JRP ENGINEERING
PROFESSIONAL ENGINEERS

Addendum M1

To: Ross rj Boyle
Architect

From: Philipp Puetz
JRP Engineering

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Reference: [PT3043] Safety Access to Tarmac

This Addendum forms part of the contract documents and is to be read, interpreted, and coordinated with all other parts. The cost of all contained herein is to be included in the contract sum. The following revisions supersede the information contained in the original drawings and specifications issued for the above-named project to the extent referenced and shall become part thereof. Acknowledge receipt of this Addendum by inserting its number and date on the Tender Form. Failure to do so may subject the Bidder to disqualification.

Additions

1. Refer to attached M/E/S specification package.

END OF ADDENDUM

9 Holgate Court, Kanata, ON, K2K 1B4 Tel.: (613) 266-8226 E-mail : admin@jrpeng.com

PTS 3043 - SAFETY ACCESS TO TARMAC

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PART 1 – GENERAL

1.1 Related Sections

.1 Section 03 20 00 Concrete Reinforcing

.2 Section 03 30 00 Cast-In Place Concrete

1.2 References

.1 Canadian Standards Association (CSA)

.1 CAN/CSA-A23.1-00, Concrete Materials and Methods of Concrete Construction.

.2 CAN/CSA-O86.1-00, Engineering Design in Wood (Limit States Design).

.3 CSA O121-M1978 (R2003), Douglas Fir Plywood.

.4 CSA O151-04, Canadian Softwood Plywood.

.5 CAN3-O188.0-M78, Standard Test Methods for Mat-Formed Wood Particleboards and Waferboard.

.6 CSA O437 Series-93 (R2006), Standards for OSB and Waferboard.

.7 CSA S269.1-1975(R2003), Falsework for Construction Purposes.

.8 CAN/CSA-S269.3-M92(R2003), Concrete Formwork.

.9 CAN/ULC-S701-97 Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.2 Council of Forest Industries of British Columbia (COFI)

.1 COFI Exterior Plywood for Concrete Formwork.

.3 ACI

.1 ACI 302.1R.96 Guide for Concrete Floor and Slab Construction.

1.3 Shop Drawings

.1 Submit shop drawings for formwork and falsework in accordance with Division 1.

.2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, water stops, dovetail anchor slots, and locations of temporary embedded parts. Show size of tie hole, plastic plug, and plug recess. Comply with CSA S269.1, for falsework drawings Comply with CAN/CSA-S269.3 for formwork drawings.

.3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

.4 Indicate sequence of erection and removal of formwork/falsework as directed by SNC.

.5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

.6 Assume full responsibility for complete design and engineering of formwork including shoring and bracing to resist loads due to wet concrete, forms, wind and other forces arising from use of equipment to place concrete.

1.4 Delivery, Storage and Handling

.1 Store materials on site in a manner to prevent damage thereto. Protect from weather. Comply with CSA A23.1, Clause 9.

.2 Protect work of this Section from damage. Protect other work from damage resulting from this work. Replace damaged work which cannot be satisfactorily repaired.

PART 2 - PRODUCTS

2.1 Materials

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121 and CAN/CSA-O86.1.

.2 For concrete with special architectural features, use formwork materials to CAN/CSA-A23.1.

.1 New Sylvaform sealed overlaid plywood by MacMillan Bloedel Building Materials.

.2 Tubular column forms: round, spirally wound laminated fiber forms, internally treated with release material. Use seamless plastic liner for exposed columns.

.3 Form ties:

.1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 1" dia. in concrete surface.

.4 For Architectural concrete:

.1 Form Ties: Threaded internal disconnecting, spreader type, adjustable in length. Ties to have maximum breakback of 1- ½" from concrete surface. Ensure ties incorporate removable tapered plastic spreader cones, with setback of 1- ½". Ensure taper of spreader matches taper of tie hole plugs. Wire ties not permitted.

.2 Tie Hole Plugs: Plastic set back plugs, grey to match concrete, 1 – ½" setback, to fit tightly into tie holes. Include for tie hole plug quantity on basis of 30" each way plug spacing pattern.

.5 Form liner:

.1 Plywood: Douglas Fir to CSA O121 T and G.

.6 Form release agent: non-staining, chemically active release agent containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing set of film of concrete in contact with form.

.1 For temperatures less than 0^{o}C: Formwork Release Agent: Eucoslip by Euclid Admixture Canada Inc., C.R.A. by Sika Canada Inc., CPD Chemical Form Release Agent by CPD Construction Products or Duogard by W.R. Meadows of Canada Ltd.. For formed concrete work in contact with soil, use material that does not alter sulphate resistant qualities of concrete.

.2 For temperatures greater than 0^{o}C: Water Based Formwork Release Agent: Eucsolip VOX by Euclid Admixture Canada Inc. or Sealtight Duogard II by W.R. Meadows of Canada Ltd.

.7 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 0.03 to 0.04 in^2 at 40°C, flashpoint minimum 150°C, open cup.

.8 Falsework materials: to CSA-S269.1.

.9 Sealant: to Division 7.

.10 Waterstops: Extrusions of plasticized PVC low temperature compound to sizes and shapes indicated on drawings by W.R. Meadows of Canada Ltd., W.R. Grace and Co. of Canada Ltd., Coodco Ltd., CPD Construction Products or Sika Canada Inc.

.11 Dovetail Anchors and Slots: Minimum 24 ga overall thickness zinc coating Z275 galvanized steel dovetail anchor slots with fillers to prevent entry of concrete during placing and minimum 14 ga overall thickness. Zinc coating Z275 galvanized steel dovetail anchors. Anchors shall project to within 3/4" of masonry face.

.12 Mechanical Fasteners: Galvanized steel screw and washer with screw of length to secure insulation to formwork without penetrating concrete finish surface.

.13 Formwork Insulation: Extruded, expanded polystyrene, CAN/ULC-S701, Type 4, minimum RSI (R) value of 5.0 per 1", compressive strength 30 psi, thickness as indicated on Drawings.

PART 3 – EXECUTION

3.1 Fabrication and Erection

.1 Verify lines, levels and column centres before proceeding with formwork and ensure dimensions agree with drawings. Verify the locations of all inserts, anchor bolts, cast-ins, etc. with structural, architectural, mechanical, electrical, and shop drawings prior to proceeding with formwork. Report any discrepancies to SNC immediately.

.1 Construct forms to produce plumb and level concrete and true to linear building lines. Maximum variations (not accumulative) as follows:

.2 Variation from plumb in concrete surfaces not to exceed 1/4" in 10' nor 3/8" in 20' or more.

.3 Variation from level or grade indicated on Drawings for tops of walls not to exceed 1/4" in 10' nor 3/8" in 20' in building length.

.4 Variation of linear building lines from established position in plan and related positions of walls not to exceed 1/4" in 10', 3/8" in 1 bay nor 1" in building length.

.5 Variation of concrete slabs and toppings from dead level or slopes as indicated on Drawings not to exceed 1/8" in 10'.

.2 Obtain SNC's approval for use of earth forms framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect falsework in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.

.5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.

.6 Do not place shores and mud sills on frozen ground.

.7 Provide site drainage to prevent washout of soil supporting mud sills and shores.

.8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.

.9 Align form joints and make watertight. Keep form joints to minimum.

.10 Locate horizontal form joints for exposed columns 8'-0" above finished floor elevation.

.11 Use 1" chamfer strips on external corners and/or 1" fillets at interior corners, joints, unless specified otherwise.

.12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.13 Construct forms for architectural concrete to achieve the following:

.1 Water-tight forms at corners, panel joints, recesses, arises and at construction joints.

.2 Accurate alignment of concrete surfaces.

.3 Surfaces without indentations other than those indicated.

.4 Sharp and straight corners (unless other wise indicated).

.14 Build in anchors, sleeves, ties, bolts, nailers, templates, shelf angles and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.15 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

.16 If slip forming and flying forms are used, submit details of equipment and procedures for SNC's approval.

.17 Use full size contact form sheeting panels wherever possible. Install contact surfaces of formwork to produce neat and symmetrical joint patterns. Ensure joints are vertical or horizontal and, where possible, stagger to maintain structural continuity. Back vertical joints solidly and nail edges of abutting sheets to same stud. Likewise solidly back horizontal joints. Ensure adjacent form panels fit accurately, tight and flush. Use straightest available lumber.

.18 Align forms to ensure no visible defects appear on finished work.

.19 Locate wall form ties in accordance with reviewed shop drawings; align on a particular member both vertically and horizontally. Arrange reuse of form so tie holes are also reused. Tighten form ties, particularly at corners.

.20 Form slab soffits using full size panels where possible. Keep number of smaller size panels to minimum.

.21 Take particular care in forming corners and openings. Ensure formwork is tight and braced so no movement occurs.

.22 Use templates to secure and align anchor bolts in formwork prior to placement of the concrete. Report any interference with reinforcing or other inserts to SNC prior to the placement of the concrete. Concrete should not be placed until interference issues are resolved in writing by the SNC.

.23 For walls and shear walls, leave one side of form open for review of reinforcing steel. Close form only after SNC has reviewed bar placement.

3.2 Removal and Reshoring

.1 Leave formwork in place for following minimum periods of time after placing concrete. Proposed removal times to be approved by SNC in writing prior to work.

.1 3 days for walls and sides of beams.

.2 3 days for columns.

.3 28 days for beam soffits, slabs, decks and other structural members, or 3 days when replaced immediately with

adequate shoring to standard specified for falsework, and when concrete has reached at least 75% of specified 28 day strength.

.4 3 days for footings and abutments.

.2 Remove formwork when concrete has reached 75 % of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

.3 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.4 Space reshoring in each principal direction at not more than 10'-0" apart.

.5 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.

.6 Strip fibre forms off architectural concrete 2 Days after placing, using power operated saw. To strip form, set power saw blade slightly less than thickness of the form, make 2 vertical cuts and remove form. Then, using broad bladed tool, carefully pry form off with short strokes by pushing handle toward column. Exercise care so not to mar concrete surface. After stripping, replace form halves on column and wire in place to protect column during construction. Leave around columns until after scaffolding and other formwork have been removed at end of construction to ensure column protection.

.7 Be responsible for safety of structure, both before and after removal of forms until concrete has reached its specified 28 Day compressive strength.

.8 Take particular care when removing forms to ensure no damage occurs at corners, arises and the like.

.9 To help avoid colour variations in architectural concrete, ensure length of time between concrete placing and form removal is approximately same for each portion of work.

.10 In hot weather, wood forms remaining in place should not be considered adequate for curing but should be removed or loosened so concrete surfaces may be kept moist or coated with curing agent.

.11 In cold weather, defer removal of formwork or insulate formwork, to avoid thermal shock and consequent cracking of concrete surface.

.12 Install tie hole plugs immediately following removal of spreader cones. Install to a snug fit, maximum setback from concrete surface as specified.

.13 When concrete is dry, install temporary polyethylene rope in reglets to prevent contamination of same.

3.3 Construction Joints

.1 Form construction joints where required and where indicated. Construction joints shall conform to CSA A23.1, Clause 20.

.2 Form 2" x 4" beveled shear keys full length on construction joints, unless detailed otherwise.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Submittals: in accordance with Section 01 00 10 – General Instructions.

.2 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.4 Closeout Submittals:

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 00 10 – General Instructions.
- .2 Operation and maintenance manual approved by, and final copies deposited with, Engineer 2 weeks before final inspection.
- .3 Operation data to include:
  - .1 Control schematics for systems including environmental controls.
  - .2 Description of systems and their controls.
  - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
  - .4 Operation instruction for systems and component.
  - .5 Description of actions to be taken in event of equipment failure.
  - .6 Valves schedule and flow diagram.
  - .7 Colour coding chart.
- .4 Maintenance data to include: Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
  - .1 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:

.1 Submit 3 copies of draft Operation and Maintenance Manual to Engineer for approval. Submission of individual data will not be accepted unless directed by Engineer.

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

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

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

.2 Use different colour waterproof ink for each service.

.3 Make available for reference purposes and inspection.

.9 As-built drawings:

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

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

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

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

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

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

1.2 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 00 10 – General Instructions.

1.3 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 00 10 – General Instructions.

Part 2 Products

2.1 MATERIALS

.1 Materials and products in accordance with Section 01 00 10 – General Instructions.

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 01 00 10 – General Instructions.

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

.3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 00 10 – General Instructions .

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work.

3.4 DEMONSTRATION

.1 Engineer will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

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

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

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

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 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 C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.2 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.3 ASTM C547-2003, Mineral Fiber Pipe Insulation.

.4 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 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 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 01010 – General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section01010. Include product characteristics, performance criteria, and limitations.

1.5 QUALITY ASSURANCE

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

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01010.

1.6 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

1.7 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 C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.

.2 Maximum "k" factor: to CAN/ULC-S702.

1.8 INSULATION SECUREMENT

.1 Contact adhesive: quick setting.

.2 Canvas adhesive: washable.

.3 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

1.9 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

Part 2 Execution

2.1 MANUFACTURER'S INSTRUCTIONS

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

2.2 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.

2.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

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

.3 Use two layers with staggered joints when required nominal 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.

2.4 PIPING INSULATION SCHEDULES

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

.2 TIAC Code: A-1.

.1 Securements: SS bands at 300 mm on centre.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code 1501-H.

.3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket

.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

.5 Thickness of insulation as listed in following table.

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Domestic HWS		A-1	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
RWL		C-2	25	25	25	25	25	25

.6 Finishes:

.1 Exposed indoors: canvas.

.2 Exposed in mechanical rooms: canvas.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Installation: to appropriate TIAC code CRF/1 through CPF/5.

2.5 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 SUMMARY

.1 Section Includes:

.1 Materials and installation for wet pipe fire protection and sprinkler systems for heated areas.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)ANSI/NFPA 13-2002, Installation of Sprinkler Systems.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SAMPLES

.1 Submit samples of following:

.1 Each type of sprinkler head.

.2 Signs.

1.4 DESIGN REQUIREMENTS

.1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13.

.2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.

.3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings. Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.

.4 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

.5 Location of Sprinkler Heads:

.1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.

.2 Uniformly space sprinklers on branch.

.6 Water Distribution:

.1 Make distribution uniform throughout the area in which sprinkler heads will open.

.2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.

1.5 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 10 – General Instructions.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 00 10 – General Instructions.

.1 Indicate:

.1 Materials.

.2 Finishes.

.3 Method of anchorage

.4 Number of anchors.

.5 Supports.

.6 Reinforcement.

.7 Assembly details.

.8 Accessories.

.3 Closeout Submittals:

.1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 00 10 – General Instructions.

.2 Manufacturer's Catalog Data, including specific model, type, and size for:

.1 Pipe and fittings.

.2 Sprinkler heads.

.3 Pipe hangers and supports.

.4 Pressure or flow switch.

.3 Design Data:

.1 Calculations of sprinkler system design.

.2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.

.4 Field Test Reports: Preliminary tests on piping system.

.5 Records:

.1 As-built drawings of each system.

.1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.

.6 Operation and Maintenance Manuals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 00 10 – General Instructions.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in wet sprinkler systems with documented experience and approved by manufacturer.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 00 10 – General Instructions.

1.7 MAINTENANCE

.1 Extra Materials: Provide maintenance materials in accordance with Section 01 00 10 – General Instructions.

.1 Provide spare sprinklers and tools as required by ANSI/NFPA 13.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 00 10 – General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Storage and Protection:

.1 Store materials indoors in dry location.

.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

Part 2 Products

2.1 ABOVE GROUND PIPING SYSTEMS

.1 Provide fittings for changes in direction of piping and for connections.

.1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.

.2 Perform welding in shop; field welding will not be permitted.

.3 Conceal piping in areas with suspended ceiling.

2.2 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous: to ANSI/NFPA 13.

.2 Copper tube: to ANSI/NFPA 13.

.2 Fittings and joints to ANSI/NFPA 13:

.3 Valves:

.1 ULC listed for fire protection service.

.4 Pipe hangers:

.1 ULC listed for fire protection services in accordance with NFPA.

2.3 SPRINKLER HEADS

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

.2 Sprinkler Head Type:

.1 Type D: recessed polished, fusible link type with ring and cup.

2.4 SUPERVISORY SWITCHES

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

.2 Valves:

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

.3 Pressure or flow switch type:

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

.2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.

.3 Connect into building fire alarm system.

.4 Connection of switch: Section 28 31 01 - Fire Alarm Systems.

.4 Pressure alarm switch:

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

2.5 SPARE PARTS CABINET

.1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

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

3.3 PIPE INSTALLATION

.1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.4 Inspect piping before placing into position.

3.4 ELECTRICAL CONNECTIONS

.1 Provide electrical work associated with this section under Section 26 05 00 - Electrical General Requirements.

.2 Provide fire alarm system under Section 28 31 01 - Fire Alarm System.

.3 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.

.4 Provide wiring in rigid metal conduit or intermediate metal conduit.

3.5 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

.1 Notify Contracting Officer in writing at least 10 days prior to connection date.

.2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.

.3 Bolt sleeves around main piping.

.4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.

.5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

3.6 FIELD QUALITY CONTROL

.1 Site Test, Inspection:

.1 Perform test to determine compliance with specified requirements in presence of Consultant.

.2 Test, inspect, and approve piping before covering or concealing.

.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 SECTION INCLUDES

.1 Materials and installation for copper domestic water service used in the following:

.1 Copper incoming domestic water service, up to NPS 2 1/2.

.2 Hard drawn copper domestic hot and cold water services inside building.

.3 Soft copper tubing inside building.

1.2 REFERENCES

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

.1 ANSI/ASME B16.15-2011, Cast Bronze Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

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

.1 ASTM B88M-2011, Standard Specification for Seamless Copper Water Tube (Metric).

.3 Canadian Standards Association (CSA International).

.1 CSA B242-2011, Groove and Shoulder Type Mechanical Pipe Couplings.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

.1 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.

.6 National Research Council (NRC)/Institute for Research in Construction.

.1 National Plumbing Code of Canada (NPCC) - 2010.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 00 10 - General Instructions.

.2 Submit product data for following: valves.

.3 Provide maintenance data for incorporation into manual specified in Section 01 00 10 - General Instructions.

1.4 FITTINGS

.1 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.2 Cast copper, solder type: to ANSI/ASME B16.18.

.3 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.4 NPS 2 and larger: roll grooved to CSA B242.

1.5 JOINTS

.1 Solder: lead free tin copper alloy.

.2 Teflon tape: for threaded joints.

.3 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.

.4 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

1.6 GATE VALVES

.1 NPS 2 and under, soldered:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc..

.2 NPS 2 and under, screwed:

.1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc.

.3 NPS 2-1/2, in mechanical rooms, flanged:

.1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim.

.4 NPS 2-1/2, other than mechanical rooms, flanged:

.1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet.

1.7 SWING CHECK VALVES

.1 NPS 2 and under, soldered:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.

.2 NPS 2 and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.

.3 NPS 2-1/2, flanged:

.1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrind seat, bronze disc, bolted cap.

BALL VALVES

.4 NPS 2 and under, screwed:

.1 Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle.

.5 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors.

Part 2 Execution

2.1 INSTALLATION

.1 Install in accordance with NPCC, OBC and local authority having jurisdiction.

.2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install DCW piping below and away from DHW and other hot piping so as to maintain temperature of cold water as low as possible.

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

2.2 VALVES

.1 Isolate equipment, fixtures and branches with valves.

2.3 PRESSURE TESTS

.1 Conform to requirements of Section 23 05 01 - Common Work Results - Mechanical.

.2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

2.4 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean of copper to Federal potable water guidelines. Let system flush for additional 2 h, then draw off another sample for testing.

2.5 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

2.6 DISINFECTION

.1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality for Departmental Representative for approval.

2.7 START-UP

.1 Timing: Start up after:

.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.
.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.
.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
.3 Bring DHW storage tank up to design temperature slowly.
.4 Monitor piping DCW and DHW piping systems for freedom of movement, pipe expansion as designed.
.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

2.8 PERFORMANCE VERIFICATION

.1 Timing:

.1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.

.2 Procedures:

.1 Sterlize DCW and DHW systems for Legionella control.
.2 Verify compliance with safety and health requirements.
.3 Check for proper operation of water hammer arrestors. Run furthest outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

2.9 OPERATION REQUIREMENTS

.1 Operational requirements include:

.1 Cleaning materials and schedules.
.2 Repair and maintenance materials and instructions.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 The installation of drainage waste and vent piping.

1.2 REFERENCES

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

.1 ASTM B32-2008, Specification for Solder Metal.
.2 ASTM B306-2013, Specification for Copper Drainage Tube (DWV).
.3 ASTM C564-2012, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA International).

.1 CAN/CSA-B70-2012, Cast Iron Soil Pipe, Fittings and Means of Joining.
.2 CAN/CSA-B125-2001, Plumbing Fittings.

1.3 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 00 01 10 - General Instructions.

Part 2 Products

2.1 MATERIAL

2.2 COPPER TUBE AND FITTINGS

.1 Above ground sanitary, storm and vent to: ASTM B306.

.1 Fittings.
.1 Cast brass: to CAN/CSA-B125.
.2 Wrought copper: to CAN/CSA-B125.
.2 Solder: lead free, tin-95:5 to ASTM B32.

2.3 CAST IRON PIPING AND FITTINGS

.1 Buried sanitary, storm and vent minimum NPS 3, to CAN/CSA-B70.

.1 Joints.
.1 Mechanical joints.
.1 Neoprene or butyl rubber compression gaskets: to ASTM C564 or CAN/CSA-B70.
.2 Stainless steel clamps.

.2 Hub and spigot.

.1 Caulking lead: to CSA B67.

.2 Cold caulking compounds.

.2 Above ground sanitary, storm and vent to CAN/CSA-B70.

.1 Joints.

.1 Hub and spigot.

.1 Caulking lead: to CSA B67.

.2 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 Execution

3.1 INSTALLATION

.1 In accordance with Section 23 05 01 - Installation of Pipework.

.2 Install in accordance with National Plumbing Code of Canada.

3.2 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify that cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.

.2 Ensure weirs are correctly sized and installed correctly.

.3 Verify provisions for movement of roof system.

.4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2No.110-2009, Construction and Test of Electric Storage Tank Water Heaters.

.2 CAN/CSA-C191 Series-2000, Performance of Electric Storage Tank Water Heaters for Household Service.

.3 CAN/CSA-C309-M90-2009, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 00 10 - General Instructions.

.2 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance and engineering data for incorporation into manual specified in Section 01 00 10 - General Instructions.

Part 2 Products

2.1 ELECTRIC

.1 To CAN/CSA C22.2 No.110, CAN/CSA-C191 and CAN/CSA-C309

.2 Refer to Drawing M-2 for Hot Water Heater Details

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

3.2 FIELD QUALITY CONTROL

.1 Manufacturer's factory trained, certified Engineer to start up [and commission] DHW heaters.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for plumbing specialties and accessories.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.2 Plumbing and Drainage Institute (PDI).

.1 PDI-WH201-2010, Water Hammer Arresters Standard.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 00 01 10 - General Instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.

.2 Indicate dimensions, construction details and materials for specified items.

.3 Shop Drawings:

.1 Submit shop drawings to indicate materials, finishes, construction and assembly details and accessories.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 00 01 10 - General Instructions, include:

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

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 00 10 - General Instructions.

Part 2 Products

2.1 FLOOR DRAINS

.1 Floor Drains to CSA B79.

.2 Refer to Plumbing Equipment Schedule on Drawing M-2.

2.2 ROOF DRAINS

.1 Controlled flow, aluminum body, under deck clamp and sump receiver to suit roof construction, flashing clamp ring with integral gravel stop, bearing pan, flow control weir assembly, polyethylene dome.

2.3 CLEANOUTS

.1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

.2 Access Covers:

.1 Wall Access: face or wall type, stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.

.2 Floor Access: Refer to Plumbing Equipment Schedule on Drawing M-2

2.4 WATER HAMMER ARRESTORS

.1 Stainless steel construction, piston type: to PDI-WH201.

2.5 TRAP SEAL PRIMERS

.1 Brass, with integral vacuum breaker, NPS1/2 solder ends, NPS1/2 drip line connection.

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 data sheet.

3.2 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada and local authority having jurisdiction.

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

3.3 CLEANOUTS

.1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

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

.3 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.4 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

3.5 TRAP SEAL PRIMERS

.1 Install for floor drains.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space.

.3 Install soft copper tubing to floor drain.

3.6 START-UP

.1 Timing: start-up only after:

.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.

.2 Provide continuous supervision during start-up.

3.7 TESTING AND ADJUSTING

.1 Timing:

.1 After start-up deficiencies rectified.
.2 After certificate of completion has been issued by authority having jurisdiction.

.2 Floor drains:

.1 Verify operation of trap seal primer.
.2 Prime, using trap primer. Adjust flow rate to suit site conditions.
.3 Check operations of flushing features.
.4 Check security, accessibility, removeability of strainer.
.5 Clean out baskets.

.3 Roof drains:

.1 Check location at low points in roof.
.2 Check security, removeability of dome.
.3 Adjust weirs to suit actual roof slopes, meet requirements of design.
.4 Clean out sumps.
.5 Verify provisions for movement of roof systems.

.4 Access doors:

.1 Verify size and location relative to items to be accessed.

.5 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.6 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

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

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

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

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

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

3.3 DRAINS

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

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

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

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

3.4 DIELECTRIC COUPLINGS

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

.2 Locations: Where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

3.5 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

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

.6 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.7 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.8 Install, except where indicated, to permit separate thermal insulation of each pipe.

.9 Group piping wherever possible and as indicated.

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

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

.12 Provide for thermal expansion as indicated.

.13 Valves:

- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above horizontal position unless otherwise indicated.
- .4 Valves accessible for maintenance without removing adjacent piping.
- .5 Use gate or ball valves at branch take-offs for isolating purposes except where otherwise specified.

.14 Check Valves:

- .1 Install swing check valves as indicated.

3.6 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

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

.2 Other floors: Terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.7 ESCUTCHEONS

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

.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.8 PREPARATION FOR FIRESTOPPING

.1 Uninsulated unheated pipes not subject to movement: No special preparation.

.2 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.

.3 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.9 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

.2 Before start-up, clean interior of piping.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.10 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Owner.

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

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

.4 Ensure daily clean-up of existing areas.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

.2 Sustainable requirements for construction and verification.

1.2 REFERENCES

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

.1 ANSI/ASME B31.1-04, Power Piping.

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

.1 ASTM A125-1996(R2001), Specification for Steel Springs, Helical, Heat-Treated.

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

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

.3 Factory Mutual (FM)

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

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

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.6 Underwriter's Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:

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

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

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

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

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

.2 Performance Requirements:

.1 Design supports, platforms, catwalks, hangers, to withstand seismic events as specified Section 23 05 49 - Seismic Restraint Systems (SRS) - Type P2 Buildings.

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 00 01 10 – General Instructions.

.2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

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

.1 Bases, hangers and supports.
.2 Connections to equipment and structure.
.3 Structural assemblies.

.4 Quality assurance submittals: submit following in accordance with Section 01 00 10 – General Instructions.

.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.

.5 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 00 10 – General Instructions.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 00 10 – General Instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 00 10 – General Instructions.
.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

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

2.2 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

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 in accordance with manufacturer's instructions and recommendations.

3.3 HANGER SPACING

.1 Fire protection: to applicable fire code.

.2 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

3.4 HANGER INSTALLATION

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

.2 Adjust hangers to equalize load.

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

3.5 HORIZONTAL MOVEMENT

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

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

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

3.7 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Seismic restraint systems for statically supported and vibration isolated equipment and systems; electrical light fixtures, transformers, fire protection, equipment and systems, both vibration isolated and statically supported.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 National Building Code of Canada (NBC)

1.3 DEFINITIONS

.1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.

.2 SRS: acronym for Seismic Restraint System.

1.4 SYSTEM DESCRIPTION

.1 SRS fully integrated into, and compatible with:

.1 Noise and vibration controls specified elsewhere.
.2 Structural, mechanical, electrical design of project.

.2 Systems, equipment not required to be operational during and after seismic event.

.3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.

.4 Designed by Professional Engineer specializing in design of SRS and registered in Province of Ontario.

1.5 SUBMITTALS

.1 Submittals: in accordance with Section 01 00 10 - General Instructions.

.2 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.3 Submit design data including:

.1 Full details of design criteria.

.2 Working drawings (prepared to same standard of quality and size as documents forming these bid documents), materials lists, schematics, full specifications for components of each SRS to be provided.

.3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).

.4 Separate shop drawings for each SRS and devices for each system, equipment.

.5 Identification of location of devices.

.6 Schedules of types of SRS equipment and devices.

.7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.

.8 Installation procedures and instructions.

.9 Design calculations including restraint loads to NBC and Supplement.

.10 Simplified, Detailed work sheets, tables.

.11 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract Documents, materials lists, design calculations, schematics, specifications.

.4 Submit additional copy of shop drawings and product data to Structural Engineer for review of connection points to building structure.

1.6 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 00 01 10 - General Instructions.

Part 2 Products

2.1 SRS MANUFACTURER

.1 SRS from one manufacturer regularly engaged in SRS production.

2.2 GENERAL

.1 SRS to provide gentle and steady cushioning action and avoid high impact loads.

.2 SRS to restrain seismic forces in every direction.

.3 Fasteners and attachment points to resist same load as seismic restraints.

.4 SRS of Piping systems compatible with:

.1 Expansion, anchoring and guiding requirements.

.2 Equipment vibration isolation and equipment SRS.

.5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.6 Attachments to RC structure:

.1 Use high strength mechanical expansion anchors.

.2 Drilled or power driven anchors not permitted.

.7 Wet pipe sprinkler systems: refer to Section 21 13 13 - Wet Pipe Sprinkler Systems.

.8 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

.1 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Install tight to structure.

.2 Cross-brace in every direction.

.3 Brace back to structure.

.4 Slack cable restraint system.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

.1 Floor mounted equipment, systems:

.1 Use one or combination of following methods:

.1 Vibration isolators with built-in snubbers.

.2 Vibration isolators and separate snubbers.

.2 SRS to resist complete isolator unloading.

.3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.

.4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Slack cable restraint system.

.2 Brace back to structure via vibration isolators and snubbers.

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

.1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

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 Attachment points and fasteners:

.1 To withstand same maximum load that seismic restraint is to resist and in every direction.

.2 Slack Cable Systems (SCS):

.1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.

.2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.

.3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.

.4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.

.5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.

.6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

.7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.

.3 Install SRS at least 25 mm from equipment, systems, services.

.4 Miscellaneous equipment not vibration-isolated:

.1 Bolt through house-keeping pad to structure.

.5 Co-ordinate connections with other disciplines.

.6 Vertical tanks:

.1 Anchor through house-keeping pad to structure.

.2 Provide steel bands above centre of gravity.

.7 Horizontal tanks:

.1 Provide at least two straps with anchor bolts fastened to structure.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After delivery and storage of Products.

.2 After preparatory work is complete but before installation commences.

.3 Twice during the installation, at 25% and 60% completion stages.

.4 Upon completion of installation.

.3 Submit manufacturer's reports to Engineer within 3 days of manufacturer representative's review.

.2 Inspection and Certification:

.1 SRS: inspected and certified by Seismic Engineer upon completion of installation.

.2 Provide written report to Engineer with certificate of compliance.

.3 Commissioning Documentation:

.1 Upon completion and acceptance of certification, hand over to Engineer complete set of construction documents, revised to show "as-built" conditions.

END OF SECTION

PART 1 - GENERAL

1.1 References

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

1.2 Samples

.1 Submit samples in accordance with Section 00 01 10.

.2 Submit samples and lists in accordance with section 00 01 10 of proposed wording for approval before engraving.

PART 2 - PRODUCTS

2.1 Manufacturers Nameplates

.1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.

.2 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.2 System Nameplates

.1 Colour:
.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, square corners, letters accurately aligned and machine engraved into core.

2.2 System Nameplates (cont'd)

.3 Sizes:

.1 Conform to following table:

Size #	Dimensions (mm x mm)	No. of Letter Lines	Height (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 200	1	8
6	20 x 100	2	5
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use average of 25 letters/numbers (maximum) per nameplate.

.3 Use size #6 for terminal cabinets and control panels.

.4 PMSS identification:

.1 General: use system of Main Identifier, Source Identifier, Destination Identifier.

.2 Equipment and Mechanical Rooms: Main Identifier: size #9; Source and Destination Identifiers: size #5.

.3 Elsewhere: Sizes as appropriate.

2.3 Piping

.1 General:

.1 To CAN/CGSB 24.3.

.2 Identify medium by lettered legend, classification by primary and secondary colours, direction of flow by arrows.

.2 Sizes:

.1 Legend: block capitals to following table:

Outside Dia. of Pipe or Insulation mm	Size of Letters mm
30	13
50	19
150	32
250	63
Over 250	88

2.3 Piping (cont'd)

.2 Primary colour bands:
.1 At valves and fittings: 500 mm long.
.2 Elsewhere: 1000 mm long.

.3 Secondary colour bands: 50 mm wide, 75 mm in from one end of primary colour band.

.4 Arrows:
.1 Outside diameter of pipe/insulation 75 mm and greater: 150 mm long x 50 mm high.
.2 Outside diameter of pipe/insulation less than 75 mm: 100 mm long x 50 mm high.
.3 Use double headed arrows where flow is reversible.

.3 Material:
.1 Paint: to CAN/CGSB-1.60.
.2 Legend markers, arrows and colour bands: pressure sensitive plastic coated cloth with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C. Apply to dry, clean prepared surfaces. Wrap tape around pipe or pipe covering with ends overlapping 1 pipe diameter.
.3 Waterproof and heat resistant pressure sensitive plastic marker tags: for pipes and tubing 20 mm nominal and smaller.

.4 Colours:
.1 Where not covered by table below, submit legend, primary and secondary classification colours to Engineer for approval.

.5 Table:

.1 Pipe and valve identification.

Pipe Marker Legend	Valve Tag Legend	Colour	Primary Colour	Secondary Colour
Fire protection water	F.P.W	Red	White	

.2 Legend and arrows:
.1 Black or white to contrast with primary colour.
.2 Fire protection: white on red background.

2.4 Ductwork

.1 50 mm high black stencilled letters and directional flow arrows 150 mm long x 50 mm high.

2.5 Valves and Controllers

.1 Brass tags with 12 mm stamped code lettering and numbers.

.2 Furnish Engineer with six identification flow diagrams of approved size for each system. Include valve tag schedule, designating number, service, function and location of each tagged item and normal operating position of valves.

2.6 Controls Identification

.1 Refer to Div. 13.

2.7 Language

.1 Identification to be English and French.

.2 Use one nameplate or label for both languages.

PART 3 - EXECUTION

3.1 General

.1 Do identification work in accordance with CAN/CGSB-24.3 except where specified otherwise.

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

.3 Identify systems and equipment to conform to PWGSC, PMSS.

3.2 Location of Nameplates

.1 In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and/or system.

.2 Provide stand-offs for nameplates on hot surfaces and insulated surfaces.

.3 Do not insulate or paint over plates.

3.4 Ductwork

.1 Stencil over final finish only.

.2 Locations of ductwork identification:

.1 On long straight runs in open areas in boiler rooms, equipment

rooms, galleries, and tunnels so that at least one is clearly visible from any one viewpoint in operating areas or walking isles and not at more than 17 m intervals.

.2 Adjacent to all changes in direction.

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

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

.5 On both sides of any separation such as walls, floors and partitions.

.6 Where ductwork is concealed in duct chase, gallery or other confined space, at entry and leaving points and adjacent to each access opening.

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

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

.9 Legend to be easily and accurately readable from usual operating areas and all readily accessible points.

.10 Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

.11 Beside each access door.

3.5 Valves and Controllers

.1 Secure tags with non-ferrous chains or closed "S" hooks for valves and operating controllers.

.2 Install copies of flow diagram and valve schedule mounted in frame with non-glare glass where directed by Engineer. Provide one copy in each operating and maintenance instruction manual.

.3 Consecutively number valves in system.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Engineer within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.4 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.5 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.6 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.7 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Engineer adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Engineer in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

1.9 START OF TAB

.1 Notify Engineer 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 Outlets installed, volume control dampers open.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5%, minus 5%.

1.11 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Engineer list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Engineer.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

1.15 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit 6 copies of TAB Report to Engineer for verification and approval, in both official languages in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Engineer.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Engineer.

.4 Pay costs to repeat TAB as required to satisfaction of Engineer.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Engineer, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Engineer.

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB, SMACNA, ASHRAE.

.2 Do TAB of systems, equipment, components, controls specified Division 23

.3 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

1.21 POST-OCCUPANCY TAB

.1 Measure DBT, WBT or %RH, air velocity, air flow patterns, NC levels, in occupied areas.

.2 Participate in systems checks twice during Warranty Period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of Warranty Period.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

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- 2010

.2 American Society for Testing and Materials (ASTM).
.1 ASTM C 335- 95, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
.2 ASTM C 921-89 (1996), Practice for Determining the Properties Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-51.10- 92, Mineral Fibre Board Thermal Insulation.
.2 CGSB 51-GP-52Ma- 89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Manufacturer's Trade Associations.
.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.5 Underwriters Laboratories of Canada (ULC)
.1 CAN/ULC-S102- M88, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 DEFINITIONS

.1 For purposes of this section:
.1 "CONCEALED" - insulated mechanical services and equipment in 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, and other accessories.

.2 TIAC Codes:
.1 CRD: Code Round Ductwork,
.2 CRF: Code Rectangular Finish.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01010

.4 Store at temperatures and conditions required by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

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

2.2 INSULATION

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

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

.3 TIAC Code C-1: Rigid mineral fibre board to CAN/CGSB51.10, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

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

2.3 JACKETS

.1 Canvas:
- .1 220 gm/m 2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.3 Aluminum:
- .1 To ASTM B 209 with moisture barrier as scheduled in PART 3 of this section.
- .2 Thickness: 0.50 mm sheet.
- .3 Finish: Corrugated.
- .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
- .1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:
- .1 Vinyl emulsion type acrylic, compatible with insulation.

.3 ULC Listed Canvas Jacket:
- .1 220 gm/m 2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

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

.5 Contact adhesive: quick-setting

.6 Canvas adhesive: washable.

.7 Tie wire: 1.5 mm stainless steel.

.8 Banding: 19 mm wide, 0.5 mm thick stainless steel.

.9 Facing: 25 mm stainless steel hexagonal wire mesh stitched on both faces of insulation.

.10 Fasteners: 2 or 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

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

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

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

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

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

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers in accordance with Section 15061 Bases, Hangers and Supports
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

.7 Provide Aluminum jacket on supply air ductwork, exhaust ductwork and manifold on roof.

3.3 DUCTWORK INSULATION SCHEDULE

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

TIAC Code	Vapour Retarder	Thickness (mm)

Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts (including manifold system, exhaust and supply ductwork on roof)	C-2	yes	50

End of Section

PART 1 - GENERAL

1.1 References

.1 SMACNA 1481, HVAC Duct Construction Standards, Metal and Flexible, 1995.

.2 SMACNA 1143, HVAC Duct Leakage Test Manual, 1985.

.3 ASHRAE Handbook, Fundamentals, and Systems Volumes.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings and product data in accordance with Section 00 01 10

.2 Indicate following:

.1 Sealants

.2 Tape

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 Pa	SMACNA Seal Class
500	C
250	Unsealed

.2 Seal classification:

.1 Class C: transverse joints and connections made air tight with gaskets, sealant, tape, or combination thereof. Longitudinal seams unsealed.

.2 Class D: Unsealed seams and joints. All return air and exhaust air ductwork.

2.2 Sealant

.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.

2.3 Duct Leakage

.1 In accordance with SMACNA 1143, HVAC Duct Leakage Test Manual.

2.5 Fittings

.1 Fabrication: to SMACNA. 1481

.2 Radiused elbows:

.1 Rectangular: Centreline radius: 1.5 times width of duct.

.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.

.2 Provide volume control damper in branch duct near connection to main duct.

.3 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20° maximum included angle.

.2 Converging: 30° maximum included angle.

2.6 Firestopping

.1 Retaining angles all around duct, on both sides of fire separation.

.2 Firestopping material and installation must not distort duct.

2.7 Galvanized Steel

.1 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.

.2 Joints: to ASHRAE and SMACNA.

2.8 Hangers and Supports

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500 mm.

.2 Hanger configuration: to ASHRAE and SMACNA.

.3 Upper hanger attachments:
.1 For open web joists.

PART 3 - EXECUTION

3.1 General

.1 Do work in accordance with ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with ASHRAE and SMACNA.

.4 Install breakaway joints in ductwork on each side of fire separation.

.5 Manufacture duct in lengths to accommodate installation of acoustic lining.

.6 Galvanized ductwork to be used on Make up air system

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 ASHRAE and SMACNA.

3.3 Watertight Duct

.1 Provide watertight duct for:
.1 Fresh air intake.

.2 Form bottom of horizontal duct without longitudinal seams. Weld joints of bottom and side sheets. Seal all other joints with duct sealer.

3.4 Sealing

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

3.5 Leakage Tests

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.2 Do leakage tests in sections.

.3 Make trial leakage tests as instructed to demonstrate workmanship.

.4 Install no additional ductwork until trial test has been passed.

.5 Test section minimum of 30 m long with not less then 3 branch takeoffs and two 90º elbows.

.6 Complete test before insulation or concealment.

END OF SECTION

PART 1 - GENERAL

1.1 Product Data

.1 Submit product data in accordance with Section 00 01 10.

.2 Indicate the following:
- .1 Flexible connections.
- .2 Duct access doors.
- .3 Turning vanes.
- .4 Instrument test ports.

1.2 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 General

.1 Manufacture in accordance to SMACNA standards.

2.2 Flexible Connections

.1 Frame: galvanized sheet metal frame 1.0 mm thick with fabric clenched by means of double locked seams.

.2 Material:
- .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, density of 1.3 kg/m^2.

2.3 Access Doors in Ducts

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene or foam rubber.

.4 Hardware:
.1 Up to 300 x 300 mm: 2 sash locks complete with safety chain.
.2 301 to 450 mm: 4 sash locks complete with safety chain.
.3 451 to 1000 mm: piano hinge and minimum 2 sash locks.

2.4 Turning Vanes

.1 Factory or shop fabricated single thickness and double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 Instrument Test Ports

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

PART 3 - EXECUTION

3.1 Installation

.1 Flexible connections:
.1 Install in following locations:
.1 Inlets and outlets to supply fan coil units .
.2 As indicated.
.2 Length of connection: 100 mm.
.3 Minimum distance between metal parts when system in operation: 75 mm.
.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.

.2 Access doors and viewing panels:
.1 Location:
.1 At control dampers.
.2 At devices requiring maintenance.
.3 At locations required by code.
.4 At fire dampers.

.3 Instrument test ports.
.1 General:
.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.
.4 Locations.
.1 For traverse readings:
.1 At inlets and outlets of other fan systems.
.2 At main and sub-main ducts.
.3 At ducted inlets to roof and wall exhausters.
.4 And as indicated.
.2 For temperature readings:
.1 At outside air intakes.
.2 In mixed air applications in locations as approved by Engineer.
.3 Coordinate with balancing contractor.
.4 Turning Vanes
.1 Install in accordance with recommendations of SMACNA and as indicated.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Fire and smoke dampers, and fire stop flaps.

1.2 REFERENCES

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

.1 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 00 01 10 - General Instructions.

Part 2 Products

2.1 FIRE DAMPERS

.1 Fire dampers: arrangement Type B, listed and bear label of ULC, meet requirements of ANSI/NFPA 90A. Fire damper assemblies fire tested in accordance with CAN4-S112.

.2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.1 Fire dampers: 1-1/2hour fire rated unless otherwise indicated.

.2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.

.3 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.4 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.5 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.

.6 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.7 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

.8 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.9 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

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 in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.4 Co-ordinate with installer of firestopping.

.5 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.6 Install break-away joints of approved design on each side of fire separation.

.7 Install in ductwork at shafts (S/A and R/A) serving groundloor.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Roof exhausters.

1.2 REFERENCES

.1 Air Movement and Control Association (AAMC)

.1 AMCA Publication 99-2003, Standards Handbook (Revised 2003).

.2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)

.1 ANSI/AMCA 210-99, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force. Provide confirmation of testing.

.2 Capacity: as indicated on schedule.

.2 Statically and dynamically balanced. Constructed to AMCA 99.

.3 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.

.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, unit to bear AMCA certified rating seal.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 00 10 – General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 00 01 10 – General Instructions.

.1 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Include :

.1 Fan performance curves showing specified point of operation.

.2 Sound rating data.

.3 Quality assurance submittals: submit following:

.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.

.4 Closeout Submittals

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 00 10 – General Instructions.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 00 10 – General Instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.7 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 00 10 – General Instructions.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.3 List of specialized tools necessary for adjusting, repairing or replacing.

Part 2 Products

2.1 ROOF EXHAUSTERS

.1 Centrifugal V belt.

.1 Housings: spun aluminum complete with resilient mounted motor and fan. SRC – spark proof construction.

.2 Impeller: aluminum non-overloading.

.3 Automatic gasketted aluminum backdraft dampers.

.4 Disconnect switch within fan housing.

.5 Continuous curb gaskets, securing bolts and screws, and sound insulating curbs where indicated. Hinge curb plate for access to internals for maintenance.

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 in accordance with manufacturer's instructions.

END OF SECTION

PART 1 GENERAL

PART 1.01 SUMMARY

A. Section Includes: Packaged rooftop units and commercial packaged, gas/electric and electric/electric

PART 1.02 REFERENCES

A. Agency Listings:
   1. Intertek ETL
   2. Canadian Standards Association (CSA).
B. Safety Standards:
   1. Underwriters Laboratories (UL).
   2. Underwriters Laboratories of Canada (ULC).
   3. National Electric Code (NEC).
   4. Canadian Electric Code (CEC).
C. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
   1. AHRI 340/360 Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
   2. AHRI 370 Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.
   3. AHRI 210/240 Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment.
D. American Society for Testing and Materials (ASTM):
   1. ASTM B117 – Standard Practice for Operating Salt Spray.
   2. ASTM 1153 – Standard Method for Methyl Isobutyl Ketone.
E. ISO 9001, Quality Management Systems.
F. Meet Military Specification MIL-P-53084

PART 1.03 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Energence® (LG) gas/electric packaged roof top units or equivalent
   2. 4 ton capacity
   3. Electrical Characteristics:
      a. 60 Hz, 575v – 3 Phase

PART 1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with Section 01 00 10 – General Instructions.
B. Product Data: Submit product data for specified products.
C. Shop Drawings:
   1. Submit shop drawings in accordance with Section 01 00 10 – General Instructions.
   2. Indicate:

a. Equipment, piping and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
b. Piping, valves and fittings shipped loose showing final location in assembly.
c. Control equipment shipped loose, showing final location in assembly.
d. Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
e. Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
f. Fan performance curves.
g. Details of vibration isolation.
h. Estimate of sound levels to be expected across individual octave bands in dB.
i. Type of refrigerant used.
j. Plan view, front view end view, back view and curb detail with dimensions.

D. Quality Assurance:
1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
3. Manufacturer's Instructions: Manufacturer's installation instructions.

E. Manufacturer's Field Reports: Manufacturer's field reports specified.

F. Closeout Submittals: Submit following:
1. Warranty: Warranty documents specified.
2. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance. Include names and addresses of spare part suppliers.
3. Provide brief description of unit, with details of function, operation, control and component service.
4. Provide equipment inspection report and equipment operation test report.

PART 1.05 QUALITY ASSURANCE

A. Qualifications:
1. Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
2. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1.

PART 1.06 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirements.
B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
C. Packing, Shipping, Handling and Delivery:
    1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
    2. Ship, handle and unload units according to manufacturer's instructions.
D. Storage and Protection:
    1. Store materials protected from exposure to harmful weather conditions.
    2. Factory shipping covers to remain in place until installation.

PART 1.07 PROJECT CONDITIONS

A. Installation Location: Refer to Mechanical Drawing

PART 1.08 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
C. Warranty: Commencing on Date of Installation.
    1. Compressors: 5 years (limited).
    2. Other Covered System Components: 1 year (limited).
    3. Stainless Steel Heat Exchangers: 15 years (limited).
    4. Prodigy™ Unit Controller 3 years (limited).

PART 2 PRODUCTS

PART 2.01 ROOFTOP UNITS

A. Products/Systems: Lennox Energence Packaged Rooftop Units (or equivalent), including the following equipment:
    1. Cabinet:
        a. Heavy gauge steel panels.
        b. Pre-painted steel panels.
        c. Heavy Gauge galvanized steel base rail.
        d. Rigging holes on all four corners.
        e. Forklift slots (on three sides, not directly below condenser coil) on base rail.
        f. Raised or flanged edges around duct and power entry openings.
        g. Electrical lines can be brought through the base of the unit or through horizontal knockouts.
        h. Insulation:
            1) All panels adjacent to conditioned air are fully insulated with foil faced fiberglass insulation.
            2) Unit base is fully insulated.

3) Unit base insulation also serves as a roof curb seal.

i. Access Panels: Hinged for compressor/controls/heating areas, blower access and air filter/economizer access; and, sealed with quarter-turn latching handles and tight air and water seal.

j. Corrosion resistant double sloped condensate Drain Pan.

k. Service Valves

2. Cooling System:
   a. Refrigerant type: R-410A.
   b. Capable of operating from 0 - 125 degrees F (-18 - 52 degrees C) without installation of additional controls.
   c. Compressors:
      1) Scroll Type.
      2) Resiliently mounted on rubber mounts for vibration isolation.
      3) Overload Protected
      4) Internal excessive current and temperature protection
      5) Isolated from condenser and evaporator fan air streams
      6) Refrigerant cooled
   d. TXV
   e. High pressure switch
   f. Freezestat
   g. High capacity filter driers
   h. Crankcase heater
   i. Low pressure switch
3. Coil Construction:
   a. Condensing/evaporator coil general construction:
      1) Aluminum Rippled and Lanced fins.
      2) Copper tube construction.
      3) Aluminum fins mechanically bonded to copper tubes.
      4) All coils are high pressure leak tested at manufacturing facility.
   b. Evaporator Coils:
      1) With balanced port thermal expansion valves, freeze protection on each compressor circuit, pressure and leak tested to 500 psi.
      2) Each compressor circuit on coil divided across face of coil and active through full depth of coil.
      3) With flexible immersed coating electrodeposited by dry film process, meets standards: Military Specification MIL-P-53084, ASTM B117 and ASTM 1153.
   c. Condenser Coils:
      1) With flexible immersed coating electrodeposited by dry film process, meets standards: Military Specification MIL-P-53084, ASTM B117 and ASTM 1153.
4. Wiring:
   a. Keyed and labeled connections, color coded and continuously marked wire to identify point-to-point component connections.
   b. Not in contact with hot-gas refrigerant lines or sharp metal edges.
5. Gas Heating System:

a. Induced draft
b. Natural gas fired system with direct spark ignition
c. Electronic flame sensors
d. Flame rollout switches
e. High heat limit switches
f. Induced draft failure switch and capable of operating to altitude of 2000 feet (610 m) with no derate to manifold pressure.
g. Service access for controls, burners and heat exchanger
h. Heat Exchanger:
    1) Tubular Design
    2) Stainless steel.
i. Gas piping system tight and free of leaks when pressurized to maximum supply pressure.
j. Gas Valve: redundant type gas heat valve with manual shutoff
k. Two stage gas heating
l. Gas Burners: Aluminized steel inshot-type gas burners
m. Direct spark pilot ignition
n. Fan and Limit Control
o. Safety Switches
p. Gas piping system tight and free of leaks

6. Heating Controls:
    a. Support 2 stages of heating control from DDC
    b. With delay time of 30 seconds between low and high heat stages
7. Supply Air Fan Motor and Drives:
    a. Belt drive
    b. Permanently lubricated ball bearings (for belt drive motors)
    c. Thermal overload protected motors with automatic reset
    d. Adjustable sheaves on belt drive motors for blower speed adjustment
    e. Optional low and high static motor/drive combinations and optional drive kits
    f. Auto Blower Belt Tensioner: Factory
9. Supply Air Fan:
    a. Double inlet type, galvanized steel with forward curved blades
    b. Statically and dynamically balanced
    c. Continuous or automatic control for occupied periods
10. Supply Air Filters:
    a. Disposable 2 inch
11. Condenser Fan Motor:
    a. ECM motors on 3-5 ton models. Direct drive with permanently lubricated ball bearings. With the exception of the first sentence, these three items (a, b, c) are not mentioned in the EHB
    b. Watertight with thermal overload protection and automatic reset
    c. Motor mount isolated from fan safety guard
12. Condenser Fans:
    a. Corrosion resistant propeller type

13. Unit Controller:
    a. Solid state control board to operate unit
    b. Scrolling digital display
    c. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard
    d. Shall provide and display alarms, alarm history and system status
    e. Service run test capability
    f. Shall accept input from a CO2 sensor (both indoor and outdoor)
    g. Economizer control
    h. Blower on/off delay
    i. 2-stage heat/4-stage cool thermostat compatible and warm-up mode
    j. Diagnostics code storage
    k. DDC compatible
    l. Indoor air quality input
    m. Low ambient controls
    n. Runtime
    o. Blower proving switch strike 3
    p. Phase/voltage monitoring/protection: Factory
    q. Realtime clock (timestamps)
    r. Guided setup
    s. USB memory stick communication interface
    t. Controls Options:
        1) CO_2 Sensor: Field Mounted
        2) Dirty Filter Switch: Factory
        3) Blower Proving Switch: Factory
        4) Phase Monitor: Factory
        5) BACnet Interoperability: Factory
        6) Fresh Air Tempering Sensor: Field
14. Accessories:
    a. Economizer dry bulb temperature : Factory
    b. Motorized Outdoor Air Damper: Factory
    c. Dehumidification system with secondary coil: Factory
    d. Power exhaust fan: Factory
    e. Smoke detector supply: Factory
    f. Smoke detector return: Factory
    g. Roof curb: Field
    h. Outdoor air hood: Field
    j. 2” MERV 13 Filters: Factory
    k. Coil Guards: Field
    l. Disconnect Switch: Field
    m. Condensate drain trap plastic: Factory
    n. Circuit breaker: Factory

PART 2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: Engineer approved equivalent.

PART 3 EXECUTION

PART 3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions and manufacturer's SPEC-DATA sheets.

PART 3.02 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions

PART 3.03 INSTALLATION

A. Install packaged rooftop units in accordance with manufacturer's instructions on roof curbs as indicated.

END OF SECTION

1 General

1.1 GENERAL

.1 Provide in this Division shall mean supply and install.

.2 All work shall conform to Canadian Metric Practice Guide CAN/CSA Z234.1 – 89(1995).

.3 All equipment and material to be new, CSA certified, manufactured to minimum standard quoted including additional specified requirements.

.4 Where there is no alternative to supply equipment which is not CSA certified submit such equipment to Inspection Authorities for special inspection and obtain approval before delivery of equipment to site.

.5 Use material and equipment available from a regular production by manufacturer concerned.

.6 All documentation to be provided in English.

.7 This contractor to retain services of balancing contractor.

1.2 CONTRACTOR

.1 The contractor must:

.1 Have a staff, or approved contracted arrangements to provide a staff of trained personnel capable of giving instructions and providing routine and emergency maintenance on the System and all System components. Response time for the emergency maintenance shall be max. 2 hours.

.2 Have a proven record of successful experiences in the supply and installation of similar computer based systems.

.3 Maintain or have approved contracted access to local supplies of essential parts.

1.3 ACCEPTABLE MANUFACTURER

.1 System must be capable of communicating with existing Reliable Controls system.

1.4 SCOPE OF WORK

.1 The work covered by this specification and related sections consists of providing shop drawings, equipment, labour, materials, engineering, technical supervision, and transportation as required to

modify the existing Energy Monitoring and Control System (EMCS) to utilize the newly installed VSD drives and relocated static pressure sensor. The contractor is responsible for interfacing of all sensors and controls, operator work station, communication links and programmable controllers to monitor and control the equipment listed on the drawings. The work in general consists of but is not limited to, the following:

.1 The preparation of submittals and provision of all related services.

.2 Furnish and install data communication equipment necessary to extend an EMCS data transmission system.

.4 Furnish and install Local Control Units (LCU) and Terminal Control Units (TCU), sensors all additional new control devices, conduit and wiring, as required to provide the operation specified.

.5 Furnish and load all software required to implement a complete and operational EMCS.

.8 Update operating and maintenance manuals and field training of operators, programmers, and maintenance personnel.

.7 Perform acceptance tests and technical support during commissioning as indicated.

.8 Miscellaneous work as indicated in these specifications and the contract drawings.

.19 Scope of work to provide controls for following systems:

- .1 Return air unit R-1 VSD. Refer to points list.
- .2 Supply air unit VSD. Refer to points list.
- .3 Supply air pressure sensor. Refer to points list.

1.5 GENERAL REQUIREMENTS

.1 The Energy Monitoring and Control System (EMCS) shall be installed to satisfy the following general requirements:

- .1 Sensed data shall be obtained from the Programmable Controllers, LCU's and TCU's which are located within their particular data environments. They shall control all aspects of their connected points.
- .2 The controllers shall be stand alone i.e. their basic operation will not depend upon any other processor in the network. The basic operation covers functions such as scanning of digital/ analog input, scaling and conversion to engineering units for analog points, digital state change detection, analog alarm generation and reporting, on-off digital control with required sequential logic, DDC control of the processes it is programmed to control.
- .3 The Controllers will be connected directly to field devices.
- .4 Failure of communication network between Controllers affect only the Controllers involved and shall not affect operation of any other Controller.

1.6 SYSTEM DESIGN AND RESPONSIBILITY

.1 The drawings do not show conduit size or wire type to link the various elements of the system . The EMCS Contractor is responsible for designing these links in view of the present and

future capabilities.

1.7 PRODUCTS

.1 Materials and equipment shall be essentially the catalogued products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturers latest standard design that complies with the specification requirements and the existing site EMCS.

1.8 ELECTRICAL WORK AND SAFETY REQUIREMENTS

.1 Electrical work shall be in accordance with NFPA 70 – 2012 and ANSI C2 - 2007. Electrical wiring, terminal blocks and other high voltage contacts shall be fully enclosed or properly guarded and identified.

1.9 WIRING

.1 All wiring associated with and required by the EMCS shall be the responsibility of Division 250501 The term “wiring” shall be construed to include furnishing of wire conduit, miscellaneous material and labour as required to install a total working system.

1.10 NAMEPLATES

.1 Laminated plastic nameplates shall be provided for all control panels and points listed or shown in the submittal and approved control diagrams. Each inscription shall identify its function, such as ’mixed air controller, ‘cold deck sensor.

.2 Warning signage: Each motor starter under remote automatic control (DO point on I/O Summary Sheet) shall be provided with signage warning of automatic starting under control of EMCS.

1.11 SHOP DRAWING REQUIREMENTS

.1 Shop Drawings: Within 30 days after award of contract and before start of construction, 6 copies of drawings in one completely marked and coordinated package:
  .1 Wiring and piping diagrams.

.2 Control schematics with Narrative Description fully showing and describing operation and/or manual procedures available to operating personnel to achieve proper operation of the building, including under complete failure of the EMCS.

.3 Shop drawing for each input/output point showing all information associated with each particular point including:
  .1 Sensing element type and location.
  .2 Details of associated field wiring schematics and schedules.
  .3 Point address and panels.

1.12 TESTS

.1 This work shall include field testing and adjustment of all major subsystems and of the complete EMCS, and an on-site final operational acceptance test of the complete operational EMCS. The Engineer shall be advised at least 2 days in advance of the dates of all tests and may attend at his discretion.

.2 Final Operational Acceptance Test: A final operational test of not less than thirty (30) consecutive days, twenty-four (24) hours per day, shall be conducted on the complete and total installed and operational Energy Monitoring and Control System to demonstrate that it is functioning properly in accordance with all requirements of this specification. The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialized control algorithms, diagnostics, and all other software. If the equipment operates at an average effectiveness level (AEL) of at least 99% during the performance test period of thirty (30) consecutive calendar days, it will be deemed to have met the Government's Standard of Performance (PWGSC), and final acceptance of the system shall be made, provided the contractor has satisfied all other requirements of this specification.

1.13 Training

.1 During system commissioning and at such time as acceptable performance of the System hardware and software has been established, the EMCS contractor shall provide on-site operator instruction to the Engineer's operating personnel. Operator instruction during normal working hours shall be performed by a competent EMCS contractor representative familiar with the System's EMCS software, hardware and accessories.

.2 At time mutually agreed upon during System commissioning as stated above, the EMCS contractor shall give 4 hours of instructions to the Engineer's designated personnel on the operation of all central processing and peripherals and describe intended use with respect to the programmed functions specified. Operator orientation of the EMCS shall include, but not be limited to, the overall operational program, equipment functions (both individually and as part of the total integrated system), commands, advisories, and appropriate operator intervention required in responding to the System's operation. An Engineer's Manual, prepared for this project by the EMCS contractor, shall be used in addition to the instruction. Two copies of the Engineer's Manual shall be provided.

.3 Two hours of additional instruction by the EMCS contractor shall be provided to the Engineer's designated personnel. This instruction shall provide a description of the chronological information flow from field sensors, contacts and devices to the centrally located System. The overview of the System's communication network shall be to provide a better understanding to the operator of the interplay between initiating devices, Field Processing Units, system communications, and their importance

within the operating system.

.4 Additional instruction time as deemed necessary by the Engineer's authorized representative, may be obtained from the EMCS contractor on a negotiated basis with the Engineer.

.5 Acronyms used in EMCS:

AEL - Average Effectiveness Level.
Al - Analog Input.
AIT - Agreement on International Trade.
AO - Analog Output.
BACnet - Building Automation and Control Network.
BC(s) - Building Controller(s).
BECC - Building Environmental Control Center.
CAD - Computer Aided Design.
CDL - Control Description Logic.
CDS - Control Design Schematic.
COSV - Change of State or Value.
CPU - Central Processing Unit.
DI - Digital Input.
DO - Digital Output.
DP - Differential Pressure.
ECU - Equipment Control Unit.
EMCS - Energy Monitoring and Control System.
HVAC - Heating, Ventilation, Air Conditioning.
IDE - Interface Device Equipment.
I/O - InputlOutput.
!SA - Industry Standard Architecture.
LAN - Local Area Network.
LCU - Local Control Unit.
MCU - Master Control Unit.
NAFTA - North American Free Trade Agreement.
NC - Normally Closed.
NO - Normally Open.
OS - Operating System.
O&M - Operation and Maintenance.
OWS - Operator Work Station, PC - Personal Computer,
PCI - Peripheral Control Interface.
PCMCIA - Personal Computer Micro-Card Interface Adapter.
RD - Proportional, Integral and Derivative.
RAM - Random Access Memory.
SP - Static Pressure.
ROM - Read Only Memory.
TCU - Terminal Control Unit.
USB - Universal Serial Bus.
UPS - Uninterruptible Power Supply.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for building automation controllers including:

.1 Master Control Unit (MCU).

.2 Local Control Unit (LCU).

.3 Terminal Control Unit (TCU).

.2 Related Sections:

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 30 02 - EMCS: Field Instrumentation.

.3 Section 25 90 01 - EMCS: System documentation

1.2 REFERENCES

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

.1 ASHRAE 2003, Applications Handbook, SI Edition.

.2 Canadian Standards Association (CSA International).

.1 C22.2 No.205-M1983(R1999), Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

.4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.

.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements .

1.4 SYSTEM DESCRIPTION

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be to support building systems and associated sequence(s) of operations as detailed in these specifications.

.1 Provide sufficient controllers to meet intents and requirements of this section.

.2 Controller quantity, and point contents to be approved by Engineer at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.

.1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.

.2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.5 DESIGN REQUIREMENTS

.1 To include:

.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:

.1 To: CSA C22.2 No.205.

.2 Electronically interface sensors and control devices to processor unit.

.3 Include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Lockable wall cabinet.

.4 Required communications equipment and wiring (if remote units).

.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

.7 Wiring terminations: use conveniently located screw type or spade lug terminals.

.4 AI interface equipment to:

.1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.

.2 Provide for following input signal types and ranges:

.1 4 - 20 mA;

.2 0 - 10 V DC;

.3 100/1000 ohm RTD input;

.3 Meet IEEE C37.90.1 surge withstand capability.

.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.5 AO interface equipment:

.1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

.2 Meet IEEE C37.90.1 surge withstand capability.

.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.

.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.

.3 Mounting details as approved by Engineer for ceiling mounting.

.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 SUBMITTALS

.1 Make submittals in accordance with Section 00 01 10 – General Instructions .

.1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE PROCEDURES

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 01 - EMCS: General requirements

Part 2 Products

2.1 MASTER CONTROL UNIT (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.

.1 MCU must support Proprietary Protocol BACnet .

.3 MCU local I/O capacity as follows:

.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.

.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).

.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.

.2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.

.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:

.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.

.5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation .

.1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Engineer .

.2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.

.3 Display simultaneously minimum of 16 point identifiersto allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English and French.

.4 Functions to include, but not be limited to, following:

.1 Start and stop points.

.2 Modify setpoints.

.3 Modify PID loop parameters.

.4 Override PID control.

.5 Change time/date.

.6 Add/modify/start/stop weekly scheduling.

.7 Add/modify setpoint weekly scheduling.

.8 Enter temporary override schedules.

.9 Define holiday schedules.

.10 View analog limits.

.11 Enter/modify analog warning limits.

.12 Enter/modify analog alarm limits.

.13 Enter/modify analog differentials.

.5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.

.6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.

.7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.

.8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.

.9 Quality required: Mach-Proconn from Reliable or equal.

2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:

.1 Include minimum 2 interface ports for connection of local computer terminal.

.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

.4 Include power supplies for operation of LCU and associated field equipment.

.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.

.6 Provide conveniently located screw type or spade lug terminals for field wiring.

.7 Quality required: Mach 2 from Reliable or equal.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.

.1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.

.2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

.3 VAV Terminal Controller.

.1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.

.2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements .

.3 Controller to operate independent of network in case of communication failure.

.4 Controller to include damper actuator and terminations for input and output sensors and devices.

.5 Quality required: Mach-Air from Reliable or equal.

2.4 SOFTWARE

.1 General.

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

.2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.

.3 Include initial programming of Controllers, for entire system.

.2 Program and data storage.

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

.2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages.

.1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.

.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Engineer .

.4 Operator Terminal interface.

.1 Operating and control functions include:

.1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.

.5 Displays.

.6 Point identification.

.5 Pseudo or calculated points.

.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.

.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

.6 Control Description Logic (CDL):

.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.

.2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.

.3 Perform changes to CDL on-line.

.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.

.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.

.6 MCU to be able to perform following pre-tested control algorithms:

.1 Two position control.

.2 Proportional Integral and Derivative (PID) control.

.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.

.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:

.1 Time of day scheduling.

.2 Calendar based scheduling.

.3 Holiday scheduling.

.4 Temporary schedule overrides.

.5 Optimal start stop.

.6 Night setback control.

.7 S/A temperature re-set

.8 Humidity level re-set

.9 Peak demand limiting.

.10 Temperature compensated load rolling.

.11 Fan speed/flow rate control.

.12 Night purge.

.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.

.3 Apply programs to equipment and systems as specified or requested by the Engineer .

.9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCUs to accumulate and store automatically run-time for binary input and output points.

.2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.

.3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.

.4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.

.5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWH, litres, tonnes, etc.).

.6 Store event totalization records with minimum of 9,999,999 events before reset.

.7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements .

Part 3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by Engineer .

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures as indicated or as directed by Engineer .

.2 Provide necessary power from local 120 V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

END OF SECTION

I General

1.1 GENERAL REQUIREMENTS

.1 Section 250501. Energy Monitoring and Control Systems, General Requirements.

.2 Provide all remote sensing points and Instrumentation as required for the complete Energy Monitoring and Control system. All sensors shall have the accuracy as stated hereinafter.

.3 All instruments of a particular category shall be of the same type and manufacturer.

.4 All external trim material shall be completely corrosion resistant with all internal parts assembled in watertight, shockproof, vibration proof, heat resistant assembly.

.5 Use standard conduit box termination with slot screwdriver compression connector block unless otherwise specifically stated.

.6 Operating conditions 00 to 32C with 10-90% RH (non condensing) unless otherwise specifically stated.

.7 Manufacturers installation instructions shall be supplied for all equipment supplied. All equipment shall be installed in accordance with manufacturers recommended methods and procedures.

2 Products

2.1 TEMPERATURE SENSORS

.1 General: Temperature Sensors shall be Resistance or Thermistor type.

.2 The following shall apply to resistance temperature sensors as applicable.

.1 RTDs shall be 100 ohm at 0C (+.2 ohms) platinum element with strain minimizing construction and 2 integral anchored lead-wires coefficient of resistivity of 0.00385 ohms/ohm/^{0} C.

.2 Sensing element to be hermetically sealed.

.3 Stem and tip construction to be Copper or 304 Stainless Steel.

.4 Sensors to have a time constant response of less than 3 seconds to a temperature change of 100 C.

.5 Immersion wells shall be of stainless steel materials. Heat transfer compound to be compatible with sensor.

.3 Temperature sensors shall be of the following types.
.1 Room type - 10K ohm thermistor, suitable for wall mounting. Element length of 10-50 mm with ceramic tube or equivalent mode of mechanical protection.
.2 Thermowell type - RTD type with compression filling for 20 mm NPT well mounting. Lengths of 100 mm to 150mm as noted.

2.2 TEMPERATURE TRANSMITTERS

.1 As applicable, RTD temperature transmitter to be provided having the following minimum specifications:
.1 input circuit to accept 2-lead, 100 ohm at 0°C, platinum resistance detectors as specified in 2.1 above.
.2 Output signal of 4-20 Ma into maximum of 500 ohm load.
.3 Output short circuit and open circuit protection.
.4 Input short circuit and open circuit protection.
.5 Output variation of less than 0.2% of full scale output for supply voltage variations of + 10%.
.6 Combined nonlinearity, repeatability and hysteresis effects not to exceed +0.5% of full scale output.
.7 Maximum current to a 100 ohm RTD sensor not to exceed 5 Ma.
.8 Integral zero and span adjustments.
.9 Temperature effect of +1.0% full scale/50°C or less.
.10 Long term output drift of equal to or less than 0.25% of full scale outputl6 months.
.11 Transmitters to be provided with ranges as follows:
.1 0°C to + 50°C, plus or minus 0.25°C.

2.3 PRESSURE TRANSMITTERS

.1 Characteristics:

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohms maximum load.

.3 Output variations: less than 0.2% full scale for supply voltage variations of plus or minus 10%.

.4 Combined non-linearity, repeatability, and hysteresis

effects: not to exceed plus or minus 0.5% of full scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5% full scale/50°C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

.2 Quality Required:

.1 AFS-262 from AFS: differential pressure sensor, 24 V DC or AC, 4-20 mA output or 3 wires 0-5 Vt 0-10 V, 0-10 inches H2O range.

.2 C264 from Setra: differential pressure sensor, 24 V DC or AC, 4-20 mA output or 3 wires 0-5 Vt 0-10 V, 0-10 inches H2O range.

.3 PR274 from Mamac: differential pressure sensor, 24 V DC or AC, 4-20 mA output or 3 wires 0-5 Vt 0-10 V, 0-10 inches H2O range.

2.5 CONTROLS TRANSFORMERS

.1 Section 250501 shall supply and install 120/24V transformers for controls devices.

2.6 SOLID STATE RELAYS

.1 Requirements:

.2 Double voltage, DPDT, module type.

.3 Coils: rated for 24V DC.

.4 Contacts: rated at minimum 5 amps at 347 V AC.

2.10 ELECTRONIC DAMPER OPERATORS

.1 Requirements:

.2 Push-pull proportional type as indicated.

.3 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.

.4 Operator: size so as to control dampers against maximum pressure or dynamic closing pressure (whichever is greater).

.5 Power requirements: 5 VA maximum at 24 V AC.

.6 Operating range: 0 - 10 V DC.

.3 Positioning time: to suit application. 90 sec maximum, 3 sec on manifold control damper, 5 sec on fume hood valve.

2.11 DAMPERS-OPERATING

.1 Opposed blade type.

.2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame. Multiple sections to have stiffening mullions and jack shafts.

.3 Pressure fit self-lubricated bronze bearings.

.4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.

.5 Dampers to withstand system pressure in manifold (up to 1250 Pa of negative pressure).

2.12 INDICATOR LIGHTS, HANDSWITCHES, ANSD PUSHBUTTONS

.1 Indicator lights:

.1 22 mm round pilot light, carrying mark CE, CSA approved.

.2 LED illuminated.

.3 24 VAC.

.4 Lens colour: Red, amber, green as per Section 259001.

.2 Handswitches:

.1 22 mm round selector handswitch, carrying mark CE, CSA approved..

.2 2-position.

.3 Maintained contact.

.3 Pushbuttons:

.1 22 mm round pushbutton, carrying mark CE, CSA approved..

.2 Momentary contact.

3 Execution

3.1 General

.1 Provide all remote sensing points and instrumentation as indicated and/or required for the complete operational capability of the Energy Monitoring and Control System.

.2 All equipment shall be installed according to manufacturers' published instructions.

.3 Temperature Sensors.

.1 All sensors shall be stabilized to such a level as to permit on-the-job installations that will require minimum field adjustments or calibration.

.2 Sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.

.3 Wells shall be installed for all piping installations (coordinate all requirements with Div. 21). Where pipe diameter is less than the insertion length of the well, the well shall be installed at an elbow location to effect proper flow across entire well area.

.4 Controllers and relays to be installed In NEMA I enclosures.

.1 Panels to be either tree standing or wall mounted enameled steel cabinets with hinged and key locked front door. Arrange for conduit and tubing entry from top, bottom or either side.

.2 Panels shall be modular multiple panels being used if required for capacity in any particular location. They shall handle all requirements with space to accommodate an additional 20% without adding further cabinets.

.3 All panels shall be lockable with same key.

.4 Field mounted transmitters and sensors to be properly supported on pipe stands or channel brackets, all wall mounted devices to be mounted on plywood panel properly attached to the wall.

.5 All field devices to be properly identified.

.6 Testing

.1 All field devices shall be properly calibrated and tested for performance and accuracy. A report detailing test performed and results to be submitted to the engineer for approval. The engineer will verify results at random. Provide all testing equipment necessary. Provide manpower necessary to assist engineer's verification.

.7 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor

END OF SECTION

1 PART - GENERAL

1.1 DESIGN DOCUMENTATION

.1 Design documentation for each system to include, as a minimum:
- .1 Narrative type of Sequence of Operation.
- .2 Control Description Logic (CDL).
- .3 Input/Output Summary Schedules.
- .4 Schematics.

1.2 EMCS LANGUAGE DESIGN CRITERIA

.1 Policy: the requirements of the Government Official Languages Policy as applied to EMCS shall be followed.

.2 Language: refer to Section 25 05 01 EMCS: General Requirements.

.3 Levels of EMCS Language
- .1 Level 1: alarm and Operational messages to convey alarm conditions or operational messages.
- .2 Level 2: full names of equipment and control points. The various systems, their equipment and components and all control points are named in accordance with this section.
- .3 Level 3: system, equipment, component and control point descriptors: unique, alpha-numeric identifiers derived from full names of corresponding system component and control point.
- .4 Level 4: commands: represent various computer functions and routines.
  - .1 Operational commands - relate to building operations and building system controls.
  - .2 Computer system commands - relate to computer maintenance, upgrading or development software used to improve and maintain the application software for the building site.
- .5 Level 5: machine language. Languages specific to each manufacturer's product, used internally to perform its functions and routines.

.4 Languages to be available simultaneously in French and English, or be available in French or English through a selection feature readily accessible to the User.

.5 Additional Equipment, Components and/or Control Points. Where additional equipment, components and/or control points are required on specific projects, the following procedures shall be adopted:
- .1 Full names of the equipment, component and control points shall be not more than 40 characters, including numerals.
- .2 SYSTEM descriptors shall be not more than 10 alpha-numeric characters. INPUT and OUTPUT descriptors shall be not more than 10 alpha-numeric characters. The letters shall be based

upon the English/French language full name, and should, where possible, be the first letter of each word of the full name.

.6 The descriptor shall be unique.

.7 Descriptors and expansions: table lists standardized system identifiers and point identifiers.

.1 Table:

Identifiers and Expansions

English Identifier English Expansion

English Identifier (10 characters max)	English Expansion (40 characters max)
OADMIN	Outside air dampers (minimum) [control]
OADMAX	Outside air dampers (maximum) [control]
OAT	Outside air temperature
OAH	Outside air humidity
OAV	Outside air volume
RAD	Return air damper [control]
RAT	Return air temperature
RAH	Return air humidity
RASP	Return air static pressure
MAD**	Mixed air dampers **
MAT	Mixed air temperature
MAPSP	Mixed air plenum static pressure

** MAD shall be used for applications where outside air and return air dampers are controlled from one (1) only output signal.

EAD	Exhaust air damper [control]
PFPD	Pre-filter pressure drop
PFIL	Pre-filter pressure drop alarm
FFPD	Final filter pressure drop
FFIL	Final filter pressure drip alarm
HVC	Heating valve [control]
HCV	Heating coil valve
HCVC	Heating coil valve [control]
HCVS	Heating coil valve status
HCEAT	Heating coil entering air temperature
HCLAT	Heating coil leaving air temperature
HCEWT	Heating coil entering water temperature
HCLWT	Heating coil leaving water temperature
BPD	Heating coil face and bypass damper
HCA	Heating coil freeze alarm
CC	Cooling coil [control]
CAV	Cooling coil valve [control]
CVC	Cooling valve [control]
CCS	Cooling coil valve status
CCEAT	Cooling coil entering air temperature
CCLAT	Cooling coil leaving air temperature
CCEWT	Cooling coil entering water temperature
CCLWT	Cooling coil leaving water temperature
HUM	Humidifier [control]
HUMVC	Humidifier valve [control]
HUMVS	Humidifier valve status
HUMDH	Humidifier discharge humidity
SF1	Supply fan #1 [control]

SF1S	Supply fan #1 status
SFH	Supply fan high speed [control]
SFHS	Supply fan high speed status
SFL	Supply fan low speed [control]
SFLS	Supply fan low speed status
SF1VIV	Supply fan #1 VIV position
SF1VSD	Supply fan #1 VSD position
SAV	Supply air volume
SAVC	Supply air volume [control]
SAT	Supply air temperature
SAH	Supply air humidity
SAVP	Supply air velocity pressure
SASP	Supply air static pressure
RF2	Return fan #2 [control]
RF2S	Return fan #2 status
RF4H	Return fan #4 high speed [control]
RF4HS	Return fan #4 high speed status
RF4L	Return fan #4 low speed [control]
RF4LS	Return fan #4 low speed status
RF4VIV	Return fan #2 VIV position
RF4VSD	Return fan #2 VSD position
RAV	Return air volume
RAVC	Return air volume [control]
RAT	Return air humidity
RAVP	Return air velocity pressure
EF3	Exhaust fan #3 [control]
EF3S	Exhaust fan #3 status
EF3VIV	Exhaust fan #3 VIV position
EF3VSD	Exhaust fan #3 VSD position
EAT	Exhaust air temperature
EAV	Exhaust air volume
CP3	Circulating pump #3 control]
CP3F	Circulating pump #3 flow rate
CP3DP	Circulating pump #3 discharge pressure
CP3S	Circulating pump #3 status
CON2	Condenser water pump #2 [control]
HTA	High temperature alarm
LTA	Low temperature alarm
HTC	High temperature cut-out
LTC	Low temperature cut-out
HLA	High level alarm
LLA	Low level alarm
HLC	High level cut-out
LLC	Low level cut-out
HWF	Heating water flow rate
HWST	Heating water supply temperature
HWRT	Heating water return temperature
STP	Steam pressure
STF	Steam flow rate
SPT	Space temperature
SPH	Space humidity
SPSP	Space static pressure (add reference point)

Examples of specific space conditions:

NP2T	Space temperature, North Perimeter, 2nd floor
SP2SP	Space static pressure, South perimeter, 2nd floor
EIH	Space humidity, East Interior, 1st floor

F	Flow
P	Pressure
ST	Supply temperature
RT	Return temperature
FA	Fire alarm
FTA	Fire trouble alarm
Air handling units	
CW	Chilled water system
CONW	Condenser water system
DTW	Dual temperature system
GL	Glycol system
HTW	High temperature hot water system
HWH	Hot water heating system
RADN	Radiation system
SW	Secondary water system
CDR	Condensate return system
HPS	Steam - High pressure syste
LPS	Steam - Low pressure system
DCW	Domestic cold water system
DHW	Domestic hot water system
Fire alarm systems	

1.3 I/O SUMMARY SCHEDULES

.1 Refer to schedule on the drawings

1.4 DESIGN DOCUMENTATION FOR SYSTEM AC-1 VSD DRIVES

.1 Supply fan S-1 is on. Static pressure sensor controls VFD to maintain a set point.

.2 Return fan R-1 is on. EMS provides signal to VFD to match supply fan S-1 airflow.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

End of Section

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements that are common to NMS sections found in Division 26 – Electrical. This section supplements requirements of Division 1.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-06, Canadian Electrical Code

.2 CSA C22.2

.3 CAN/CSA-C22.3 No. 1-01, Overhead Systems.

.4 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English and French.

.4 Use one nameplate or label for each language.

1.4 SUBMITTALS

.1 Shop drawings:

.1 Submittals: in accordance with Section 00 01 10 – General Instructions.

.2 Submit drawings for review, prior to ordering/purchasing any equipment.

.2 Quality Control:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit, upon completion of Work, load balance report as described in PART 3 - Load Balance.

.6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Engineer.

.3 Manufacturer's Field Reports: submit to Engineer, manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in QUALITY ASSURANCE.

.4 Provide operation and maintenance data for incorporation into manual specified in Section 01 00 10 – General Instructions.

1.5 QUALITY ASSURANCE

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 00 01 10 – General Instructions.

1.6 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 00 10 – General Instructions.

1.7 SYSTEM STARTUP

.1 Instruct, Departmental Representative, Engineer and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Material and equipment to be CSA certified. Where CSA certified equipment is not available, obtain special approval from authority having jurisdiction.

.2 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Divisions 21 and 23 and as shown on mechanical drawings.

2.3 WARNING SIGNS

.1 As specified and to meet requirements of Electrical Inspection Department and Engineer.

.2 Decal signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Engineer prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

2.6 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.10-07.

.4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.8 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

.1 Locate outlets as shown on drawings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct and pay for the following tests:

.1 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system, communications.

.6 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of Engineer.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Report(s).

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.8 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

3.9 COORDINATION OF MECHANICAL AND ELECTRICAL WORK

.1 Provide complete wiring and connections for all motors and other electrical equipment specified in Division 23 and 25.

.2 Determine characteristics of equipment specified in Division 23 and 25. Provide proper starters, relays, coils, auxiliary contacts and interlocks.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65-93(R1999), Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable, flexible conduit as required.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 In general, the wiring is not shown on the drawings for the different systems: the necessary wiring shall however be provided between all outlets and the panels and/or relays to which they are referred to on drawings. In some cases, the panel identification is not given for each circuit but is shown for particular area.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Connectors:

.1 Watertight, approved for TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90 - lead sheath over cable assembly and under armour.

.3 Armour: interlocking type fabricated from aluminum strip.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34.

.2 All cables in suspended ceiling shall be properly strapped.

.3 Use armoured cables only in suspended ceilings when making final connection to equipment or in location(s) pre-approved by Engineer.

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Install cables.

.1 Group cables wherever possible on channels.

.2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0 - 1000 V.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.

.2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 System and circuit, equipment, grounding conductors, bare, stranded copper, soft annealed, size as required.

.3 Insulated grounding conductors: to section 26 05 21.

.4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at both end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 – Electrical General Requirements.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

1.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

Part 2 Execution

2.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

2.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

2.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Electrical General Requirements.

.2 Install size 2 identification labels indicating voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA C22.1-2006, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.2.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.3 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

.5 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.3 CONDUIT BOXES

.1 Cast, malleable iron boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

.2 FITTINGS - GENERAL

.1 Threaded.

.2 Provide threaded plug fillers to prevent entry of debris.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

Part 1 General

1.1 LOCATION OF CONDUITS

.1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel, threaded.

.2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.3 Rigid pvc conduit: to CSA C22.2 No. 211.2.

.4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 5 m oc.

.4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90 degree bends are required for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Use rigid galvanized steel threaded conduit except where conduit is subject to mechanical injury.

.4 Use electrical metallic tubing (EMT) for general use, except in cast concrete.

.5 Use rigid pvc conduit underground.

.6 Use flexible metal conduit for connection to motors in dry areas, connection to recessed incandescent fixtures without a prewired outlet box, connection to surface or recessed fluorescent fixtures and work in movable metal partitions.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.8 Install conduit sealing fittings in hazardous areas. Fill with compound.

.9 Minimum conduit size for lighting and power circuits: 19 mm.

.10 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.11 Mechanically bend steel conduit over 19 mm dia.

.12 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.13 Install fish cord in empty conduits.

.14 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.15 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Dry type transformers with ratings up to 5000 kVA single phase and up to 7500 kVA three phase and voltage class up to 46 kV.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C9-M1981(R2001), Dry-Type Transformers.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC GL1-3-1988, Transformer and Reactor Bushings.

.3 National Electrical Manufacturers Association (NEMA)

1.3 SOURCE QUALITY CONTROL

.1 Submit test certificate to Consultant.

1.4 SHOP DRAWINGS

.1 Submit shop drawings electronically in PDF format.

.2 Include:

.1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data:

.1 kVA rating.

.2 Primary and secondary voltages.

.3 Frequency.

.4 Phase

.5 Polarity or angular displacement.

.6 Full load efficiency.

.7 Regulation at unity pf.

.8 BIL.

.9 Insulation type.

.10 Sound rating.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Store transformers indoors in dry location.

Part 2 Products

2.1 MATERIALS

.1 Dry-type transformers: to CSA C9.

2.2 TRANSFORMER CHARACTERISTICS

.1 Provide one (1) 75kVA transformer:

.1 Type: ANN
.2 Rating: 75 kVA, 3 phase, 60 Hz.
.3 220 insulation system class, 150 degrees C temperature rise.
.4 Impedance: 4.5-5.5 %
.5 BIL 10kV
.6 Primary winding: 600V, delta
.7 Secondary winding: 480V, wye
.8 Sound rating: 50dB max.

2.3 ENCLOSURE

.1 Fabricated from sheet steel.

.2 Bolted removable panels for access to tap connections, enclosed terminals

.3 Designed for floor.

.4 Ventilated, self cooled type, enclosure c/w drip shield.

2.4 VOLTAGE TAPS

.1 Standard.

2.5 WINDINGS

.1 Primary and secondary coils:

.1 Copper.

2.6 WARRANTY

.1 Guarantee that all materials are first-class and proper for their intended use. Further guarantee is required on all materials and workmanship for a period of one (1) year from start-up or a maximum of eighteen (18) months after delivery. Make any repairs at no extra cost during this warranty period so that all equipment operates properly.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2No.29-M1989(R2000), Panelboards and enclosed Panelboards.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 26 05 00 – Electrical General Requirements.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.3 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.4 Two keys for each panelboard and key panelboards alike.

.5 Copper bus with neutral of same ampere rating as mains.

.6 Mains: suitable for bolt-on breakers.

.7 Trim with concealed front bolts and hinges.

.8 Trim and door finish: baked grey enamel

2.2 BREAKERS

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

2.3 EQUIPMENT IDENTIFICATION

.1 Nameplate for each panelboard size 4 engraved.

.2 Nameplate for each circuit in distribution panelboards size 2 engraved.

.3 Complete circuit directory with typewritten legend showing location and load of each circuit.

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Connect loads to circuits.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches.

1.2 SUBMITTALS

.1 Submit product data in accordance with Section 00 01 10 General Instructions.

1.3 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.4 Circuit breakers with interchangeable trips as indicated.

.5 Breaker interrupting capacity

.1 600V panelboards: 25kA symmetrical.

.2 250V panelboards: 10kA symmetrical.

1.4 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

Part 2 Execution

2.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Submit product data in accordance with Section 26 05 00 – Electrical General Instructions.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible/non-fusible, disconnect switch in CSA Enclosure, size as indicated.

.2 Provision for padlocking in on-off switch position by locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated.

.5 Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 – Electrical General Requirements.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1-97, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.

1.2 RELATED SECTIONS

.1 Section 00 01 10 – General Instructions.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 26 05 00 – General Instructions.

Part 2 Products

2.1 LAMPS

.1 LED – As per lighting schedule or approved equivalent.

2.2 BALLASTS

.1 LED – As per lighting schedule or approved equivalent.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install luminaries as indicated.

3.2 WIRING

.1 Connect luminaries to existing lighting circuits.

3.3 LUMINAIRE SUPPORTS

.1 Suspended mount luminaries.

3.4 LUMINAIRE ALIGNMENT

.1 Align luminaries mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaries mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for fire alarm systems.
.2 Manual alarm stations.
.3 Automatic alarm initiating devices.
.4 Audible/strobe signal devices.
.5 Annunciators.

1.2 REFERENCES

.1 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524-2001, Standard for the Installation of Fire Alarm Systems.
.2 CAN/ULC-S525-1999, Audible Signal Device for Fire Alarm Systems.
.3 CAN/ULC-S528-1991, Manual Pull Stations for Fire Alarm.

.2 National Fire Protection Agency

.1 NFPA 72-2002, National Fire Alarm Code.
.2 NFPA 90A-2002, Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings in accordance with Section 00 01 10 – General Instructions.
.2 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 MATERIALS

.1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

.2 Audible signal devices: to CAN/ULC-S525.

.3 Manual pull stations: to CAN/ULC-S528.

1.5 WIRING

.1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor. Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor

.2 Wire to remote annunciators: No. 18 AWG minimum solid copper conductor.

.3 Insulation 75 degrees C minimum with nylon jacket.

.4 Colour code wiring.

1.6 AS-BUILT RISER DIAGRAM

.1 Fire alarm system riser diagram: in glazed frame on black lamicoid sheet with bevelled edges, white lettering and designations, minimum size 600 x 600 mm.

Part 2 Execution

2.1 MANUFACTURER'S INSTRUCTIONS

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

2.2 INSTALLATION

.1 Locate and install manual alarm stations and connect to alarm circuit wiring.

.2 Connect alarm circuits to main control panel.

.3 Locate and install signal bells/ horn devices and connect to signalling circuits.

.4 Connect signalling circuits to main control panel.

.5 Install end-of-line devices at end of alarm and signalling circuits .

.6 Locate and install remote relay units to control fan shut down. Sprinkler system: wire alarm and supervisory switches and connect to control panel.

2.3 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 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C117-95, Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136-01, Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D422-98, Test Method for Particle-Size Analysis of Soils.

.4 ASTM D698-00a, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft) (600 kN-m/m).

.5 ASTM D1557-00, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 *ft lbf/ft)* (2,700 kN-m/m).

.6 ASTM D4318-00, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.2- M88, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA)

.1 CAN/CSA-A23.1/A23.2-00, Concrete Materials and Methods of Concrete Construction.

.4 Ontario Provincial Standards Specifications (OPSS)

.1 OPSS 1010 - Aggregates - Granular A,B, M and Select Subgrade Material.

.2 OPSS 501: Construction Specification for Compacting.

.3 OPSS 1001: Material Specification for Aggregates-General.

1.2 Definitions

.1 Excavation classes: two classes of excavation will be recognized; common *excavation* and rock excavation.

.1 Rock : any solid material in excess of 0.76 m^3 and which cannot be removed by means of duty mechanical excavating equipment having a 0.95 to 1.15 m^3 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: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.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 Unsuitable materials:

.1 Weak and compressible materials under excavated areas.

.2 Frost susceptible materials under excavated areas.

.3 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 D422 and ASTM C136: Sieve sizes to CAN/CGSB-8.2.

.2 Table

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45-100
0.02 mm	10-80
0.005	0-45

.3 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieves.

.7 Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.3 Measurement Procedures

.1 Excavation and backfill to limits shown on drawings will not be measured separately for payment.

.2 Shoring, bracing, cofferdams, underpinning and de-watering of excavation will not be measured separately for payment.

.3 Removal of excess and unsuitable material from the site will not be measured separately for payment.

.4 Additional excavation required due to inadequate founding soil at the limits shown on the drawings will be measured in cubic metres compacted in place.

1.4 Protection of existing features

.1 Existing buried utilities and structures:

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed. Obtain services of ‘locate’ company to locate existing underground services.

.2 Prior to commencing excavation work, notify Engineer and SNC, establish location and state of use of buried utilities and structures, to clearly mark such locations to prevent disturbance during work.

.3 Confirm locations of buried utilities by careful test excavations.

.4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.

.5 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before re-routing. Costs for such work to be paid by Engineer.

.6 Record location of maintained, re-routed and abandoned underground lines.

.2 Existing buildings and surface features:

.1 Conduct, with Engineer, 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 to approval of Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Granular A: to OPSS 1010.

.2 Granular B, Type I: to OPSS 1010.

.3 Granular B, Type II: to OPSS 1010.

.4 Fill types and compaction:

.1 Use types of fill as indicated or specified below. Compaction densities are percentages of standard Proctor maximum dry density using suitable vibratory compaction equipment to OPSS 501.

.2 Engineered fill: Granular B, Type II placed in maximum 300mm thick lifts and compacted to 95%.

.3 Exterior side of new foundation walls: Granular B, Type I placed in maximum 300mm thick lifts and compacted to 95%.

.4 Under basement floor and around weeping tile pipe: 19mm clear stone.

.5 Exterior side of stair walls: Granular B, Type I placed in maximum 300mm thick lifts and compacted to 95%.

.6 Original basement foundation: random loose fill from site excavations. Compaction not required.

.7 Original basement walls adjacent to roadways: Granular B, Type II placed in maximum 300mm thick lifts and compacted to 95%.

PART 3- EXECUTION

3.1 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.

3.2 STRIPPING OF TOPSOIL

.1 Commence topsoil stripping of areas indicated after area has been cleared of grasses and removed from site.

.2 Strip topsoil to depth as directed by Engineer. Do not mix topsoil with subsoil.

.3 To section 329121

3.3 EXISTING BURIED UTILITIES

.1 Prior to commencing any excavation work, notify applicable consultant or authorities, establish location and state of the use of buried utilities and structures clearly mark such locations to prevent disturbance during work.

.2 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated. Obtain direction of utility Consultant before moving or otherwise disturbing utilities or structures.

3.4 STOCKPILING

.1 Stockpile fill materials in areas designated by Owner. 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.

.4 Remove all excavated material from site.

3.5 COFFERDAMS, SHORING, BRACING AND UNDERPINNING

.1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with the Occupational Health and Safety Act of Ontario.

.2 Where space restrictions dictate, provide closed sheeting fully braced to resist lateral earth pressure.

.3 During backfill operation:

.1 Unless otherwise indicated or directed by Engineer, 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 Upon completion of substructure construction:

.1 Remove cofferdams, shoring and bracing.

.2 Remove excess materials from site.

3.6 DEWATERING

.1 Keep excavations free of water while Work is in progress.

.2 Control ground water inflow into excavation by pumping from well filtered sumps established in the floor of excavation.

.3 Protect open excavations against flooding and damage due to surface run-off.

3.7 EXCAVATION

.1 General

.1 Advise Engineer at least 7 days in advance of excavation operations for initial cross sections to be taken.

.2 Excavate to lines, grades, elevations and dimensions as indicated as directed by Engineer.

.3 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.

.4 Excavation must not interfere with normal display of bearing from bottom of any footing.

.5 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe Or sawNotify geotechnical engineer when bottom of excavation is reached and obtain engineer's approval of completed excavation.

.6 For trench excavation, unless otherwise authorized by Engineer in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.7 Dispose of excavated material of site.

.8 Do not obstruct flow of surface drainage or natural watercourses.

.9 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.10 Notify Engineer when bottom of excavation is reached.

.11 Obtain Engineer approval of completed excavation.

.12 Remove unsuitable material from trench bottom to extent and depth *as* directed by Engineer.

.13 Correct unauthorized over-excavation as follows:

.1 Fill under bearing surfaces and footings with concrete specified for footings fill concrete.

.2 Fill under other areas with Type 2 fill compacted to not less than 95% of corrected maximum dry density.

.14 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Engineer.

.15 Vacuum excavation to be used starting and pass 1m away from existing underground services.

3.8 Fill Types and Compaction

.1 Use fill of types as indicated or specified below.

Compaction densities are percentages of maximum densities obtained from ASTM D1557.

.1 Exterior side of perimeter walls: use Type 3 fill to subgrade level. Compact to 95%.

.2 Within building area: use Type 2 to underside of base course for floor slabs. Compact to 98%.

.3 Under concrete slabs: provide 150 mm compacted thickness base course of Type 1 fill to underside of slab. Compact base course to 100%.

.4 Retaining walls: use Type 2 fill to subgrade level on high side for minimum 500 mm from wall and compact to 95%..For remaining portion, use Type 3 fill compacted to 95%.

3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact sand for bedding and surround of underground services in 150 mm layers, a minimum bedding of 100 mm shall be raked uniformly the entire length of the pipe run and graded to a minimum slope of 0.2%. Prior to back filling, remove any foreign materials such as shoring, braces and support blocks Carefully compact the area directly around the conduit in 150 mm layers. Haunching materials to be compacted to densities shown in 3.6. Primary backfilling of fill types specified in 3.6 shall be packed and tamped to 150 mm over the top of the jacket of the piping system.

.2 Place bedding and surround material in unfrozen condition.

3.10 BACKFILLING

.1 Vibratory compaction equipment: to OPSS 501.

.2 Do not proceed with backfilling operations until completion of following:

.1 Engineer has inspected and approved installations.

.2 Engineer has inspected and approved of construction below finish grade.

.3 Inspection, testing, approval, and recording location of underground utilities.

.4 Removal of concrete formwork.

.5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.

.6 Installation of foundation waterproofing.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Use new backfill only.

.5 Place backfill material in uniform layers not exceeding 300 mm. Compact each layer before placing succeeding layer.

.6 Backfilling around installations.

.1 Place bedding and surround material as specified elsewhere.

.2 Do not backfill around or over until cast-in-place concrete has reached a minim 75% of its 28 day strength.

.3 Place layers simultaneously on both sides of installed Work to equalize loading.

.4 Where temporary unbalanced earth pressures are liable to develop on walls or other structures:

.1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Engineer:

.2 If approved by Engineer erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Engineer.

3.11 REINSTATEMENT AND SITE CLEAN-UP

.1 Upon completion of Work, remove waste materials and debris and dispose off site.

.2 Remove and dispose off site all excavation materials.

.3 Rough grade to match existing conditions. Slope to existing surrounding grades.

.4 “Back blade” site where disturbed to provide level surface. Slope to provide positive drainage to existing ditches, swales etc.

END OF SECTION

PART 1 - GENERAL

1.1 Related Section

.1 Ontario Provincial Standard Specifications (OPSS).

- .1 OPSS 302 - Priming.
- .2 OPSS 310 - Hot Mixed, Not Laid Asphalt concrete Paving and Hot Mixed Patching.
- .3 OPSS 314 - Untreated Granular, Subbase, Base, Surface, Shoulder and Stockpiling.
- .4 OPSS 1010 - Aggregates - Granular A, B, M and Select Subgrade Material.
- .5 OPSS 1103 - Emulsified Asphalt.
- .6 OPSS 1150 - Hot Mixed, Hot Laid Asphaltic Concrete.

.2 Canadian General Standards Board.

1.2 Samples

.1 Submit samples in accordance with Section 00 01 10 – General Instructions

.2 Submit to Engineer, samples of material for sieve analysis the mix design for the HL3 and HL8 material and asphalt content of the material being used, at least 2 weeks before commencing work.

PART 2 Products

2.1 Materials

.1 Aggregates to: OPSS 1010.

- .1 Granular A.
- .2 Granular B Typell.
- .3 Select subgrade materials.

.2 Prime coat: MTO Primer RC-30 or SS-1 to OPSS 1103.

.3 Tack coat: SS-1 to OPSS 1103.

.4 Asphalt concrete: to OPSS 1150.

.5 Traffic paint: yellow and white to CGSB 1-GP-74M.

.6 Paint thinner: to CGSB 1.4.

PART 3- EXECUTION

3.1 Foundations

.1 Foundations for roadways comprise:

- .1 400 mm compacted thickness of granular subbase B Type II.

.2 150 mm compacted thickness of granular base A.

.2 Foundations for parking lots to comprise:

.1 400 mm compacted thickness of granular base A.

.3 Construction of granular foundations: OPSS 314.

3.2 Pavement Thickness

.1 Pavements for roadways and parking lots:

.1 Base course: 50 mm of HL8.

.2 Wear course: 40 mm of HL3.

3.3 Pavement Construction:

.1 Application of prime coat: OPSS 302

.2 Construction of asphalt concrete: OPSS 310

3.4 Scarifying and Shaping

.1 Scarify, shape and generally prepare road subgrade after trench filling.

.2 Blade and trim roadbed material to required elevation and cross section dimensions.

.3 Construct step joint in asphalt, as per Engineer instructions.

3.5 Compaction Equipment

.1 Compaction equipment must be capable of obtaining required densities in materials.

3.6 Compacting

.1 Compact to density not less than 97% of density obtained with Marshall specimens prepared in accordance with ASTM D698-00a.

.2 Compact reshaped material to approval of Engineer.

.3 Shape and roll alternately to obtain a smooth, even and uniformly compacted base.

.4 Apply water as necessary during compacting.

.5 In areas not accessible to compaction equipment, compact to specified density, with mechanical tampers approved by Engineer.

3.7 Finish Tolerances

.1 Shape granular base surface to be within plus or minus 10 mm of elevation of original grade, but not uniformly high or low.

.2 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

.3 Placement of asphalt surface course (HL3) to be within plus or minus 5 mm of elevation of original grade, but not uniformly high or low and shall be flush with adjacent edges.

3.8 Maintenance

.1 Maintain shaped surface in a condition conforming to this section until succeeding material is applied.

3.9 Traffic Markings

.1 Paint parking space divisions and other pavement markings in accordance with manufacturers recommendations.

.2 Use paint thinner in accordance with manufacturer's requirements.

.3 Paint all roadway and parking lot space lines and other markings damaged by construction activities.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 31 23 10 - Excavating, Trenching and Backfilling.

.2 Section 32 12 17 - Asphalt Concrete Paving .

.3 Section 03 10 00 - Concrete Forming and Accessories.

.4 Section 03 20 00 - Concrete Reinforcing.

.5 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D698-91(1998), Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.2-98, Boiled Linseed Oil.

.2 CAN/CGSB-3.3-99, Kerosene.

.3 Canadian Standards Association (CSA)

.1 CAN/CSA-A23.1/A23.2-94, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

1.3 MEASUREMENT PROCEDURES

.1 Concrete walks: will be measured in square metres linear metres.

.2 Concrete curbs: will be measured in linear metres.

.3 Concrete gutters: will be measured in linear metres.

.4 Borrow material: will be measured in tonnes cubic metres compacted in place.

Part 2 Products

2.1 MATERIALS

.1 Concrete mixes and materials: to Section 03 30 00 - Cast-in-Place Concrete.

.2 Reinforcing steel: to Section 03 20 00 - Concrete Reinforcing.

.3 Joint filler Curing Compound: to Section 03 30 00 - Cast-in-Place Concrete.

.4 Granular base: to Section 31 23 10 - Excavating, Trenching and Backfilling, type fill finish.

.5 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.

.6 Fill material: to Section 31 23 10 - Excavating, Trenching and Backfilling, type fill finish.

.7 Boiled linseed oil: to CAN/CGSB-1.2.

.8 Kerosene: to CAN/CGSB-3.3.

Part 3 Execution

3.1 GRADE PREPARATION

.1 Do grade preparation work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

.2 Construct embankments using excavated material free from organic matter or other objectionable materials. Dispose of surplus and unsuitable excavated material in approved location on site off site.

.3 When constructing embankment provide for minimum 1 m shoulders, where applicable, outside of neat lines of concrete.

.4 Place fill in maximum 150 mm layers and compact to at least 95% of maximum density to ASTM D698.

3.2 GRANULAR BASE

.1 Obtain Engineer's 's approval of subgrade before placing granular base.

.2 Place granular base material to lines, widths, and depths as indicated.

.3 Compact granular base to at least 95% of maximum density to ASTM D698.

3.3 CONCRETE

.1 Obtain Engineer's 's approval of granular base and reinforcing steel prior to placing concrete.

.2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.

.4 Provide edging as indicated with 10 mm radius edging tool.

.5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Engineer can be demonstrated. Hand finish surfaces when directed by Engineer .

3.4 TOLERANCES

.1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

3.5 EXPANSION AND CONTRACTION JOINTS

.1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 1.5 m for concrete sidewalks and slabs.

.2 Install expansion joints as indicated at intervals of 6 m for curbs, gutters and concrete sidewalks.

.3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

3.6 ISOLATION JOINTS

.1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.

.2 Install joint filler in isolation joints in accordance with Section 03 30 00 - Cast-in-Place Concrete as indicated.

.3 Seal isolation joints with sealant approved by Engineer .

.4 Install 12mm asphalt impregnated board in expansion joint.

.5 Seal expansion joints with approved sealant.

3.7 CURING

.1 Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound approved by Engineer .

.2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.

.3 Apply curing compound evenly to form continuous film. In accordance with manufacturer's requirements.

3.8 BACKFILL

.1 Allow concrete to cure for 7 days prior to backfilling.

.2 Backfill to designated elevations with material approved by Engineer . Compact and shape to required contours as indicated or as directed by Engineer .

3.9 LINSEED OIL TREATMENT

.1 After concrete has cured for specified curing time and when surface of concrete is clean and dry, apply two coats of linseed oil mixture uniformly to surfaces of curbs, walks and gutters.

.2 Linseed oil mixture to consist of 50% boiled linseed oil and 50% mineral spirits by volume.

.3 Apply treatment when air temperature above 10EC.

.4 Apply first coat at 135 mL/m^2.

.5 Apply second coat at 90 mL/$m^2$when first coat has dried.

END OF SECTION

Part 1 General

1.1 MATERIAL

.1 All material to be supplied by contractor.

Part 2 Products

2.1 TOPSOIL

.1 Topsoil for seeded areas planting beds : mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.

- .1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70 % sand, minimum 7 % clay, and contain 2 to 10 % organic matter by weight.
- .2 Contain no toxic elements or growth inhibiting materials.
- .3 Finished surface free from:
  - .1 Debris and stones over 50 mm diameter.
  - .2 Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume.
- .4 Consistence: friable when moist.

Part 3 Execution

3.1 STRIPPING OF TOPSOIL

.1 Commence topsoil stripping of work scope areas after area has been cleared of brush weeds and grasses and removed from site.

.2 Strip topsoil to depths to avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application.

.3 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2m.

.4 Disposal of unused topsoil is to be in an environmentally responsible manner but not used as landfill..

.5 Protect stockpiles from contamination and compaction.

3.2 PREPARATION OF EXISTING GRADE

.1 Verify that grades are correct. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative .

.2 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.

.3 Remove debris, roots, branches, stones in excess of 50 mm iameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75 mm above surface. Dispose of removed material off site.

.4 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

.1 Place topsoil after Departmental Representative has accepted subgrade.

.2 Spread topsoil in uniform layers not exceeding 150 mm.

.3 For sodded areas keep topsoil 15 mm below finished grade.

.4 Spread topsoil as indicated to following minimum depths after settlement.

.1 135 mm for sodded areas.
.2 300 mm for flower beds.
.3 500 mm for shrub beds.

.5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.4 FINISH GRADING

.1 Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

.2 Consolidate topsoil to required bulk density using equipment approved by Departmental Representative . Leave surfaces smooth, uniform and firm against deep footprinting.

3.5 ACCEPTANCE

.1 Departmental Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.6 SURPLUS MATERIAL

.1 Dispose of materials except topsoil not required where directed by Departmental Representative off site.

3.7 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 32 91 21 - Topsoil Placement and Grading.

1.2 SCHEDULING

.1 Schedule installation with Departmental Representative.

.2 Schedule sod laying to coincide with preparation of soil surface.

.3 Schedule sod installation when frost is not present in ground.

Part 2 Products

2.1 MATERIALS

.1 Commercial Grade Turf Grass Nursery : sod that has not been grown as Turf Grass Nursery Sod crop.

.1 Mow sod at height directed by Departmental Representative within 36 hours prior to lifting, and remove clippings.

.2 Water:

.1 Supplied by Departmental Representative at designated source.

.3 Fertilizer:

.1 To Canada "Fertilizers Act" and "Fertilizers Regulations".

.2 Complete, synthetic, slow release with 65 % of nitrogen content in water-insoluble form.

2.2 SOURCE QUALITY CONTROL

.1 Obtain approval from Departmental Representative of sod at source.

.2 When proposed source of sod is approved, use no other source without written authorization from Departmental Representative .

Part 3 Execution

3.1 PREPARATION

.1 Verify that grades are correct and prepared in accordance with Section 32 91 21 - Topsoil Placement and Grading. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative .

.2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.

.3 Fine grade surface free of humps and hollows to smooth, even grade, to contours and elevations indicated, to tolerance of plus or minus 8 mm, for Turf Grass Nursery Sod and plus or minus 15 mm for Commercial Grade Turf Grass Nursery, surface to drain naturally.

.4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site in location as directed by Departmental Representative .

3.2 SOD PLACEMENT

.1 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.

.2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.

.3 Roll sod as directed by Departmental Representative. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

3.3 SOD PLACEMENT ON SLOPES AND PEGGING

.1 Install and secure geotextile fabric in accordance with manufacturer's instructions.

.2 Start laying sod at bottom of slopes.

.3 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1 m of catch basins and within 1 m of drainage channels and ditches to following pattern:

.1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.

.2 Not less than 3-6 pegs per square metre.

.3 Not less than 6-9 pegs per square metre in drainage structures. Adjust pattern as directed by Departmental Representative .

.4 Drive pegs to 20 mm above soil surface of sod sections.

3.4 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following operations from time of installation until acceptance.

.2 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.

.3 Cut grass to 50 mm when or prior to it reaching height of 75 mm. Remove clippings which will smother grassed areas as directed by Departmental Representative .

.4 Maintain sodded areas weed free 95% .

.5 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well .

3.5 ACCEPTANCE

.1 Sodded Commercial Grade Turf Grass Nursery Sod areas will be accepted by Departmental Representative provided that:

.1 Sodded areas are properly established.

.2 Extent of surface soil visible when grass has been cut to height of 60 mm is acceptable.

.3 Sod is free of bare or dead spots and extent of weeds apparent in grass is acceptable.

.4 Sodded areas have been cut minimum 2 times prior to acceptance.

.5 Fertilizing in accordance with fertilizer program has been carried out at least once.

.2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

3.6 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until end of warranty period:

.1 Water sodded Turf Grass Nursery Sod and Commercial Grade Turf Grass Nursery Sod areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm .

.2 Repair and resod dead or bare spots to satisfaction of Departmental Representative .

.3 Cut grass and remove clippings that will smother grass as directed by Departmental Representative to height as follows:

.1 Commercial Grade Turf Grass Nursery Sod :

.1 60 mm during normal growing conditions.

.2 Cut grass at 2 week intervals or as directed by Departmental Representative , but at intervals so that approximately one third of growth is removed in single cut.

.3 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well .

.4 Eliminate weeds by mechanical or chemical means to extent acceptable to Departmental Representative .

3.7 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for gravity sewers.

1.2 RELATED SECTIONS

.1 Section 31 23 10 - Excavating Trenching and Backfilling.

.2 Section 03 30 00 - Cast-in-Place Concrete.

1.3 MEASUREMENT PROCEDURES

.1 Measure excavation and backfill under Section 31 23 10 - Excavating Trenching and Backfilling.

.2 Measure supply and installation of sanitary sewer including testing and including excavation and backfilling and granular bedding and surround horizontally from building face to manhole face in metres of each size pipe and depth class installed.

.3 Measure concrete bedding and encasement of pipes in cubic metres in place.

.4 Measure granular bedding and surround in cubic metres compacted in place.

1.4 REFERENCES

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

.1 ANSI/AWWA C111/A21.11-[00], Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

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

.1 ASTM D2680-[01], Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

.2 ASTM D3034-[00], Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.3 ASTM D3350-[02], Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

1.5 DEFINITIONS

.1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure,which is part of sewer system.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with Section 00 0110 - General Instructions

.2 Indicate proposed method for installing carrier pipe for undercrossings.

.3 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.

.4 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

.5 Ensure certification is marked on pipe.

.6 Submit manufacturers information data sheets and instructions in accordance with Section 00 01 10 - General Instructions

Part 2 Products

2.1 PLASTIC PIPE

.1 Type PSM Polyvinyl Chloride (PVC): to ASTM D3034.

.1 Standard Dimensional Ratio (SDR): 35.

.2 Locked-ingasket and integral bell system.

.3 Nominal lengths: 6 m.

2.2 SERVICE CONNECTIONS

.1 Type PSM Poly (Vinyl) Chloride: to CSA-B182.2.

2.3 CEMENT MORTAR

.1 Portland cement: to CAN/CSA-A5, normal type.

.2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry.

.1 Add only sufficient water after mixing to give optimum consistency for placement.

.2 Do not use additives.

2.4 PIPE BEDDING AND SURROUND MATERIALS

.1 Granular material to following requirements:

.1 Crushed or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C136 and [ASTM C117. Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

.2 Table

Sieve Designation	% Passing Stone/Gravel	% Passing Gravel/Sand
200 mm	-	-
75 mm	-	-
50 mm	-	-
38.1 mm	-	-
25 mm	[100]	-
19 mm	-	-
12.5 mm	[65-90]	[100]
9.5 mm	-	-

Sieve Designation	% Passing Stone/Gravel	% Passing Gravel/Sand
4.75 mm	[35-55]	[50-100]
2.00 mm	-	[30 - 90]
0.425 mm	[10-25]	[10 - 50]
0.180 mm	-	-
0.075 mm	[0-8]	[0-10]

.3 Concrete mixes and materials for cradles, encasement, supports: to Section 033000 - Cast-in-Place Concrete.

2.5 BACKFILL MATERIAL

.1 As indicated.

.2 Type 3, in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

.3 Unshrinkable fill: to Section 31 23 10 - Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 PREPARATION

.1 Clean and dry pipes and fittings before installation.

.2 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.2 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

.2 Do not allow contents of any sewer or sewer connection to flow into trench.

.3 Trench alignment and depth require approval of Departmental Representative prior to placing bedding material and pipe.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete Work in accordance with Section 033000 - Cast-in-Place Concrete.

.1 Place concrete to details as directed by Departmental Representative.

.2 Position pipe on concrete blocks to facilitate placing of concrete.

.1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR BEDDING

.1 Place bedding in unfrozen condition.

.2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness.

.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.

.1 Do not use blocks when bedding pipe.

.4 Shape transverse depressions as required to suit joints.

.5 Compact each layer full width of bed to at least 95] % maximum density to ASTM D698.

.6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material or lean mix concrete.

3.5 INSTALLATION

.1 Lay and join pipes to: ASTM C12.

.2 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.

.3 Handle pipe using methods approved by Departmental Representative.

.1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

.4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.

.1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.6 Do not exceed maximum joint deflection recommended by pipe manufacturer.

.7 Do not allow water to flow through pipe during construction, except as may be permitted by Departmental Representative.

.8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.9 Install plastic pipe and fittings in accordance with CSA B182.11.

.10 Pipe jointing:

.1 Install gaskets in accordance with manufacturer's recommendations.

.2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

.3 Align pipes before joining.

.4 Maintain pipe joints free from mud, silt, gravel and other foreign material.

.5 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.

.6 Complete each joint before laying next length of pipe.

.7 Minimize joint deflection after joint has been made to avoid joint damage.

.8 At rigid structures, install pipe joints not more than [1.2] m from side of structure.

.9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

.11 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.

.12 Plug lifting holes with pre-fabricated plugs approved by Departmental Representative set in shrinkage compensating grout.

.13 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.14 Make watertight connections to manholes.

.1 Use shrinkage compensating grout when suitable gaskets are not available.

.15 Use prefabricated saddles or field connections approved by Departmental Representative for connecting pipes to existing sewer pipes.

.1 Joints to be structurally sound and watertight.

3.6 PIPE SURROUND

.1 Place surround material in unfrozen condition.

.2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.

.1 Leave joints and fittings exposed until field testing is completed.

.3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.

.4 Place layers uniformly and simultaneously on each side of pipe.

.5 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum density to ASTM D698.

.6 When field test results are acceptable to Departmental Representative , place surround material at pipe joints.

3.7 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

.3 Under paving and walks, compact backfill to at least 95 % maximum density to ASTM D698.

.4 Place unshrinkable fill in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling].

3.8 SERVICE CONNECTIONS

.1 Install pipe to manufacturer's instructions and specifications.

.2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless directed otherwise by Departmental Representative .

.3 Service connections to main sewer: standard fittings- Departmental Representative approved saddles.

.4 Service connection pipe: not to extend into interior of main sewer.

.5 Make up required horizontal and vertical bends from 45 degrees bends or less, separated by straight section of pipe with minimum length of four pipe diameters.

.1 Use long sweep bends where applicable.

.6 Plug service laterals with water tight caps or plugs as approved by Departmental Representative.

.7 Place location marker at ends of plugged or capped unconnected sewer lines.

.1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.

3.9 FIELD TESTING

.1 Repair or replace pipe, pipe joint or bedding found defective.

.2 Remove foreign material from sewers and related appurtenances by flushing with water.

.3 Perform pressure testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for storm sewer.

1.2 RELATED SECTIONS

.1 Section 00 01 10 - General Instructions.

.2 Section 31 23 10 - Excavating, Trenching and Backfilling.

.3 Section 03 30 00 - Cast-in-Place Concrete.

1.3 MEASUREMENT PROCEDURES

.1 Measure excavation and backfill under Section 31 22 30 - Excavating Trenching and Backfilling.

.2 Measure supply and installation of storm sewer including testing and including excavation and backfilling and granular bedding and surround horizontally from building face to manhole face in metres of each pipe size and depth class installed.

.3 Measure concrete bedding and encasement of pipes in cubic metres in place.

.4 Measure granular bedding and surround in cubic metres compacted in place.

1.4 REFERENCES

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

.1 ASTM D2680-01, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

.2 ASTM D3034-00, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

1.5 DEFINITIONS

.1 A pipe section is defined as length of pipe between successive catchbasins and/or manholes.

1.6 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Shop drawings to indicate proposed method for installing carrier pipe for undercrossings.

.3 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.

.4 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

.5 Certification to be marked on pipe.

.6 Submit to Departmental Representative 1 copy of manufacturer's installation instructions.

Part 2 Products

2.1 PLASTIC PIPE

.1 Type PSM Poly Vinyl Chloride (PVC): to ASTM D3034.

.1 Standard Dimensional Ratio (SDR): 35.

.2 Locked-in gasket and integral bell system.

.3 Nominal lengths: 6 m.

.2 Large diameter, ribbed PVC sewer pipe and fittings: to ASTM F794.

2.2 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular material in accordance following requirements:

.1 Crushed or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C136 and [ASTM C117.

.2 Table

Sieve Designation (mm)	% Passing Stone/Gravel	Gravel/Sand
200	-	-
75	-	-
50	-	-
38.1	-	-
25	[100]	-
19	-	-
12.5	[65-90]	[100]
9.5	-	-
4.75	[35-55]	[50-100]
2.00		[30-90]
0.425	[10-25]	[10-50]
0.180	-	-
0.075	[0-8]	[0-10]

.3 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Section 033000 - Cast-in-Place Concrete.

2.3 BACKFILL MATERIAL

.1 As indicated.

.2 Type 3 to Section 31 23 10 - Excavating Trenching and Backfilling.

.3 Unshrinkable fill: in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 PREPARATION

.1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

3.2 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

.2 Do not allow contents of sewer or sewer connection to flow into trench.

.3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

3.3 CONCRETE BEDDING AND ENCASEMENT

.1 Do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete. Place concrete to details as directed by Departmental Representative.

.2 Position pipe on concrete blocks to facilitate placing of concrete.

.1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.

.3 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR BEDDING

.1 Place bedding in unfrozen condition.

.2 Place granular bedding material in uniform layer[s] not exceeding 150 mm compacted thickness.

.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.

.4 Shape transverse depressions as required to suit joints.

.5 Compact each layer full width of bed to at least 95 % maximum density to ASTM D698.

.6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.5 INSTALLATION

.1 Lay and join pipes to: ASTM C12.

.2 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative .

.3 Handle pipe using methods approved by Departmental Representative.

.1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

.4 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.

.1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.6 Lay corrugated steel pipe:

.1 With outside circumferential laps facing upgrade and longitudinal laps or seams at side or quarter points.

.2 With longitudinal centre line of paved invert coinciding with flow line.

.7 Do not exceed maximum joint deflection recommended by pipe manufacturer.

.8 Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative

.9 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.10 Install plastic pipe and fittings in accordance with CSA B182.11.

.11 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.

.12 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.

.13 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.14 Make watertight connections to manholes and catch basins.

.1 Use shrinkage compensating grout when suitable gaskets are not available.

.15 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.

.1 Joint to be structurally sound and watertight.

.16 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.6 PIPE SURROUND

.1 Place surround material in unfrozen condition.

.2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.

.1 Leave joints and fittings exposed until field testing is completed.

.3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.

.4 Place layers uniformly and simultaneously on each side of pipe.

.5 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum density to ASTM D698.

.6 Compact each layer from mid height of pipe to underside of backfill to at least 90 % maximum density to ASTM D698.

.7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

.3 Under paving and walks, compact backfill to at least 95 % maximum density to ASTM D698. In other areas, compact backfill to at least 90 % maximum density to ASTM D698.

.4 Place unshrinkable backfill in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

3.8 FIELD TESTING

.1 Repair or replace pipe, pipe joint or bedding found defective.

.2 Remove foreign material from sewers and related appurtenances by flushing with water.

.3 Television and photographic inspections:

.1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.

.2 Provide means of access to permit Departmental Representative to do inspections.

.3 Payment for inspection services in accordance with payment procedures in PART 1.

END OF SECTION