 Pipes NPS 2. and under: isolating unions, no dielectric couplings.
- .3 Pipes NPS 2-1/2 dia. and over: isolating flanges.
- 1.20 DRAIN VALVES**
 - .1 Locate at low points and at section isolating valves unless otherwise specified.
 - .2 Minimum NPS ¾ unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.
- 1.21 TRIAL USAGE**
 - .1 Owner reserves the right to use any piece of mechanical equipment, device or material installed under this contract, for such reasonable lengths of time and at such times as Consultant may require, to make complete and thorough test of same, before final completion and acceptance of any part of contract. It is agreed and understood, that no claim for damage will be made for any injury or breakage to any parts of the above due to aforementioned tests, whether caused by weakness or inaccuracy of parts, or by defective materials or workmanship of any kind whatsoever. Supply all labour and equipment for such tests.
- 1.22 SAFETY DEVICE TESTING**
 - .1 Make complete inspection of all safety devices to ensure:
 - .1 That safety devices are complete in accordance with specifications and manufacturer's recommendations.
 - .2 That the safety devices are connected and operating according to all local regulations.
- 1.23 TEMPORARY USE OF EQUIPMENT**
 - .1 Permanent systems and/or equipment is not to be used during construction period without Consultant's written permission.
 - .2 Equipment used during construction period to be thoroughly cleaned and overhauled. Replace work or damaged parts so equipment is in perfect condition, to entire satisfaction of Consultant and owner.
 - .3 Provide proper care, attention and maintenance for equipment while it is being used. If in opinion of consultant, sufficient care and maintenance is not being given to equipment and systems, Consultant reserves the right to forbid further use of said equipment and systems.
 - .4 Temporary use of equipment shall in no way relieve Contractor of providing twelve month guarantee period to commence as of date of final acceptance of building by Owner as interpreted by Consultant.
 - .5 All air filters and pipe strainers are to be replaced prior to turning systems over to the Owner.

1.24 INSTRUCTIONS TO OWNER'S PERSONNEL

- .1 Contractor to schedule and co-ordinate start-up supervision and instruction of Owner's personnel required of individual equipment suppliers as noted in other sections of Divisions 21 to 23. Contractor's construction supervision is also required to instruct Owner's personnel in operation and maintenance of all equipment and systems to satisfaction of Consultant.
- .2 Provide Owner with three copies of O&M manuals incorporating following:
 - .1 Service instructions – including lists of spare and replacement parts and names and addresses of suppliers.
 - .2 Maintenance & Operating instructions.
 - .3 Revised shop drawings.
- .3 Provide Owner with one set of Record Drawings.
- .4 Forward manuals and drawings to Consultant prior to final acceptance. Final payment will not be made until all required manuals have been received.
- .5 Review instructions with Owner's representative to ensure a thorough understanding of equipment and its operation.

1.25 RECORD DRAWINGS

- .1 Provide one set of Record Drawings, marked clearly in red pencil, with all changes and deviations from piping and ductwork, etc. shown on Contract Drawings, including all Work Order Changes.
- .2 "Record" drawings to be maintained on a weekly basis to ensure they are up-to-date and accurate.
- .3 Provide Owner with one set of drawing prints with all "Record" changes noted. Eradicate piping and/or ductwork, etc. shown on original drawings that has been affected by the changes.

1.26 PAINTING

- .1 Apply at least one coat of corrosion resistant primer paint and finish coat to ferrous supports and site fabricated work.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.27 CLEANING AND FLUSHING OF PIPING SYSTEMS

- .1 On completion, each piping system shall be flushed out before installation of equipment, fixtures, etc. in order to remove any foreign material in piping.
- .2 Flush with water, unless noted otherwise in individual mechanical sections of specifications.

- .3 All equipment shall be thoroughly cleaned and left in first class operating condition.

1.28 CUTTING AND PATCHING

- .1 General.
 - .1 The equipment and piping installation work specified in this contract includes the installation by the contractor of equipment, piping and materials supplied by the Contractor. Cutting and patching of the existing structure is required to implement this work. Providing the necessary cutting and patching and related architectural and civil works shall be co-ordinated by and provided by the Contractor using trade persons skilled and regularly involved in the work being carried out. These works may be simply detailed/described on the drawings or specifications; it is the responsibility of the Contractor to fully investigate and provide the services and materials necessary to execute these works.
 - .2 Contractor to obtain and pay for x-ray analysis prior to any penetrations through structural concrete members required for the mechanical works.

1.29 EQUIPMENT WARRANTIES AND ACCEPTANCE

- .1 Quality Warranty
 - .1 Manufacturer warrants that equipment furnished shall conform to description and specifications contained herein and shall be free from all defective materials and workmanship and all defects due to design. Upon Owner's request, manufacturer shall, at its sole expense, promptly repair or replace, all or any part of said equipment which is defective in any respects, within 1 year from the date of acceptance by Owner after all tests have been complete to satisfaction of Consultant. This does not apply to failure of equipment due to improper usage.

1.30 TAKE OVER PROCEDURES

- .1 Prior to application for Certificate of Substantial Performance, the Contractor shall carefully inspect the minor construction deficiencies are complete and/or corrected and that the building is clean and in condition for occupancy. Notify the Consultant in writing, of satisfactory completion of inspection and request an inspection.
- .2 During the Consultants inspection, a list of deficiencies will be tabulated and signed by the Consultant. Correct all deficiencies.
- .3 When the Consultant considers that all deficiencies have been corrected and that it appears the requirements of the Contract have been performed including delivery of operation and maintenance manuals, make application for Certificate of Substantial Performance.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS)..

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 21 05 01.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for pump, circulator, and equipment, and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Shop Drawings:
 - .1 Provide shop drawing in accordance with Section 21 05 01.
 - .2 Shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and operation data for incorporation into manual in accordance with Section 21 05 01.

1.4 MAINTENANCE

- .1 Provide maintenance materials in accordance with Sections 21 05 01.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 21 05 01.
- .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

Part 2 PRODUCTS

2.1 EQUIPMENT

- .1 Size and select components to: CSA-B214.

2.2 DOMESTIC WATER BOOSTER SYSTEM

- .1 Packaged duplex system, factory assembled, tested and adjusted, ready for site piping and electrical connections.

.1 Approved Product:

- .1 Goulds Model #AFDB-AQ10eSV-4 complete with:

.2 Two vertical multistage centrifugal pumps

.1 Approved Product:

- .1 Goulds SSV Series Model #10SV4FG4F20 complete with:

.2 Stainless Steel Wetted Construction

.3 Viton Elastomers

.4 Mechanical Seal with Carbon vs Silicon Carbide Faces

.5 5 HP, TEFC Enclosure, 208/3/60, Electric Motors

.6 2" 250# ANSI Flange Connections

.7 Capacity per Pump: 63 USGPM @ 50 PSI

.8 Total Booster Capacity: 126 GPM @ 50 PSI

.3 One custom booster pump controller, complete with:

.1 Main Disconnect Switch

.2 Thermomagnetic Motor Protectors

.3 Across the Line Contactors

.4 Control Transformer c/w Secondary Fuse

.5 1 only Power on Pilot Light

.6 2 only 'Run' Pilot Lights

.7 1 only 'No Flow Shut Down' LED Pilot Light

.8 2 only H-O-A Selector Switches

.9 2 only Overload/Trip Red LED Pilot Light and DPDT Alarm Relay

.10 1 only Low Level Supply Tank Red LED Pilot and DPDT Alarm Relay

.11 1 only Flashing Red Beacon for Alarms

.12 1 only Alarm Buzzer c/w Silence Push Button

.13 1 only 0 – 300 PSI Discharge Pressure Transducer

.14 1 only Digital Pressure Adjustment Interface for Lag Pump Start/Stop

.15 1 only Digital Pressure Adjustment Interface for No Flow Shut Down

.16 1 only Aquastat

.17 Automatic Transfer to Non-Operating Pump in Case of Motor Overload or Short Circuit

.18 Automatic Alternation

.19 FloCorp Ranger Ultrasonic Level Transmitter

- .20 FloCorp DigaCom 2000 Universal Process Display
- .21 FloCorp eXmod Relay Expansion Module
- .22 Nema 4X Stainless Steel Enclosure
- .23 400 W Heater and Thermostat
- .24 Elapsed Time Meters
- .2 All components mounted on a fabricated skid base complete with:
 - .1 3" Stainless Steel Suction and Discharge Headers
 - .2 Discharge Check Valves
 - .3 Suction and Discharge Isolation Valves
 - .4 Pressure Gauges
 - .5 2 only Zurn Wilkinson Model # 600XLHLR Pressure Reducing Valves
 - .6 All Electric Wiring

Part 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Check power supply.
 - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .4 Adjust flow from water-cooled bearings.
- .5 Adjust impeller shaft stuffing boxes, packing glands.

3.4 START-UP

- .1 General:
 - .1 In accordance with manufacturer's recommendations.

- .2 Procedures:
 - .1 Check power supply.
 - .2 Check starter O/L heater sizes.
 - .3 Start pumps, check impeller rotation.
 - .4 Check for safe and proper operation.
 - .5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
 - .6 Test operation of hands-on-auto switch.
 - .7 Test operation of alternator.
 - .8 Adjust leakage through water-cooled bearings.
 - .9 Adjust shaft stuffing boxes.
 - .10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
 - .11 Check base for free-floating, no obstructions under base.
 - .12 Run-in pumps for 12 continuous hours.
 - .13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .14 Adjust alignment of piping and conduit to ensure full flexibility.
 - .15 Eliminate causes of cavitation, flashing, air entrainment.
 - .16 Measure pressure drop across strainer when clean and with flow rates as finally set.
 - .17 Replace seals if pump used to degrease system or if pump used for temporary heat.
 - .18 Verify lubricating oil levels..

3.5 PERFORMANCE VERIFICATION (PV)

- .1 Verify that manufacturer's performance curves are accurate.
 - .1 Obtain manufacturer's approval, before performing PV, to ensure warranties remain intact.
 - .2 Application tolerances:
 - .1 Flow: +/- 10%.
 - .2 Pressure: Plus 20%, minus 5%.
 - .3 PV procedures:
 - .1 Open pump balancing valve fully.
 - .2 Measure differential pressure (DP) across pump.
 - .3 Measure amperage and voltage and compare with manufacturer's data sheets and motor nameplate data.
 - .4 If suction is different size than discharge connection, add velocity head correction factor to DP.
 - .5 Mark this DP on manufacturer's pump curve.

- .6 If flow rate is higher than specified, slow close balancing valve until specified DP is reached.
- .7 Repeat measurements of amps and volts. Compare with manufacturer's data sheets.
- .8 Calculate BHP and compare with nameplate data.

3.6 CLEANING

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

- .1 Supply and installation of required valves as indicated on the drawings.

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings.
 - .2 ANSI/ASME B16.10, Face-to-Face and End-to-End Dimensions Valves.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A49, Specification for Heat-Treated Carbon Steel Joint Bars.
 - .2 ASTM A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - .3 ASTM A194/A194M-03b, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High Temperature Service
 - .4 ASTM A216/A216M-1993, Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
 - .5 ASTM B85-03, Specification for Aluminum-Alloy Die castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
 - .1 MSS SP-25-1998, Standard Marking System for Valves,
 - .2 MSS SP-61-2003, Pressure Testing of Steel Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data: Submit WHMIS MSDS -- Material Safety Data Sheets in accordance with Section 21 05 01.
 - .1 Submit shop drawings and product data in accordance with Section 21 05 01.
 - .2 Submit data for valves specified this section.
 - .3 Submit product data in accordance with Section 21 05 01.
- .2 Closeout Submittals
 - .1 Provide maintenance data for incorporation into manual specified in Section 21 05 01.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 00 20.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 PRODUCTS

2.1 VALVE IDENTIFICATION SCHEDULE

Valve Type	Size	Iron	CS	SS	Other
Gate	2-1/2in & over	V1200	V1400	V1600	V1800
Gate	2in & less	V1300	V1500	V1700	V1900
Globe	2-1/2in & over	V2200	V2400	V2600	V2800
Globe	2in & less	V2300	V2500	V2700	V2900
Check	2-1/2in & over	V3200	V3400	V3600	V3800
Check	2in & less	V3300	V3500	V3700	V3900
Ball	2-1/2in & over	V4200	V4400	V4600	V4800
Ball	2in & less	V4300	V4500	V4700	V4900
Butterfly	3in & over	V5200	V5400	V5600	V5800
Stop Check	3in & over	V3201	V3401	V3601	V3801

NOTES:

1. The size range shown is that which is available from the manufacturer, all sizes and valve types shown are not necessarily applicable to the project. Valve size to be line size.
2. Only one manufacturer is listed for each valve description, it is selected as an illustrative example and does not indicate the sole source when accompanied by "or Approved Equal".
3. Valve descriptions describe minimum service requirements; all referenced Codes and Standards shall be the latest edition.

2.2 BALL VALVES

- .1 V4700 Ball Valve
 - .1 Ball valve, threaded connections, 1500psi WOG, SS 316 CF8M body, 316 SS full port ball and blow-out proof stem, two-piece, reinforced PTFE seats, lockable lever handle.
 - .2 Approved Product: M.A. Stewart Model G2 or approved equal.

2.3 BUTTERFLY VALVES

- .1 V5400 Butterfly Valve
 - .1 Lugged Cast Iron Body: to ASTM A-126, Class B
 - .2 Ductile Iron/Nickle Plated Disc: to ASTM A-536 GR 65/45/12
 - .3 Stainless Steel Stem: to ASTM A-276
 - .4 EPDM Seat, Teflon Gar-Fil Bearing, Carbon Steel Pin
 - .5 Approved Products:

- .1 Keystone Series 60L or Approved Equal

2.4 GATE VALVES

.1 V1200

- .1 NPS 2-1/2 to 8 (Suitable for waste water application), outside screw and yoke (OS&Y) rising stem, iron trim, solid wedge disc:
 - .1 Body and multiple-bolted bonnet: with full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.
 - .2 Disc: solid offset taper wedge, bronze to ASTM B 62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.
 - .3 Seat rings: renewable bronze screwed into body.
 - .4 Stem: nickel-plated steel.

2.5 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.
- .2 Install rising stem valves in upright position with stem above horizontal.

2.6 COMMISSIONING

- .1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Design, select, supply and install a piping support system suitable for the applications indicated
- .2 Provide accommodation for pipe expansion where required.

1.2 CODES AND STANDARDS

ANSI/ASME	B31.3	Process Piping
ANSI/ASME	B31.9	Building Services Piping
ANSI/MSS	SP-58	Pipe Hangers and Supports – Materials, Design and Manufacture
ANSI/MSS	SP-69	Pipe Hangers and Supports – Selection and Application
ANSI/MSS	SP-58	Pipe Hangers and Supports – Fabrication and Installation Practices

*** All Codes and Standards are to the latest editions

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 21 05 01.
- .2 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit shop drawings for the following items:
 - .1 Bases, hangers and supports,
 - .2 Connections to equipment and structure,
 - .3 Structural assemblies.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 21 05 01.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 21 05 01 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .3 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

2.2 GENERAL

- .1 Fabricate bases, hangers and supports in accordance with the codes and standards mentioned in Section 1.2.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are epoxy coated.
- .2 Upper Attachments
 - .1 Requirements (Suspension from lower flange of I-Beam):
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .2 Cold piping NPS 2-1/2 or greater & hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, ULC listed to MSS SP 58.
 - .2 Requirements (Suspension from upper flange of I-Beam):
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, ULC listed to MSS SP 69.
 - .2 Cold piping NPS 2-1/2 or greater & hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut, ULC listed.
 - .3 Requirements (Upper attachment to concrete):
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with welded forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

- .2 Concrete inserts: wedge shaped body with knowkout protector plate UL listed to MSS SP 69.
 - .3 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies: Galvanized carbon steel to be used with a U-bolt to MSS SP 69 with 2 nuts at each end to ASTM A 564.
 - .2 Steel brackets: In accordance with the requirements of ASME B31.1 and MSS SP 58.
 - .3 Refer to Unistrut recommended execution details.
 - .4 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of piping is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
 - .5 Pipe Attachments: material to MSS SP 58
 - .1 Attachments for steel piping: galvanized carbon steel.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports for hot pipework to accommodate thermal insulation and avoid penetrating the vapour retarder.
 - .6 Adjustable Clevis:
 - .1 Material to MSS SP 69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for riveting to insulation shields.
 - .7 U-Bolt:
 - .1 Material to MSS SP 58 and MSS SP 69, galvanized carbon steel.
 - .2 Acceptable Products:
 - .1 Grinnell Fig. 137, Galvanized or Approved Equal
- 2.4 RISER CLAMPS**
- .1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed.
 - .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
 - .3 Bolts: to ASTM A 307.
 - .4 Nuts: to ASTM A 563.
- 2.5 INSULATION PROTECTION SHIELDS**
- .1 Insulated cold piping:
 - .1 4 lb/ft³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 9.85 foot span.
 - .2 Insulated hot piping:
 - .1 Curved plate 12 inch long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.6 SUPPLEMENTARY STRUCTURAL MEMBERS

- .1 Provide as required for support of piping, anchoring and sway bracing under active loading, shall be galvanized.

2.7 EXPANSION JOINTS

- .1 Provide prefabricated expansion joints where required for thermal movement.

2.8 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel, submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 HOUSE-KEEPING PADS

- .1 Provide 4 inch high (unless otherwise specified on drawings) high concrete housekeeping pads for base-mounted equipment; size pads 2 inch larger than equipment; chamfer pad edges.

Part 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 HANGER SPACING

- .1 Spacing and middle attachment (rod) diameter as specified in paragraphs below or as found in table below, whichever is more stringent

- .1 Plumbing Piping: most stringent requirements of Canadian Plumbing Code, or authority having jurisdiction.
- .2 Gas and fuel oil piping: up to NPS ½: every 1.8 m.
- .3 Flexible Joint Roll Groove Pipe: in accordance with table below for steel, but not less than one (1) hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .4 Within 12 in. of each horizontal elbow

Pipe Size (NPS)	Maximum Spacing for Steel (ft)	Maximum Spacing for Copper (ft)
Up to 1 ¼	7	6
1 ½	9	8
2	9	8
2 ½	12	10
3	12	10
3 ½	12	11
4	12	12
5	14	
6	14	
8	14	
10	16	
12	16	

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

3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Paint all supplementary support steel as noted in Section 21 05 01.

3.4 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:

- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Furnish and install a complete UL Listed, CSA Certified or FM approved system of heating cables, components and controls to prevent both wastewater system and potable water (portion installed outdoors) pipes from freezing.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 21 05 01. Provide product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section
- .2 Quality assurance submittals: submit following in accordance with Section 21 05 01.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.
 - .1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 21 05 01.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

Part 2 PRODUCTS

2.1 PIPE/TANK TRACING HEATING CABLES

- .1 Type D: self-regulating heating cable with two 16 AWG mickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. The heating cable shall be covered by a radiation-crosslinked, modified polyolefin

dielectric jacket. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper and an outer jacket of fluoropolymer (-CT), cold leads factory spliced and as indicated.

- .2 In order to conserve energy and to prevent overheating, the heating cable shall have a self-regulating factor of at least 90 percent.
- .3 The heating cable shall operate on line voltages of 208 volts without the use of transformers.
- .4 Heating capacity:
 - .1 Wastewater Pipe System: 8 W/ft; for use with 208V power supply.
 - .2 Potable Water Supply System: 8 W/ft; for use with 208V power supply.
- .5 Power connection, end seal, and tee kit components shall be applied in the field.
- .6 Heating cable circuit shall be protected by a ground-fault device for equipment protection.
- .7 Breaker to be sized to accommodate design to -30F.
- .8 Provide "Electric Traced" labels, power connection kit, fiberglass tape and all recommended accessories from the manufacturer.
- .9 Approved Product:
 - .1 Raychem XL-Trace or approved equal.

2.2 CONTROLS

- .1 Thermostatic Control-Line Sensing:
 - .1 The system shall be controlled by a line sensing electronic thermostat for pipe freeze protection application.
 - .1 Approvals: Ordinary Areas: UL, CSA, FM
 - .2 Enclosure: Nema 4X
 - .3 Mounting: Wall mounted
 - .4 Ambient installation: 30°F to 110°F
 - .5 Setpoint Range: 0°F to 225°F
 - .1 Factory Preset at 40°F
 - .6 Switch Type: SPST (normally open)
 - .7 Deadband: -0°F, +3°F
 - .8 Max Switch Current: 30A at 277 VAC
 - .9 Sensor failure: Shorted or open sensor
 - .10 LED's
 - .1 Green LED for power available,
 - .2 Green LED for heating cable on,
 - .3 Red LED for sensor failure.
 - .11 Temperature Sensor:
 - .1 Type: Thermistor – 0.2°C, 10K ohm

- .2 Construction: 3 wire (twisted shielded pair plus ground)
- .3 Exposure Temperature:
 - .1 Min: -40°F
 - .2 Max: 212°F
- .4 Sensor Sheath: 304 stainless steel.
- .12 Connection Terminals:
 - .1 Power supply input: Screw Rising Cage Clamp, 18 – 6 AWG,
 - .2 Heating cable output: Screw Rising Cage Clamp, 18 – 6 AWG,
 - .3 Ground: Screw Rising Cage Clamp, 18 – 6 AWG,
 - .4 Thermistor (sensor): Screw Rising Cage Clamp, 22 – 14 AWG
- .13 Accessories:
 - .1 Pipe support bracket.
- .14 Acceptable Product:
 - .1 Pentair DigiTrace EC-TS.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install Type D heating cables in accordance with manufacturer's instructions. Distribute and fasten cable evenly on pipe using pipe strap or tape at maximum spacing 0.5 m. Ensure that heating cables do not touch or cross each other. Run only cold leads in conduit and ensure sensing bulb does not touch cable. Ground shield to building ground. Coordinate cable installation with insulation application. Loop additional cable at fittings, valves, and flanges.
- .2 Apply "Electric Traced" labels to the outside of the thermal insulation.
- .3 Make power and control connections.
- .4 Provide space on submersible pump control panel unistrut frame to allow for mounting of heat trace controller.

3.3 FIELD QUALITY CONTROL

- .1 Use 500 V Megger to test cables for continuity and insulation value and record readings before, during and after installation.
- .2 Where resistance of 50 megohms or less is measured, stop work and advise Consultant.
- .3 Verification requirements include:
 - .1 Materials and resources.

- .2 Construction waste management.
- .3 Local/regional materials.
- .4 Low-emitting materials.

3.4 CLEANING

- .1 Proceed in accordance with Section 21 05 01.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

Part 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and requirements for the identification of piping systems, including the installation and location of identification systems.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .2 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 21 05 01.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 21 05 01.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 21 05 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Refer to Section 21 05 01.

Part 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.

- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

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

- .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size #9

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Consultant.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Propane gas: to CSA/CGA B149.1 and Authority Having Jurisdiction.

2.5 IDENTIFICATION OF PIPING SYSTEMS

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

- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
 - .1 If facility has existing colours and legends, match existing.
 - .2 Where not listed, obtain direction from Consultant.
 - .3 Colours for legends, arrows: to following table:

<u>Background colour:</u>	<u>Legend, arrows:</u>
Yellow	BLACK
Green	WHITE
Red	WHITE
 - .4 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
Waste water		WASTE WATER
Domestic cold water supply	Green	DOM. CWS

2.6 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.

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

2.7 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE

- .1 Identification in English.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TIMING

- .1 Provide identification only after painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.

3.4 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.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

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

- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

- .1 Proceed in accordance with Section 21 05 01.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Supply and installation of external duct insulation where shown on the drawings.
- .2 Supply and installation of external duct insulation on all ducts connected to the exterior of the building. The insulation shall extend 10 feet from the exterior wall or until the first modulating damper, whichever is longer.

1.2 REFERENCES

ASTM	C411-82(1992)	Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
CGSB	51-GP-52MA-89	Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

*** All Codes and Standards are to the latest editions

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" – insulated mechanical services and equipment tin suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 :EXPOSED" – will mean "not concealed" as defined herein.
 - .3 Insulation systems – insulation material, fasteners, jackets, etc.

Part 2 PRODUCTS

2.1 GENERAL

- .1 Components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Materials to be tested in accordance with ASTM C411.

2.2 D-2 MINERAL FIBRE BLANKET WITH VAPOUR BARRIER -40 TO +600 C

- .1 Application: on exterior of ductwork where shown on the drawings.
- .2 Material:
 - .1 CAN/CGSB-51.11, CAN/CGSB-51.5M; Type II, (FSKfacing), inorganic glass fibre blanket, 1 lb/ft3 .
 - .2 Acceptable material: Knauf Duct Wrap or approved equal.
- .3 Thickness:
 - .1 Fresh air intakes: 2 in.
 - .2 Exhaust ducts where noted: 1 ½ in.
 - .3 Supply air ducts: 1 ½ in.

2.3 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Tape: self-adhesive, aluminum, 3 inch wide minimum.

Part 3 EXECUTION

3.1 APPLICATION

- .1 Apply insulation after required tests have been completed and approved by Consultant.
- .2 Surfaces shall be clean and dry during application of insulation and finishes.
- .3 Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified.
- .4 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves and supports.
- .5 Insulate strap hangers 4 in. beyond insulated duct.
- .6 Use stand-offs for duct mounted control accessories.
- .7 Apply 1.0 mm thick galvanized sheet metal corners (nosings) in traffic areas to ductwork in mechanical rooms.

3.2 INSTALLATION

- .1 General:
 - .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
 - .2 Adhere and seal vapour barrier using vapour seal adhesives.
 - .3 Stagger longitudinal and horizontal joints on multi layered insulation.
- .2 Mechanical fastenings:
 - .1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 8 in. centres, but not less than 2 rows per side and bottom.

END OF SECTION

Part 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B 209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C 335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C 547-2003, Mineral Fiber Pipe Insulation.
 - .7 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 DEFINITIONS

- .1 For purposes of this section:

- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIACs:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 21 05 01.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 21 05 01. Include product characteristics, performance criteria, and limitations.
 - .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 21 05 01.
- .4 Samples:
 - .1 Submit samples in accordance with Section 21 05 01.
 - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 21 05 01.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 21 05 01.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .4 Storage and Protection:

- .1 Protect from weather, construction traffic.
- .2 Protect against damage.
- .3 Store at temperatures and conditions required by manufacturer.

Part 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25 .
 - .2 Maximum smoke developed rating: 50 .

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket and reinforced kraft paper all service jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 .
 - .2 Maximum "k" factor: to CAN/ULC-S702.
 - .3 Acceptable Products:
 - .1 Knauf 1000° with Proto 25/50 rated fitting covers or Approved Equal
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket and reinforced kraft paper all service jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 .
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 .
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 .
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
- .7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
 - .1 Insulation: to ASTM C 533.
 - .2 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C 449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 1.6 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 ABS Plastic:
 - .1 One-piece moulded type and sheet with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint ,
 - .3 Minimum service temperatures: -40 degrees C.
 - .4 Maximum service temperature: 82 degrees C.
 - .5 Moisture vapour transmission: 0.012 perm.

- .6 Thickness: 0.75 mm.
- .7 Fastenings:
 - .1 Solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .8 Locations:
 - .1 For Outdoor use ONLY.
- .3 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: compatible with insulation.
- .4 Aluminum:
 - .1 To ASTM B 209.
 - .2 Thickness: 0.50mm sheet.
 - .3 Finish: stucco embossed.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .5 Stainless steel:
 - .1 Type: 316.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: stucco embossed.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturer's instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Insulation securements:.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code:.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Insulation securements:.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: A-2.
 - .1 Insulation securements:.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation as listed in following table.

- .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
- .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

.8	Application	Temp Deg. C	TIAC	Pipe sizes (NPS) and insulation thickness			
				To 1	1-1/4 to 2	2-1/2 to 4	5 to 6
	Domestic CWS with vapour retarder		C-2	50	50	50	50

Waste Water (pre-insulated pipe, see Specification 33 34 00.

- .9 Finishes:
 - .1 Exposed indoors: PVC jacket.
 - .2 Concealed, indoors: all service jacket on piping, valves, fittings. No further finish.
 - .3 Outdoors: water-proof ABS Plastic Jacket.
 - .4 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.
 - .5 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.6 CLEANING

- .1 Proceed in accordance with Sections 21 05 01.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and installation procedures for electric heating and cooling controls.

1.2 REFERENCES

- .1 Not used.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 21 05 01. Include product characteristics, performance criteria, and limitations.

- .2 Submit shop drawings. The shop drawings shall indicate description of materials, general construction, specific modifications, component connections, anchorage connections, hardware, software and installation procedures, including the following specific requirements, (shop drawings shall be prepared in AutoCAD format).

.3 Control Diagrams:

- .1 Use at least one individual sheet for each major system.
- .2 System flow diagram with sensing, control and interlock devices shown.
- .3 Internal control panel layouts, control panel cover layouts, electrical connections inside control panels.
- .4 Ladder type wiring diagrams showing interlock, monitoring and control wiring to and from mechanical and electrical equipment.
- .5 Communications wiring schematic drawings indicating interconnections between application specific controllers, custom application controllers, application generic controllers, OWS's and other system peripherals.
- .6 Flow chart control sequences.

- .4 Descriptive data and sequence of operations for operating users and application software including operator's manual and programmer's manual.

- .5 Point to point and basic function commissioning forms to be used on site for the start, test and check of controls components and systems.

- .6 Functional performance test documentation and procedures to be used in commissioning control sequences.

- .7 List of component sizes, mounting orientations, capacities and locations for; Valves, damper actuators, pressure taps and temperature well schedules.

- .8 Provide installation details and specific instructions for equipment.

- .9 Submit drawings indicating specific locations of electrical power to control panels.

- .10 Quality assurance submittals:
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Consultant will make available 1 copy of systems supplier's installation instructions.
- .11 Maintenance Data and Service:
 - .1 Provide maintenance data for incorporation into maintenance manuals as specified in section 23 05 00 - Common Work Results for HVAC.
 - .2 Provide as-built information in accordance with Section 23 05 00 - Common Work Results for HVAC.
- .12 Guarantee
 - .1 Provide a written guarantee stating the controls and instrumentation are guaranteed against faulty material and workmanship for a period of one year from the date of the Certification of Substantial Completion.
- .13 Operating Instructions
 - .1 Provide operating instructions for the heat recovery control system in accordance with the General Conditions of the contract and include a description of the sequence of operation and "as-built" drawings of the system schematics.
- .14 Special servicing conditions and expanded warranty or service contract proposals.
- .15 List of recommended spare parts and calibration tools for Owner's Maintenance Staff.

1.4 SCOPE OF WORK

- .1 Design and installation of low voltage, automatic controls for,
 - .1 Exhaust Fan, EF-1,
 - .2 Outside Air Motorized Damper, MD-1,
- .2 Provide all labour, materials, products, equipment and service to provide a new ventilation control panel as described below:
 - .1 Provide integrate and install new ventilation control panel.
 - .2 Incorporate low voltage automatic control systems for new equipment.
 - .1 Room temperature sensor,
 - .1 Control analog output to new ventilation control panel,
 - .2 Motorized damper located in intake ductwork,
 - .1 Power to open, spring to close, minimum position 15%
 - .3 Exhaust fan, EF-1
 - .1 Control input to motor of EF-1 from new ventilation control panel.
 - .4 NO₂ Detector,
 - .1 Confirm signal type, re-calibrate with test vapour.
 - .5 CO Detector,
 - .1 Confirm signal type, re-calibrate with test vapour.

- .3 Provide graphic interface on new ventilation control panel.
- .3 Verify sequence of exhaust fan, unit heater, motorized dampers and alarm systems as defined in the Sequence of Operation and drawing M-3.
- .4 Responsibility for all control wiring, mounting and operational commissioning of loose supplied controls provided by others as part of a packaged equipment supply.
- .5 Provision O&M manuals, as-built control shop drawings and Owner training of systems use and one-year warranty services.
- .6 Refer to Division 26 Electrical drawings for control wiring methods to Division 26 standards; co-ordinate and pay for all installation wiring under this section.
- .7 Provide O&M training.

1.5 QUALIFICATIONS AND SUPPORT

- .1 Controls Manufacturer Minimum Qualifications; demonstrate to Owner/Engineer not less than 5 years experience in the production of specified products or functionality equivalent products.
- .2 The Control Contractor shall provide qualified manpower for a complete control system design, installation and testing and commissioning. Sufficient staff shall be dedicated to the project to ensure its timely execution in accordance with the overall project design and construction schedules.
- .3 The Controls Contractor shall be capable of supporting all peripheral functions, including start-up, testing, commissioning and Owner staff training, as well as providing on-site warranty and maintenance services.

1.6 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those items obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

Part 2 PRODUCTS

2.1 TEMPERATURE SENSOR

- .1 To suit application.

2.2 MOTORIZED DAMPERS

- .1 MD-1,
 - .1 Temperature control and LEL purge modulating damper and actuator complete with limit switch to prove open.

- .2 Approved Product:
 - .1 Tamco 9000 (insulated) or approved equal.

2.3 VAPOUR DETECTORS

- .1 NO₂ CO,
 - .1 The monitor will be powered by 24 VAC. The monitor will incorporate an Electrochemical cell for toxic gas monitoring.
 - .2 The monitor will be capable of transmitting gas concentrations to a DDC system through its 4-20 mA output. For local activation of fans or louvers (or other equipment), two on-board DPDT relays 5 A, 30 Vdc or 250 Vac (resistive load) will be activated at programmable set points (and programmable before and after time delays). An 8 character, 2 line backlit LCD display will provide local gas concentration readings.
 - .3 Transmitter will be capable of operating within relative humidity ranges of 5-95% non-condensing and temperature ranges of -4° F to 104° F (-20° C to 40° C).
 - .4 The transmitter will have a plug-in capability for a gas cartridge with a smart sensor technology with self-testing capabilities accuracy of +/- 3% of full scale @ 25 C.
 - .5 Enclosure will be Polycarbonate with rubberized sealed cover and LED visual indications for power, alarm & fault conditions.
 - .6 For local activation of audible alarms, the monitor shall have an on-board device able to generate an audible output of 85 dBA @ 10 ft (3m).
 - .7 Approved Product:
 - .1 Honeywell E3SRMNO2 or approved equal model to suit application.
 - .2 Honeywell E3SASCO or approved equal model to suit application.
 - .8 Monitor alarm levels are to activate and the unit is to be installed in accordance with the following parameters:

TOXIC GASES	FIRST ALARM SET POINT (TLV-TWA)	SECOND ALARM SET POINT (TLV-STEL)	SENSOR LOCATION	RADIUS OF COVERAGE
Carbon Monoxide (CO)	12 PPM	25 PPM	3-5 ft above the floor	50 feet
Diesel (NO ₂)	.72 PPM	2 PPM	1 ft below the ceiling	50 feet

2.4 CONTROL PANEL

- .1 Custom built to suit application.

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install control devices.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25mm from exterior wall.
- .3 All thermostats to be installed complete with a lockable protective cover.
- .4 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

3.3 PROJECT SPECIFIC REQUIREMENTS

- .1 The Contractor shall provide but not necessarily be limited to the design, network management, device and controller materials supply, installation, start-up and commissioning for the systems as illustrated and herein described.
- .2 Responsibility for mounting and connecting including providing required wiring methods for control devices, remote control panels, etc. that are supplied loose with packaged equipment.
- .3 Mechanical Systems Minimum Control & Control Panel Function:
 - .1 Control to design sequence of operation,
 - .2 Status Displays,
 - .3 Alarming.
- .4 As a minimum all control wiring shall be run in EMT conduit or as dictated by Code. The more restrictive requirements shall apply.
- .5 Refer to drawing M-3 for details.
- .6 Device Listing:
 - .1 Room Temperature Sensor; TS-1,
 - .2 Motorized Damper, MD-1 complete with prove open limit switch, power to open, spring closed, 2-position,
 - .3 NO₂ Sensor;
 - .4 CO Sensor;
 - .5 Outdoor alarm strobe beacon and audible horn,
 - .6 Ventilation Control Panel.

3.4 SEQUENCE OF OPERATION

- .1 Ventilation Controls
 - .1 Motorized damper, MD-1; normally closed (normally closed position shall be set at nominal 15% open), damper is powered open once room temperature rises above 20°C set point (adjustable) as sensed by TS-1. Alarms: Room low temperature alarm initiates outdoor strobe beacon (locate above mandoor).

- .2 Exhaust Fan EF-1; is commanded to run when the outside air damper MD-1 limit switch is proven open, EF-1 runs continuously until room temperature setpoint is satisfied.
- .3 NO_x detection, upon sensing NO_x levels above 2 ppm, MD-1 is powered fully open, once damper is proven open EF-1 is commanded on. EF-1 runs continuously until NO_x levels are below alarm level; Alarms: NO_x alarm initiates outdoor strobe beacon (locate above mandoor).
- .4 CO detection, upon sensing CO levels above 25 ppm, MD-1 is powered fully open, once damper is proven open EF-1 is commanded on. EF-1 runs continuously until CO levels are below alarm level; Alarms: CO alarm initiates outdoor strobe beacon (locate above mandoor).

3.5 TESTING AND COMMISSIONING

- .1 Testing all field end devices through proper input/output ranges.
- .2 Testing shall be complete, detailed and documented on approved point-to-point verification forms.
- .3 All field calibration must be done with calibrated instrumentation tools suitable for their intended use. Calibration tools shall be calibrated before and after project completion and reports of same submitted to the Project Manager.
- .4 Testing and documentation criteria:
 - .1 Verify that all field devices are properly sized, for anticipated operating range. Devices are adjusted for correction position, orientation and full range.
 - .2 Conductor Integrity; test continuity of all wiring from field devices to correct input/output.
 - .3 Conductor Termination; verify that all wiring terminations to devices are per the manufacturer's recommendations.
 - .4 Conductor to Output; test linear scaling calibration of every analog output point.
 - .5 Alarm Graphics and interlocking; verify all alarm signals from devices initiation through all required notification components.
- .5 Device Calibration; all field devices are to be calibrated, sensor accuracy verified. Calibration shall be done at or close to normal operating conditions.
 - .1 Calibration Criteria; establish calibration criteria suitable for the intended system function. Suggested HVAC/R calibration criteria;
 - .1 Space temperature, +/- 0.5 degrees Celsius.
 - .2 Duct/unit air temperature, +/- 0.5 degrees Celsius.
 - .3 Fluid temperature, +/- 1 degree Celsius.
 - .4 Air flow rate, +/- 5%.
 - .5 Liquid flow rate, +/- 5%.
 - .6 Differential pressure, +/- 3%.
 - .7 Static pressure, +/- 3%.
 - .8 Relative humidity, +/- 2%.

- .9 CO monitoring, +/- 3%.
- .10 CO2 monitoring, +/- 3%.
- .11 Refrigerant monitoring, +/- 5%.

.6 Functional Performance Testing:

- .1 Comprehensive functional performance testing shall be performed on every system installation. The BAS Contractor shall test and document that all logic control sequences have been verified as detailed on the Shop Drawing control sequences. Functional testing shall be documented on forms indicating the date of the testing and personnel performing the testing.
- .2 Deficiencies resulting from the functional testing shall be resolved by the BAS Contractor as soon as possible.
- .3 System functional testing shall be repeated until successful system test can be documented.

.7 Demonstrations and Training:

- .1 Following completion of functional performance testing demonstrate to Project Manager and Owner the satisfactory operation of all control systems.

3.6 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Supply and installation of propane piping as shown on drawings.

1.2 Codes and Standards

ANSI/ASME	B16.5-1988	Pipe Flanges and Flanged Fittings
ANSI	B18.2.1-1981	Square and Hex Bolts and Screws
ASTM	A47M-90	Specification for Ferric Malleable Iron Castings
ASTM	A53-90a	Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
CAN/CGA	B149.1	Natural Gas and Propane Installation Code Handbook
CAN/CGA	B149.2	Propane Storage and Handling Code
CAN/CSA	B137	Thermoplastic Pressure Piping Compendium

*** All Codes and Standards are to the latest editions

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 21 05 01.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in 21 05 01.

Part 2 PRODUCTS

2.1 PIPE

- .1 Polyethylene pipe: to ASTM D2837 and CSA B137:
 - .1 PE3408 compound.
 - .2 Wall Thickness: 0.15 to 0.3170, dependent on pipe size
 - .3 Schedule: SDR 8.8
 - .4 Joints: thermal butt fusion
 - .5 Fittings: to CSA B137

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

- .1 Install in accordance with applicable Provincial Codes, CAN/CSA B149.1 and CAN/CSA B149.2.
- .2 Install drip points:
 - .1 At low points in piping system.
- .3 Piping exposed to elements shall be painted with metal primer, and given at least one coat of exterior enamel paint.
- .4 Expansion loops shall be used in accordance with CAN/CGA B149.1.
- .5 Slope piping down in direction of flow to low points.
- .6 Use eccentric reducers at pipe size change installed to provide positive drainage.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Supply and installation of outside air ductwork related to the EF-1 intake air systems and combustion air.

1.2 CODES AND STANDARDS

- .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 1985.
- .2 SMACNA HVAC Duct Leakage Test Manual, 1985.
- .3 ASTM A52M-87, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- .4 ANSI/NFPA 90A-1989, Installation of Air Conditioning and Ventilating Systems.
- .5 NBCC, National Building Code of Canada, Part 6.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 PRODUCTS

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

	Maximum Pressure <u>Pa</u>	SMACNA Seal <u>Class</u>
All:	500	A

- .2 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.2 SEALANT

- .1 Sealant; oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30° C to plus 93° C.
- .2 Acceptable material: Ductmate Proseal/Fibreseal or approved equal.

2.3 FITTINGS

- .1 Fabrication: to SMACNA.

- .2 Radiused elbows:
 - .1 Rectangular: standard radius or short radius with single thickness turning vanes Standard (1.5 times width of duct).
 - .2 Round: smooth radius (1.5 times diameter).
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45° entry on branch.
 - .2 Round main and branch: enter main duct to 45° with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Transitions:
 - .1 Diverging: 20o maximum included angle.
 - .2 Converging: 30o maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
- 2.4 FIRE STOPPING**
 - .1 Fire stopping material and installation must not distort duct.
- 2.5 GALVANIZED STEEL**
 - .1 Lock forming quality: to ASTM A525M, Z90 zinc coating.
 - .2 Thickness, fabrication and reinforcement: to SMACNA.
 - .3 Joints: to SMACNA
- 2.6 FLEXIBLE CONNECTIONS**
 - .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
 - .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40° C to plus 90° C, density of 1.3 kg/m2.
- 2.7 HANGERS AND SUPPORTS**
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 20 in.
 - .2 Hanger configuration: to SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA following table:

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (mm)
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50x50x6	10

.4 Upper hanger attachments:

- .1 For steel joist: manufactured joist clamp or steel plate washer.
- .2 For steel beams: manufactured beam clamps.
- .3 For wood framing: 3 in. long, galvanized lag screws, fastened to structural framing.
- .4 For concrete: manufactured concrete inserts.

Part 3 EXECUTION

3.1 GENERAL

- .1 To SMACNA standards referenced.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
- .3 Support risers in accordance with SMACNA as indicated/where applicable.
- .4 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .5 Balancing dampers on all branch supply run-outs.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA as follows:

<u>Duct Size</u> (inch)	<u>Spacing</u> (inch)
to 60	120
61 and over	100

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intakes.
 - .2 Exhaust air wall penetrations.
- .2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer.
- .3 Slope horizontal branch ductwork down towards hoods served. Slope header ducts down toward risers.
- .4 Provide insulating blanket on duct exterior at outside air intakes.

3.4 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.

3.5 FLEXIBLE CONNECTIONS

- .1 Install where indicated.
- .2 Length of connection: 4 in.
- .3 Minimum distance between metal parts when system in operation: 3 in.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
 - .1 Ducting on each side of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.

3.6 LEAKAGE TESTS

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Do leakage tests in sections.
- .3 Complete test before performance insulation or concealment work.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Supply, installation and commissioning of exhaust fan EF-1.

1.2 REFERENCES

- .1 AMCA 99-1986, Standards Handbook.
- .2 ANSI/AMCA 210-1985, Laboratory Methods of Testing Fans for Rating.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 20 – General Requirements.
- .2 Provide fan curves and sound rating data, showing point of operation and efficiency.
- .3 Indicate following: motors, wheels, bearings and accessories.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 00 20 – General Requirements.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

Part 2 PRODUCTS

2.1 FANS – GENERAL

- .1 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .2 Sound ratings: comply with AMCA (Air Moving and Conditioning Association) 301, tested to AMCA 300.
- .3 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51.
- .4 Factory primed before assembly in colour standard to manufacturer.

- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

2.2 EXHAUST AIR FAN, EF-1

- .1 General: Belt driven, axial type sidewall fan, fabricated steel propellers secured to fan shaft, statically and dynamically balanced. Motor shall be permanently lubricated, heavy duty type, carefully matched to fan load and furnished at specified voltage, phase and enclosure.
- .2 Ground and polished steel fan shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to wheel and motor shafts. Motor sheaves shall be adjustable for system balancing.
- .3 Drive frame and panel assemblies shall be galvanized steel. Drive frames shall be formed channels and fan panels shall have pre-punched mounting holes, formed flanges and a deep formed inlet venture. Drive frames and panels shall have bolted or welded construction.
- .4 The axial exhaust fans shall bear the AMCA Certified Ratings Seals for both sound and air performance.
- .5 Options and Accessories: TEFC motor with CSA approval, disconnect switch rating by electrical, toggle, junction box mounted and wired, wall housing, gravity operated damper, motor guard, 45 degree weatherhood.

- .6 Approved product: Greenheck Model GB-330-30 or approved equal.

- .7 Exhaust Fan Performance:

<u>Item</u>	EF- 1
Flow (cfm)	800
SP (inch w.c.)	0.25
RPM	625
Motor (hp)	1/2
Electrical	208V 1 phase (Confirm voltage with Electrical Engineer)

Part 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.2 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings and flexible electrical leads.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.

- .4 Access doors and access panels to be easily accessible.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Site works as indicated on drawings and described within specifications.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
- .1 ASTM C 117-04 Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-63 2002, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D 698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m³).
 - .5 ASTM D 1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2,700 kN-m/m³).
 - .6 ASTM D 4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
- .1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
 - .2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 DESCRIPTION

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
- .1 Rock : solid material in excess of 1.00 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m³ bucket. Frozen material not classified as rock.

- .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.
- .2 Unclassified excavation: excavation of deposits of whatever character encountered in Work.
- .3 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 1 inch in any dimension.
- .4 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .5 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .6 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .7 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials.
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1.
 - .3 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 21 05 01.
- .2 Submit shop drawings for civil, structural, hydraulic, mechanical and electrical elements.
- .3 Indicate individual components by manufacturer's model number and accompany with technical and performance characteristics.

1.5 EXISTING CONDITIONS

- .1 Buried Services:
 - .1 Before commencing work establish location of buried services that interfere with execution of work: pay costs of relocating services.

- .2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work: pay costs of relocating services.
- .3 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
- .4 Prior to beginning excavation work, notify and coordinate with applicable Consultant and Authorities Having Jurisdiction. Establish location and state of use of buried utilities and structures.
- .5 Where utility lines or structures exist in area of excavation, obtain direction of Engineer and General Contractor.
- .6 Record location of maintained, re-routed and abandoned underground lines.
- .7 Confirm locations of recent excavations adjacent to area of excavation.
- .2 Existing Buildings and Surface Features:
 - .1 Conduct, with Consultant, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Consultant and General Contractor.
 - .3 Where required for excavation, cut roots or branches after consulting General Contractor.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Type 1 material is to consist of well graded pit-run material conforming to the grading requirements of City of Winnipeg Standard Construction Specification Table CW 2030.1.
- .2 Type 2 and Type 3 material is to consist of sound, hard, crushed rock or crushed gravel free from organic or soft material that would disintegrate through decay or weathering, well graded throughout conforming to the grading requirements of City of Winnipeg Standard Construction Specification Table CW 2030.1. Type 2 material is to have a 100% crush content and be well graded throughout.

Part 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 SITE PREPARATION

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
- .2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 PREPARATION/PROTECTION

- .1 Protect existing features in accordance with applicable local regulations.
- .2 Keep excavations clean, free of standing water, and loose soil.
- .3 Where soil is subject to significant volume change due to change in moisture content, cover and protect to Consultant approval.
- .4 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .5 Protect buried services that are required to remain undisturbed.

3.4 STRIPPING OF TOPSOIL

- .1 Begin topsoil stripping of areas as directed by Consultant after area has been cleared of brush, weeds and grasses and removed from site.
- .2 Strip topsoil to depths as directed by Consultant.
 - .1 Do not mix topsoil with subsoil.
- .3 Stockpile in locations as directed by Consultant or General Contractor.
 - .1 Stockpile height not to exceed 2 m and should be protected from erosion.
- .4 Dispose of unused topsoil as directed by General Contractor.

3.5 STOCKPILING

- .1 Stockpile fill materials in areas designated by General Contractor.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.

- .3 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.6 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Health and Safety Act for the Province of Manitoba.
 - .1 Where conditions are unstable, Consultant to verify and advise methods.
- .2 Construct temporary Works to depths, heights and locations as directed and approved by Consultant.
- .3 During backfill operation:
 - .1 Unless otherwise indicated or directed by Consultant, remove sheeting and shoring from excavations.
 - .2 Do not remove bracing until backfilling has reached respective levels of such bracing.
 - .3 Pull sheeting in increments that will ensure compacted backfill is maintained at elevation at least 500 mm above toe of sheeting.
- .4 When sheeting is required to remain in place, cut off tops at elevations as indicated.
- .5 Upon completion of substructure construction:
 - .1 Remove cofferdams, shoring and bracing.
 - .2 Remove excess materials from site and restore watercourses as indicated directed by Consultant.

3.7 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Consultant's review of details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
 - .1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
- .4 Protect open excavations against flooding and damage due to surface run-off.
- .5 Dispose of water to approved collection or runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

- .6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.8 EXCAVATION

- .1 Perform excavation in accordance with Province of Manitoba "W210 The Workplace Safety and Health Act" and "Guidelines for Excavation Work".
- .2 Excavate to lines, grades, elevations and dimensions as directed by Consultant.
- .3 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.
- .4 Excavation must not interfere with bearing capacity of adjacent foundations.
- .5 Do not disturb soil within branch spread of trees or shrubs that are to remain.
 - .1 If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
- .6 Dispose of surplus and unsuitable excavated material off site.
- .7 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
- .8 Obtain Consultant approval of completed excavation.

3.9 BACKFILLING

- .1 Do not proceed with backfilling operations until completion of following:
 - .1 Consultant has inspected and approved installations.
 - .2 Inspection, testing, approval, and recording location of underground utilities.
 - .3 Removal of concrete formwork.
 - .4 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .5 Provide a foundation consisting of Type 3 material over the entire bottom of shafts made for trenchless installation in accordance with City of Winnipeg Standard Construction Specification Standard Detail, SD-001. Compact to a density of at least 95% of Standard Proctor Density.

- .6 Classes of Backfill
 - .1 Class 2 Backfill
 - .1 Backfill the excavation with Type 1 material in maximum 300 millimeter thick layers to the grade required for backfill in accordance with the Drawings and Specifications or as directed by General Contractor. Compact each layer with a vibratory compactor to at least 95% of Standard Proctor Density.

3.10 RESORATION

- .1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 00 20, trim slopes, and correct defects as directed by Consultant.
- .2 Replace topsoil as indicated by Consultant.
- .3 Reinstall lawns to elevation which existed before excavation.
- .4 Reinstall pavements and sidewalks disturbed by excavation to thickness, structure and elevation which existed before excavation.
- .5 Clean and reinstall areas affected by Work as directed by Consultant.
- .6 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.
- .7 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Supply and installation of precast reinforced concrete sump pit as specified within and as indicated on drawings.
- .2 Excavation and backfill necessary to accommodate sump pit as specified within and as indicated on drawings.
- .3 Supply and installation of sanitary pump lift station as specified within and as indicated on drawings.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM[°]C 478-97, Standard Specification for Precast Reinforced Concrete Manhole Sections.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .2 CSA-A3001, Cementitious Materials for Use in Concrete.
 - .3 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 DESCRIPTION

- .1 Reinforced concrete enclosure. Pumping system to be factory assembled and disassembled (if necessary) for shipment with mating components clearly identified. Principal items of equipment to include a packaged sanitary sewage lift station including two pumps, guide rails, liquid level controls, vent complete with screens, cover, electrical wiring, custom control panel with circuit breakers and motor starters.
- .2 Equipment and installation to include following:
 - .1 Temporary sheet piling.
 - .2 Excavation for sewage lift station.
 - .3 Concrete slab with embedded anti-floatation flange.
 - .4 Compacted 6 inch sub-base with lean mix concrete skin coat.
 - .5 Connection of power to control panel as indicated.
 - .6 Connections to sanitary sewers.
 - .7 Supply and installation of packaged sewage lift station in accordance with manufacturer's instructions.

- .3 Wet well sewage lift station:
 - .1 Fully automatic, consisting of duplex submersible solids handling sewage pumps mounted on a rail system. Control to be by series of liquid level bulbs.
 - .1 Base discharge elbow complete with floor mount.
 - .2 25 foot stainless steel lifting wire to hook and bracket below sump roof.
 - .2 Inlet and outlet wall plate and link seals as noted on drawings.
 - .3 Pumps to alternate as lead pump on each cycle.
 - .4 Incorporate time delay relays in control circuits to allow continuation of pump for pre-set time after normal pump shut down signal is received.
 - .5 Operate both pumps when lag pump "on" water level is reached in wet well. Lag pump to shut off when water level drops to pump "off" water level.
 - .6 Locate control system in control station mounted above lift station cover plate.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 21 05 01.
- .2 Submit shop drawings for civil, structural, hydraulic, mechanical and electrical elements.
- .3 Indicate individual components by manufacturer's model number and accompany with technical and performance characteristics.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for sewage lift station for incorporation into manual specified in Section 21 05 01.
- .2 Include in this information:
 - .1 Record drawings, wiring diagrams, electrical schematics of equipment as installed.
 - .2 Interconnections with numbers and wire sizes.
 - .3 Certified pump characteristic curves.
 - .4 Detailed operation and maintenance instructions.
 - .5 Spare parts list comprising a complete schedule clearly identified to facilitate re-ordering.

1.6 SCHEDULING

- .1 Schedule work to minimize interruptions to existing services.
- .2 Maintain existing sewage flows during construction.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Materials and resources in accordance with Section 21 05 01.

2.2 SANITARY LIFT STATION SUMP PIT

- .1 Work listing described within specification to be in coordination with scope of work items shown and described in Drawings.
- .2 Structure: leak free, precast reinforced concrete with access opening, ladder and designed for following forces:
 - .1 Dead load of station and components, dynamic and kinetic forces of rotating equipment,
 - .2 Dead load from soil over structure, superimposed live load of 12 kN/m² or single wheel load of 54 kN over an area of 1220x813 mm.
 - .3 Hydrostatic uplift forces,
 - .4 Horizontal earth loading and full hydrostatic pressure assuming water at elevations shown on drawings.
- .3 Concrete benching to be supplied by Mechanical Contractor.
- .4 Materials:
 - .1 Precast concrete to CAN/CSA-A257.
- .5 Accessories:
 - .1 Sump to be complete with all necessary hardware and sump piping, valves, floats, brackets and pumps.
 - .2 Pump base discharge elbow complete with floor mounting flange,
 - .3 Inlet aluminum sleeve for 4 inch inlet piping,
 - .4 4 inch vent coupling,
 - .5 Inlet link-seal,
 - .6 Outlet aluminum sleeve for 3 inch force main,
 - .7 Force main link-seal,
 - .8 Halliday hatch,
 - .9 Halliday trash basket.

2.3 SANITARY LIFT STATION, SP-1, SP-2

- .1 Pumps: Submersible solids handling effluent pumps complete with,
 - .1 Durable Epoxy Coated Cast Iron Construction
 - .2 1 ½ HP, 208/3/60 Thermal Overload Protected Motor
 - .3 Non Clogging Vortex Impeller Design
 - .4 Stainless Steel Shaft
 - .5 Dual Mechanical Shaft Seals

- .6 Silicon Carbide Faces on Lower Seal
- .7 25 ft Power Cable
- .8 2" Solids Handling Capability
- .9 3" NPT Discharge
- .10 Capacity: 100 USGPM @ 36 ft TDH
- .11 Power: 208V/3 Phase/60 Hz
- .12 Acceptable Product:
 - .1 Zoeller 6290 Series Model #6294, (Quantity: 2)

Each pump complete with 25 foot long stainless steel lifting chain.

.2 Accessories:

- .1 2 Zoeller Model #6030-0160 3" Discharge Check Valves.
- .2 2 Zoeller Discharge Plug Valves

.3 Guide Rail Assemblies, complete with:

- .1 Cast Iron Construction
- .2 Stainless Steel Guide Plate
- .3 Stainless Steel Upper Rail Support
- .4 Intermediate Bracket, Stainless Steel, (If required)
- .5 Stainless Steel Cable Kit
- .6 Stainless Steel Lifting Bail
- .7 3" x 3" Connections
- .8 Acceptable Product:
 - .1 Zoeller Model #39-0075, (Quantity: 2)

.4 Duplex Custom Control Panel, complete with:

- .1 Disconnect Switches
- .2 Thermomagnetic Motor Protectors
- .3 Across The Line Contactors
- .4 Control Transformer c/w Secondary Fuse
- .5 1 only Power on Pilot Light
- .6 2 only 'Run' Pilot Lights
- .7 2 only H-O-A Selector Switches
- .8 2 only Overload/Trip Red LED Pilot Light and DPDT Alarm Relay
- .9 1 only High Level Sump Pit Red LED Pilot and DPDT Alarm Relay
- .10 1 only High Level Storage Tank Red LED Pilot and DPDT Alarm Relay
- .11 1 only Flashing Red Beacon for Alarms
- .12 Automatic Transfer to Non Operating Pump in Case of Motor Overload or Short Circuit
- .13 Automatic Alternation
- .14 FloCorp Ranger Ultrasonic Level Transmitter
- .15 FloCorp DigaCom 2000 Universal Process Display
- .16 FloCorp eXmod Relay Expansion Module
- .17 4 Float Switches, 3 Wire, 30 ft Cord
- .18 Nema 4X Stainless Steel Enclosure

- .19 400 W Heater and Thermostat
- .20 Elapsed Time Meters
- .21 High Level Alarm Buzzer, c/w Silencer and Pilot Light
- .22 High Level Alarm Relay
- .23 Acceptable Product:
 - .1 NES-DS3/1/208/3-39

The complete assembly shall be factory tested before shipping, all components shall be CSA listed.

2.4 PIPING AND VALVES

- .1 Carbon Steel, Sch. 40, epoxy painted.

2.5 FACTORY TESTING

- .1 Perform operational tests on pumps at factory to check for excessive vibration, for leaks in piping or seals and for correct operation of automatic control system and auxiliary equipment. Pump suction and discharge lines to be coupled to reservoir and pumps to recirculate water for minimum of 1 hour under simulated service conditions.
- .2 Provide certification that pumps and controls have been factory tested and all deficiencies rectified prior to delivery to site.

Part 3 EXECUTION

3.1 EXCAVATION BACKFILLING AND COMPACTION

- .1 Excavate, backfill and compact in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.

3.2 CONCRETE

- .1 Do concrete work in accordance with this section.

3.3 EQUIPMENT INSTALLATION

- .1 Install equipment, piping and controls in accordance with manufacturers' recommendations.

3.4 WATERPROOFING

- .1 Waterproof in accordance with Manufacturer' Installation Requirements.

3.5 PUMP INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.
- .4 Place 150 mm sand under sump pit tank.

3.6 FIELD QUALITY CONTROL

- .1 After completion of installation, demonstrate functional operation of systems, including sequence of operation, to approval of Consultant.
- .2 Test in presence of Consultant and representative from equipment supplier.
- .3 Provide labour and ancillary equipment necessary to fulfill tests.
- .4 Test to demonstrate that:
 - .1 Pumps and equipment run free from heating, or vibration.
 - .2 Operation meets requirements of these specifications.
 - .3 Pumps and pumping are free and clear of debris and obstructions.
 - .4 Check settings and operation of hand-off-auto selector switch, operating safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .5 Replace equipment found defective. Repeat test until equipment is accepted by Consultant.

3.7 PERFORMANCE VERIFICATION – SANITARY PUMPS

- .1 Fill sump at rate slower than capacity of pump #1.
- .2 Record levels at which pump #1 starts and stops. Determine flow rate by observing time taken to down water level.
- .3 Fill sump at rate faster than capacity of pump #1 but slower than capacities of pumps #1 and #2 operating in parallel.
- .4 Record levels at which pumps start and stop - water level rising and water level falling.
- .5 Verify operation of alternator.
- .6 Adjust water level controls as necessary.
- .7 Fill sump at rate faster than capacities of pumps #1 and #2 operating in parallel.
- .8 Record levels at pump starts and stops - water level rising and falling.

- .9 Check operation of alternator.
- .10 Adjust level controls as necessary.
- .11 Check level at which high water level alarm starts and stops. Adjust as necessary.
- .12 Check removability of pumps for servicing without interfering with installation or operation of other equipment.
- .13 Verify non-clog capability and maximum size of solids, using procedures recommended by manufacturer.

3.8 DEMONSTRATION

- .1 Operating Personnel Training
 - .1 Provide on-site training by qualified personnel for designated operating personnel prior to final commissioning. Training to be in accordance with training plan approved by Consultant.
 - .2 Provide training for 3 designated Owner's Personnel on all routine maintenance procedures, minor repairs, replacement of parts, including disassembly of major components.
 - .3 Provide safety precaution procedures for all systems.

3.9 REPORTS

- .1 In accordance with Section 21 05 01.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE

- .1 Provide and install PVC Schedule 80 and 304L Stainless Steel Schedule 10S and 40S piping and fittings to meet or exceed all applicable ASTM, NSF and CSA standards suitable for potable water.
- .2 This specification includes potable water piping from the water storage tank to the booster pump station and from the booster pump station to the site water distribution piping.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM D 1784-11, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - .2 ASTM D 2657-97, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - .3 ASTM D 2996-01, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
- .2 NSF/ANSI
 - .1 NSF/ANSI Standard 61 Drinking Water System Components – Health Effects
 - .2 NSF/ANSI Standard 14 – Plastics Piping System Components and Related Materials
- .3 CSA
 - .1 CSA B 137.0, Definition, General Requirements and Methods of Testing for Thermoplastic Pressure Piping

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule Work to minimize interruptions to existing services.
 - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
 - .3 Notify Consultant and building manager or superintendent 24 hours minimum in advance of any interruption in service.
 - .4 Notify fire department of any planned or accidental interruption of water supply to hydrants.
 - .5 Provide "Out of Service" sign on hydrant not in use.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 21 05 01.
- .2 Submit manufacturer's test data and certification that pipe materials meet requirements of this section at least 4 weeks prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 Shop Drawings:
 - .1 Indicate on drawings proposed method for installing carrier pipe for undercrossings.
- .5 Certificates:
 - .1 Certification to be marked on pipe.
- .6 Manufacturer's Instructions: submit to Consultant 1 copy of manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 21 05 01 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 PVC PIPE, JOINTS AND FITTINGS:

- .1 Rigid PVC (Polyvinyl chloride) used in the extrusion of Schedule 80 pipe and fittings complies with the material requirements of ASTM D1784. Raw material used in the extrusion shall contain the standard specified amounts of color pigment, stabilizers and other additives. The compounds used are listed to the requirements of NSF 61 for use in potable water service.
- .2 Physical dimensions and properties and fittings shall meet the requirements of ASTM D1785.

- .3 Joints: solvent weld using manufacturer's recommended products.
- .4 Fittings: Schedule 80 all fittings shall conform to ASTM D2467, all fittings must be certified to NSF 14.
- .5 Insulation: Refer to Specification 23 07 15.

2.2 STAINLESS STEEL PIPE, JOINTS AND FITTINGS:

ITEM	NOM. DIA. (inches)	CONN.	DESCRIPTION/SPECIFICATION
PIPE	2 ½ to 12	B.W.	S.S. ASTM A312 Gr. TP304L welded or seamless, ANSI B36.19 Sch. 10S
NIPPLE	¾ to 2	Thr'd	S.S. ASTM A312 Gr. TP304L welded or seamless, ANSI B36.19 Sch. 40S
		Thr'd	S.S. ASTM A312 Gr. TP316L welded or seamless, ANSI B36.19 Sch. 40S TBE & TOE
FITTINGS	1½ TO 12	B.W.	S.S. ASTM A403 Gr. WP316L, ANSI/ASME B16.9 Sch. 10S
COUPLINGS	½ TO 2	Thr'd	S.S. ASTM A182 Gr. F316L, ANSI/ASME B16.11 CL.. 3000, w'olet, thr'let
HALF COUPLINGS		Thr'd	S.S. ASTM A182 Gr. F316L, ANSI/ASME B16.11 CL.. 3000
	½ TO 2	S.W.	S.S. ASTM A182 Gr. F316L, ANSI/ASME B16.11 CL.. 3000
FLANGES	2 ½ TO 24	Vanstone	S.S. ASTM A403 Gr WP304L stub-end, MSS short. Back-up ring drilling to ASA B-16.5 Class 150, carbon steel galvanized. See Note 1
	2 ½ TO 24	Welded	S.S. ASTM A105 Gr WP304L, ANSI B16.5, Class 150, R.F., slip-on. See Note 1, Note 3
BOLTS & NUTS			Designation B3 in Standard 23 05 08
BLIND FLANGES	2 ½ to 12	Bolted	Galvanized carbon steel, ASTM A285 Gr. C, OD, thickness c/w S.S., lining, ASTM 240 Type 316L, No. 1 finish, 1/16" thick, OD = Vanstone Ring face OD, continuous weld to C.S. flange plate.
GASKETS	½ to 6 8 to 12		1/16" thickness 1/8" thickness Compressed synthetic fibres, non-asbestos, NBR binder, anti-stick releasing agents both sides, ANSI B16.21 self-centering flat ring. Maximum pressure 1500 psig. Identifiable under ASTM F-104. Buna N or Approved Equal.
BRANCH CONN.	½ to 2	Welded x Thr'd	On ¾ to 12: Weld on th'olet. (also for instrument connection)
	all sizes	B.W. & BW.	Equal dia. to run pipe: Equal Tee.

Part 3 EXECUTION



3.1 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of Consultant.
 - .2 Remove defective materials from site as directed by Consultant. Pipes and fittings to be clean and dry.

3.2 INSTALLATION

- .1 Install pipes in accordance with manufacturer's recommendations.
- .2 Join pipes in accordance with manufacturer's recommendations.
- .3 Avoid damage to pipes in handling and moving pipe.
- .4 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .5 Align pipes carefully before jointing.
- .6 Joint deflection permitted within limits in accordance with pipe manufacturer's written recommendations.
- .7 Keep pipe and pipe joints free from foreign material.

3.3 FIELD TESTING

- .1 Testing of piping to be carried out in presence of Consultant.
- .2 Strut and brace caps, bends and tees, to prevent movement when test pressure is applied.
- .3 Expel air from piping, by slowly filling main with water.
- .4 Apply hydrostatic test pressure of 75 psig (1.5 times dead head pressure of pump) based on elevation of lowest point in line and corrected to elevation of test gauge for leakage test.
- .5 Apply pressure for 2 hour for leakage test.
- .6 Examine exposed pipe, joints and fittings while system is under pressure.
- .7 Remove defective joints, pipe and fittings and replace with new sound material.
- .8 Repeat test until no leakage found in full length of piping.

3.4

CLEANING

- .1 Progress Cleaning: clean in accordance with Section 21 05 01,
 - .1 Leave Work area clean at end of each day.
- .2 Upon completion of Work, remove waste materials and debris in accordance to Section 21 05 01.

END OF SECTION

Part 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 32 32 13.13 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C900-07, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inch Through-12 Inch (100 mm-300 mm), for Water Transmission and Distribution.
 - .2 ASTM International
 - .1 ASTM D 698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort ((12,400 ft-lbf/ft³) (600kN-m/m³)).
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.
 - .4 CSA International
 - .1 CSA B137 Series – 09, Thermoplastic Pressure Piping Compendium.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule Work to minimize interruptions to existing services.
 - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
 - .3 Notify Consultant and building manager or superintendent 24 hours minimum in advance of any interruption in service.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 21 05 01.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:

- .1 Indicate on drawings proposed method for installing carrier pipe for undercrossings.
- .4 Certificates:
 - .1 Certification to be marked on pipe.
- .5 Manufacturer's Instructions: submit to Consultant 1 copy of manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 21 05 01 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 POLYETHYLENE PRESSURE PIPES (PRE-INSULATED):

- .1 The pipe shall be pre-insulated complete with integral conduit for electrical heat trace cable and outer jacket.
 - .1 Pipe Type/Series: HDPE SDR 17 to CSA B137.
 - .2 Joints: thermal butt fusion or flanged with steel backing flanges where indicated.
 - .3 Insulation: 2" Rigid polyurethane foam, factory applied.
 - .1 Density: (ASTM D 1622) (2.2 to 3.0 lbs/ft³)
 - .2 Insulated pipe joints shall consist of prefabricated rigid polyisocyanurate or urethane foam half shells supplied complete with:
 - .1 Urecon Slipjoint allowing for expansion and contraction by having one end fixed while the other end is free to slide. It is comprised of 0.125 inch wall split polyethylene casing, stainless steel bands and band-it clips for above grade applications.
 - .4 Polyethylene Fittings: to CSA B137, for pipe sizes 4" and less.
 - .1 Insulation of associated joints, fittings and accessories shall be per pipe manufacturer's installation recommendations.
 - .2 Include factory supplied field applied insulation kits for insulation of fittings.

- .5 Outer Jacket: PE extruded
 - .1 The outer protective jacket on the casing system shall consist of high density polyethylene copolymer black PE, UV inhibited, factory applied as per the following specifications:
 - .1 Minimum cell classification 435560A for PE as per ASTM D 3350,
 - .2 Minimum 2% carbon black, well dispersed,
 - .3 Density 0.953 gm/cc ASTM D 4883,
 - .4 Tensile Strength at yield (2 inch) 3,700 psi, ASTM D 638,
 - .5 Minimum recommended PE extruded jacket thickness (above grade application)
 - .1 Jacket OD < 12 inch @ 0.125 inch
- .6 Electric Heat Tracing System:
 - .1 The electric tracing system and associated controls shall be as per the manufacturer's recommendations. All tracing cables and related accessories to be CSA approved and comply with CSA heat-tracing standard C22.2 No. 130-03.
- .2 Acceptable Product:
 - .1 Urecon Pre-Insulated HDPE Pipe complete with PE extruded jacket with U.I.P. system or approved equal.

Part 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewer pipe installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- .1 Pipes and fittings to be clean and dry.

3.3 INSTALLATION

- .1 Install pipes in accordance with manufacturer's recommendations.
- .2 Join pipes in accordance with manufacturer's recommendations.

- .3 Avoid damage to pipes in handling and moving pipe.
- .4 Maintain grade and alignment of pipes.
- .5 Align pipes carefully before jointing.
- .6 Joint deflection permitted within limits in accordance with pipe manufacturer's written recommendations.
- .7 Keep pipe and pipe joints free from foreign material.

3.4 FIELD TESTING OF FORCE MAIN

- .1 Testing of force main to be carried out in presence of Consultant.
- .2 Strut and brace caps, bends and tees, to prevent movement when test pressure is applied.
- .3 Expel air from force main, by slowly filling main with water.
- .4 Apply hydrostatic test pressure of 25 psig (1.5 times dead head pressure of pump) based on elevation of lowest point in line and corrected to elevation of test gauge for leakage test.
- .5 Apply pressure for 2 hour for leakage test.
- .6 Examine exposed pipe, joints and fittings while system is under pressure.
- .7 Remove defective joints, pipe and fittings and replace with new sound material.
- .8 Repeat test until no leakage found in full length of force main.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 21 05 01,
 - .1 Leave Work area clean at end of each day.
- .2 Upon completion of Work, remove waste materials and debris in accordance to Section 21 05 01.

END OF SECTION