ST. PATRICK ELEMENTARY SCHOOL
School Modernization

Street Address: 5302 48 Street
Taber, AB T1G 1H3

Pre-Bid Meeting: Tuesday, May 16, 2017 10:30 a.m. – 2:00 p.m.

Bid Closing: **Thursday, May 30, 2017, at 2:00:00 p.m.**

Inquires Contact: Robert Camarta: robert.camarta@gov.ab.ca
(include the Plan No. in the subject line).

Plan Holder List: is available at www.purchasingconnection.ca – accessible from the opportunity notice for this project.

Project ID: B4166A-0001
Building No: B4166A **Plan No:** 016559G

VOLUME 2 OF 2

Alberta Infrastructure

ST. PATRICK ELEMENTARY SCHOOL
School Modernization

Project ID: B4166A-0001
Building No: B4166A **Plan No:** 016559G

Prime Consultant:

Sahuri + Partners Architecture Inc.
Suite 201, 123 Forge Road SE
Calgary, Alberta
T2H 0S9

PREAMBLE

The division and section arrangement of these Specifications is generally based on MasterFormat™, 2004 edition, published jointly by Construction Specifications Canada and the Construction Specifications Institute.

Where it is indicated that a division of MasterFormat™ is "Not Used", or where a division heading is omitted entirely, this does not necessarily mean that work normally specified in that division is not required. It may be specified elsewhere.

End of Table of Contents

1. General

1.1 RELATED SECTIONS

.1	Submittal Procedures	Section 01 33 00.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Operation and Maintenance Data and Manuals	Section 01 78 23.
.4	Building-in and grouting frames in masonry:	Section 04 20 00.
.5	Perimeter sealant to frames:	Section 07 92 00.
.6	Metal doors & panels:	Section 08 13 13.
.7	Supply of door hardware templates:	Section 08 70 00.
.8	Glazing of framed lights:	Section 08 81 00.
.9	Building-in frames in drywall:	Section 09 29 00.
.10	Painting:	Section 09 91 05.

1.2 REFERENCE DOCUMENTS

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

.1	ASTM A653/A653M -09	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
.2	ASTM B29-03 (R2009)	Refined Lead
.3	ASTM B749-03 (R2009)	Lead and Lead Alloy Strip, Sheet and Plate Products

.2 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-1.181-99	Ready-Mixed Organic Zinc-Rich Coating
.2	CGSB 41-GP-19Ma -84	Rigid Vinyl Extrusions for Windows and Doors

.3 Canadian Standards Association (CSA):

.1	CAN/CSA-G40.20/G40.21-04	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
.2	CAN/CSA-G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
.3	CSA W59-03(R2008)	Welded Steel Construction (Metal Arc Welding)

.4 Canadian Steel Door Manufacturers' Association (CSDMA):

.1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000

.2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990

.5 Green Seal: Standards:

.1	GC-03	Green Seal Environmental Criteria for Anti-Corrosive

		Paints, Second Edition, January 7, 1997
.2	GS-11	Green Seal Environmental Criteria for Paint, First Edition, May 1993

.6 Master Painters Institute:

.1 Master Painters Institute Green Performance Standard GPS-1-08

.7 National Fire Protection Association (NFPA):

.1	NFPA 80-99	Fire Doors and Fire Windows
.2	NFPA 252-03	Fire Tests of Door Assemblies

.8 South Coast Air Quality Management District (SCAQMD), California State:

.1	SCAQMD Rule 1168	June 2006, Adhesives and Sealants Applications

.9 Underwriters' Laboratories of Canada (ULC):

.1	CAN/ULC-S701-05	Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
.2	CAN/ULC-S702-09	Thermal Insulation, Mineral Fibre, for Buildings
.3	CAN/ULC-S704-03	Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced
.4	CAN4-S104-M80 (R1985)	Fire Tests of Door Assemblies
.5	CAN4-S105-09	Fire Door Frames Meeting the Performance Required by CAN4-S104

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit two copies of WHMIS MSDS Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's for adhesives.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Division 01.

.2 Clearly indicate each type of frame, material, material thicknesses, mortises, reinforcements, anchors, finish, and special features.

.3 Reference frames to door schedule. Indicate door numbers and construction where applicable.

.3 Samples:

.1 Submit one 300 mm x 300 mm "L" section of frame showing corner detail and reinforcement for butts, and glazing stops.

.2 Submit a 300 mm long section of removable mullion and connection parts.

.4 Sustainable Design Submittals:

.1 Submit product data for site applied touch-up primer for interior applications verifying compliance with GC-03, Green Seal Environmental Criteria for Anti-Corrosive Paints, for VOC content.

.2 Submit shop paint primer manufacturer's product data verifying compliance with MPI Green Performance Standard GPS-1-08, for VOC content.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Receive and store materials as recommended by materials manufacturer.

.2 Storage and Handling Requirements:

.1 Adequately protect surfaces from damage during moving, handling and storage.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Management and Disposal.

1.5 QUALITY ASSURANCE

.1 Manufacture fire door and frame components and assemblies to ULC/ULI/Warnock Hersey/Factory Mutual requirements

.2 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:

.1 Steel Fire Rated Doors and Frames: Labelled and listed by organization accredited by Standards Council of Canada for ratings specified or indicated.

.2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:

.1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by agency to individual manufacturers.

.2 Fabricate rated doors, frames, and screens to labelling authority standard.

.3 Affix appropriate label to each opening requiring indicating a labelling requirement and as follows:

.1 At standard size openings: fire endurance rating.
.2 At oversized openings: unclassified as to fire rating.

2. Products

2.1 MATERIALS

.1 Frames: 1.6 mm for interior locations, 1.6 mm for exterior doors, commercial quality steel cold rolled to ASTM A653M-96; zinc coated to Z275 coating designation for exterior frames, ZF075 for interior frames;

.1 SCAQMD Rule 1113 – Architectural Coatings
.2 Maximum VOC limit 250 g/l.

.2 Accessories: Glazing stops, floor anchors, channel spreaders, 1.6 mm tee anchors, 1.2 mm wall stud anchors, zinc coated to ASTM A653M, coating designation ZF075 Corrugate tee anchors for masonry bond, drill stud anchors for wire tie to studs and lag bolts, shields and bushing for existing or concrete openings.

.3 Guard Boxes: 0.50 mm steel, ZF075 coating designation zinc finish to ASTM A653M.

.4 Door Bumpers: black neoprene.

.5 Reinforcement for Hardware: carbon steel, prime painted, to the following thicknesses:

Hinge & Pivot reinforcements	30 mm x 250 mm 3.5 mm
Strike reinforcements	1.6 mm
Flush Bolt reinforcements	1.6 mm
Closer reinforcements	2.5 mm
Surface hardware reinforcements	2.5 mm

.6 Door Jamb Reinforcement: 100 mm x 40 mm structural steel channel to CAN3-G40.21.

2.2 FABRICATION

.1 Fabricate frames in accordance with details and approved shop drawings. Provide 100 mm head section where detailed. To Underwriters requirements and provide Underwriters labels.

.2 Mortise, reinforce, drill and tap frames and reinforcements to receive hardware using templates provided. Locate mortising to National Builders Hardware Association Standards.

.3 Install 2 double stud bumpers on strike jamb of frame for each single door and 2 bumpers at head of double door frames.

.4 Protect strike, hinge and overhead concealed door closer reinforcement completely by guard boxes welded to frame.

.5 Attach temporary wood spreaders to frame; ensure proper frame alignment.

.6 Where frames terminate at finished floor, provide floor plates for anchorage to floor structure.

.7 Cut mitres accurately and weld on inside of frame profile.

.8 Grind welded corners to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.9 Fill surface depressions and butted joints with metallic paste filler and sand to a uniform smooth finish.

.10 Touch-up frames by priming areas where galvanizing is damaged.

.11 Reinforce head of frames wider than 1200 mm with 2.5 mm formed steel channel welded in place, flush with top of frame.

.12 Provide three jamb anchors per jamb for frames up to 2130 mm high and one additional for each 600 mm over 2130 mm high.

.13 Minimum depth of stop: 15 mm. Glazing stops butt joints, channel shape 15 mm wide with counter screws.

.14 Reinforce head section at junction with removable mullion.

.15 Reinforce both jambs where door openings occur in screens. Install reinforcing continuous structure to structure.

3. Execution

3.1 INSTALLATION

.1 Set frames in plumb and square at correct elevation. Limit of acceptable frame distortion - 2 mm out of plumb measured on face of frame, maximum twist corner to corner of 3 mm.

.2 Secure anchorages and connections to adjacent construction. Anchor door jamb reinforcement securely to structure.

.3 Brace frames solidly to maintain in position while being built-in.

.4 Install a temporary horizontal wood spreader at mid-height of door opening to maintain frame width until building work completed.

.5 For frames over 1200 mm in width, provide vertical support at the centre of head.

.6 Remove temporary spreaders only after completion of adjacent work.

.7 Co-ordinate grouting of all frames solid to adjacent construction.

.8 Provide formed metal drip section full width of frame opening for exterior doors.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Submittal Procedures	Section 01 33 00.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Operation and Maintenance Data and Manuals	Section 01 78 23.
.4	Hollow metal frames:	Section 08 12 13.
.5	Wood doors:	Section 08 14 16.
.6	Supply of hardware and weatherstripping:	Section 08 70 00.
.7	Glass and glazing:	Section 08 81 00.
.8	Painting:	Section 09 91 05.

1.2 REFERENCE DOCUMENTS

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

.1	ASTM A653 /A653M-09	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
.2	ASTM E90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

.2 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-1.181-99	Ready-Mixed Organic Zinc-Rich Coating
.2	CGSB 41-GP-19Ma -84	Rigid Vinyl Extrusions for Windows and Doors

.3 Canadian Standards Association (CSA):

.1	CAN/CSA-G40.20 /G40.21-04	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
.2	CAN/CSA G164-M92 (R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
.3	CSA W59-03(R2008)	Welded Steel Construction (Metal Arc Welding)

.4 Canadian Steel Door Manufacturers' Association (CSDMA):

.1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000

.2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990

.5 Master Painters Institute:

.1 Master Painters Institute Green Performance Standard GPS-1-08

.6 National Fire Protection Association (NFPA):

.1	NFPA 80-99	Fire Doors and Fire Windows
.2	NFPA 252-03	Fire Tests of Door Assemblies

.7 South Coast Air Quality Management District (SCAQMD), California State:

.1	SCAQMD Rule 1168	June 2006, Adhesives and Sealants Applications

.9 Underwriters' Laboratories of Canada (ULC):

.1	CAN/ULC-S701-05	Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering
.2	CAN/ULC-S702-09	Thermal Insulation, Mineral Fibre, for Buildings
.3	CAN/ULC-S704-03	Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced
.4	CAN4-S104-M80(R1985)	Fire Tests of Door Assemblies
.5	CAN4-S105-09	Fire Door Frames Meeting the Performance Required by CAN4-S104

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 REFERENCE STANDARD

.1 Except as otherwise specified, comply with requirements of Canadian Manufacturing Standards for Steel Doors and Frames published by the Canadian Steel Door and Frame Manufacturers' Association.

1.5 FIRE RATED DOORS

.1 Provide doors produced under label service program of a testing agency acceptable to authorities having jurisdiction.

.2 Doors shall bear testing agency label indicating following:

.1 At standard size openings: fire endurance rating.

.2 At oversized openings: unclassified as to fire rating.

1.6 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's for adhesives.

.2 Shop Drawings:

.1 Clearly indicate each type of door, material, metal thicknesses, mortises, reinforcements, location of exposed fasteners and special features.

.2 Reference door types to door schedule. Indicate door numbers where applicable.

.4 Sustainable Design Submittals:

.1 Submit shop paint primer manufacturer's product data verifying compliance with MPI Green Performance Standard GPS-1-08, for VOC content.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Receive and store materials as recommended by materials manufacturer.

.2 Storage and Handling Requirements:

.1 Adequately protect surfaces from damage during moving, handling and storage.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Management and Disposal.

1.8 QUALITY ASSURANCE

.1 Manufacture fire door and frame components and assemblies to ULC/ULI/Warnock Hersey/Factory Mutual requirements

.2 Testing Agencies: Provide doors produced under label service program of a testing agency acceptable to Authorities Having Jurisdiction, and as follows:

.1 Steel Fire Rated Doors and Frames: Labelled and listed by organization accredited by Standards Council of Canada for ratings specified or indicated.

.2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled:

.1 List by nationally recognized agency having factory inspection service and construct as detailed in Follow-up Service Procedures/Factory Inspection Manuals issued by agency to individual manufacturers.

.2 Fabricate rated doors, frames, and screens to labelling authority standard.

.3 Affix appropriate label to each opening requiring indicating a labelling requirement and as follows:

.1 At standard size openings: fire endurance rating [radiation protection].
.2 At oversized openings: unclassified as to fire rating [radiation protection].

2. Products

2.1 MATERIALS

.1 Sheet Steel: to ASTM A653M commercial quality steel, cold rolled, zinc coated to ZF075 coating designation.

2.2 CORE MATERIAL

.1 Honeycomb core material: rigid pre-expanded resin impregnated kraft paper having maximum 25 mm hexagonal shaped cells.

.2 Fiberglass: to CAN/ULC S702, semi rigid density 24 kg/m3.

2.3 REINFORCEMENT

.1 Reinforcement for Hardware: carbon steel, welded in place, prime painted, to the following thicknesses:

.1	Hinge, pivot and panic bar reinforcements:	3.5 mm
.2	Lock face, flush bolts, concealed bolts:	2.5 mm
.3	Concealed or surface closer reinforcements:	2.5 mm
.4	Other surface hardware reinforcements:	2.5 mm

2.4 ACCESSORIES

.1 Adhesives:

.1 Honeycomb Core: Heat resistant spray grade resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.2 Primer: Touch-up primer to CAN/CBSB -1.181.

.3 Glazing stops: 1.0 mm steel, primed, butt joints, counter sink for screws.

2.5 FABRICATION

.1 Hollow metal doors shall be of seamless construction with no visible seams or joints on faces at vertical edges.

.2 Steel face sheet thickness:

.1 Interior doors: 1.6 mm.

.2 Exterior doors: 1.6 mm.

.3 Core Construction shall be one of the following:

.1 Internally steel stiffened with continuous vertical steel stiffeners at 150 mm O.C. spot welded to both face sheets; fill voids with glass fibre insulation.

.2 Composite construction consisting of honeycomb core with steel face sheets pressure laminated to core.

.4 Refer to door schedule for required classes and ratings of fire doors, glazing or other requirements.

.5 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using templates provided.

.6 Join door faces at intersecting edges with continuous welds, fill and grind smooth. Finish door faces flush without visible joints or distortion.

.7 Close top and bottom edges of door with recessed minimum thickness 1.2 mm steel channel, full width welded. Provide closure channel at top edge of exterior doors. Provide weep holes in exterior door bottom channel.

.8 Make provisions for glass, provide glazing stops. Weld stops to door on security side.

.9 Touch-up doors by priming areas where zinc coating is damaged.

.10 Provide astragals for pairs of doors in accordance with Underwriters requirements.

.11 Profile edge of doors as follows: Single acting swing doors - Bevel 3 mm in 50 mm Double acting swing doors - Radius of 54 mm.

3. Execution

3.1 INSTALLATION

.1 Install doors and hardware in accordance with templates and manufacturer's instructions. Maximum permissible warp of 3 mm measured diagonally across door.

.2 Adjust operable parts for correct function.

.3 Apply hardware to Class 'A' fire rated doors prior to delivery.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Submittal Procedures	Section 01 33 00.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Operation and Maintenance Data and Manuals	Section 01 78 23.
.4	Hollow metal frames:	Section 08 12 13.
.5	Finishing hardware:	Section 08 70 00.
.6	Painting and finishing:	Section 09 91 05.

1.2 REFERENCE DOCUMENTS

.1 Architectural Woodwork Manufacturers Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI):

- .1 Architectural Woodwork Standards, 1st Edition, 2009

.2 American National Standards Institute (ANSI):

.1	ANSI/NPA A208.1-2009	Particleboard
.2	ANSI A208.2-2009	Medium Density Fiberboard (MDF) for Interior Applications

.3 Canadian Standards Association (CSA):

.1	CSA O115-M1982 (R2001)	Hardwood and Decorative Plywood
.2	CAN/CSA O132.2 Series 90(R1998)	Wood Flush Doors

.4 Green Seal: Standards:

.1	GS-11	Green Seal Environmental Criteria for Paint, First Edition, May 1993

.5 National Fire Protection Association (NFPA):

.1	NFPA 80	Fire Doors and Windows
.2	NFPA 252	Fire Tests of Door Assemblies

.6 NLGA National Lumber Grading Authority:

.1	NLGA-07	Standard Grading Rules for Canadian Lumber

.7 South Coast Air Quality Management District (SCAQMD), California State:

.1	SCAQMD Rule 1113	January 2004, Architectural Coatings

.2 SCAQMD Rule 1168 June 2006, Adhesives and Sealants Applications

.8 Underwriters' Laboratories of Canada (ULC):

.1 CAN4 S104 Fire Tests of Door Assemblies

.2 CAN4 S105 Fire Door Frames

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit two copies of WHMIS MSDS Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's for:

.1 Finishes
.2 Adhesives
.3 Sealants

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Clearly indicate door construction and cut-outs for lights and louvres.

.3 Clearly indicate reinforcement for door hardware in mineral core fire rated doors.

.4 Reference door types to Door Schedule; indicate door and frame numbers as applicable.

.3 Samples:

.1 Deliver one additional interior door of most common size shown on Door Schedule.

.2 A door from this range will be taken at random and cut as required to verify compliance with specifications.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver doors and panels to minimize storage on site and when site conditions conform to requirements for storage.

.2 Storage and Handling Requirements:

.1 Store and handle doors and panels in accordance with AWMAC requirements, and as follows:

.1 Arrange delivery after work causing abnormal humidity has been completed.
.2 Protect doors from dampness.
.3 Store doors in well ventilated area, off floor.
.4 Protect doors from scratches, handling marks and other damage.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Management and Disposal.

2. Products

2.1 MATERIALS

.1 Door materials: to meet AWMAC requirements and requirements specified in this Section.

2.2 SOLID CORE DOORS

.1 Flush wood doors: solid core to AWMAC Standard.

.1 Construction:

.1 Solid Particleboard Core: with minimum 57 mm stile and rail frame bonded to particleboard core and as follows:
.1 Reinforcement: with wood lock blocks.
.2 Construction: 5-ply
.3 Use: interior use.
.4 STC Rating: 50
.5 Fire Rating: 45 minute

.2 Solid Wood Core: glued block core with wood edge band and as follows:
.1 Construction: 5-ply.
.2 Use: interior.

.3 Door Thickness: 45 mm overall.

.2 Face Panels:

.1 Birch Veneer:
.1 Grade: B, Sap (white)

.2 Veneer Cut: Rotary.
.3 Match: Book.

.2 Paired doors to have matching veneer pattern for uniform appearance.

.3 Adhesive: Type II (water resistant) for interior use.

2.5 ACCESSORIES

.1 Transom and Side Panels: to match materials and construction of adjacent doors and as follows:

.1 Meeting edges of doors and transom panels to be square.
.2 Veneer of doors and transom panels to be end and colour matched.

2.6 FABRICATION

.1 Fabricate doors in accordance with AWMAC Standards specified in this Section.

.2 Fabricate fire rated doors to sizes required to allow clearances specified in NFPA 80 and as follows. Coordinate with door frames and door hardware to be utilized.

.1 Between door and jamb or head: 3.2 mm maximum.
.2 Between meeting edges of paired doors: 3.2 mm maximum.
.3 Between door and noncombustible finished floor: 19.05 mm maximum.
.4 Between door and floor coverings: 12.7 mm maximum.
.5 Between door and raised noncombustible sill or threshold: 9.5 mm maximum.

.3 Door Edges: provide 13 mm thick vertical edge strips matching face veneer, to AWMAC AWS Edge Detail No.1, and edge profiles at strike side as follows:
.1 Single Acting Swing Doors: bevel 3 mm in 50 mm.
.2 Double Acting Swing Doors: radius of 55 mm.

.4 Prepare doors to receive hardware using templates provided.

2.7 FINISHING

.1 Finish doors using materials specified in Section 09 91 23.

.2 Doors shall be factory finished or finished off-site, at the Contractor’s option.

3. Execution

3.1 INSTALLATION

.1 Protect doors in accordance with AWMAC Standards.

.2 Install doors and hardware in accordance with templates and hardware manufacturer's instructions.

.3 Adjust hardware for correct function.

.4 Secure transoms and side panels by means of [stops] [concealed fasteners] [countersunk screws concealed by means of wood plugs matching panel in grain and colour].

.5 Prepare doors for specified finish. Protect labels for rated doors from finish.

3.2 ADJUSTMENT

.1 Re-adjust doors and hardware to function freely and properly just prior to completion of work.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Waste Management and Disposal — Section 01 74 19.

1.2 REFERENCE DOCUMENTS

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

.1	ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
.2	ASTM A36	Standard Specification for Carbon Structural Steel, Hot Rolled Steel
.3	ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
.4	ASTM A312	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
.5	ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
.6	ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
.7	ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
.8	ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.3 SUBMITTALS

.1 Product Data: Submit for action, product data for each type and size of overhead coiling door and accessory including the following:
- .1 Summary of forces and loads on walls and jambs
- .2 Include description of fire release system including testing and resetting instructions

.2 Shop Drawings: Submit for Consultants action shop drawings for special components and installations not dimensioned or detailed in manufacturer's product data.

.3 Samples for Initial Selection: Submit for Consultants action manufacturer's colour charts showing full range of colours available for units with factory applied finishes for initial selection.

.4 Certificates: Submit for Consultants action certification for door assemblies having fire ratings of labelled assemblies.

.5 Source Quality Control Testing: Submit for Consultants action documentation from a certified testing agency indicating that fire door self closing governor mechanism and fire door operator meet specified performance requirements.

1.4 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit for Consultants action manufacturer's written instructions for operations and maintenance procedures, include name of original installer and contact information:

1.5 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where overhead coiling doors are required to fit within openings; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating overhead coiling doors without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions.

2. Products

2.1 MATERIALS

.1 Curtains: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand lateral loading up to 10 PSF (0.5 kPa), in a continuous length for width of door without splices with slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

.1 Steel Door Curtain Slats: Zinc coated (galvanized), cold rolled structural steel (SS) sheet; in accordance with ASTM A653M, Z275 coating designation:

.2 Minimum Core Metal (Uncoated) Thickness: 0.72 mm.

.3 Flat profile slats 38 mm high x 13 mm deep.

.2 Endlocks: Stamped, hot-dipped, galvanized endlocks riveted (solid rivets, minimum 6 mm thick) to each end of alternate slats to prevent lateral movement and to limit slat deflection and bending stress.

.3 Bottom Bar: (Match to slat material) Double Angle Extruded Aluminum Bottom Bar of minimum 25 mm x 38 mm x 3 mm, designed to reinforce curtain bottom. Finish to match curtain.

.4 Curtain Jamb Guides: Fabricate curtain jamb guides of steel sheet, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand

loading. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent over travel of curtain.

.5 Removable Posts and Jamb Guides: Manufacturer's standard.

.6 Integral Frame, Hood, and Fascia:
- .1 Fabricate from minimum 1.5 mm thick, hot dip galvanized steel sheet with Z275 zinc coating, in accordance with ASTM A653M.
- .2 Contour to fit end brackets; roll and reinforce top and bottom edges for stiffness.
- .3 Provide closed ends for surface mounted hoods and provide fascia for any portion of between jamb mounting projecting beyond wall face; provide intermediate support brackets to prevent sagging.
- .4 Hood Material: Fabricate hoods for steel doors of minimum 0.72 mm thick, hot dip galvanized steel sheet with Z275 zinc coating, in accordance with ASTM A653M.
- .5 Shape: Square.

2.2 COUNTERBALANCE MECHANISM

.1 Counterbalance doors using adjustable tension, steel helical torsion spring mounted around steel shaft and contained in spring barrel connected to door curtain with barrel rings using manufacturer’s standard grease sealed or self lubricating graphite bearings for rotating members.

.2 Fabricate spring barrel from hot formed, structural quality, welded or seamless carbon steel pipe, of sufficient diameter and wall thickness to support rolled up curtain without distortion of slats and to limit barrel deflection to not more than 2.5 mm/m of span under full load.

.3 Fabricate spring balance from one or more oil tempered, heat treated steel helical torsion springs; size springs to counterbalance weight of curtain with uniform adjustment accessible from outside barrel; include cast steel barrel plugs to secure ends of springs to barrel and shaft.

.4 Fabricate torsion rod for counterbalance shaft of cold rolled steel, sized to hold fixed spring ends and carry torsion load.

.5 Provide manufacturer's standard cast iron or cold rolled steel plate mounting brackets.

2.3 LOCKING

.1 Provide slide locks for latching and locking door on coil side bottom bar at each jamb extending into slots in guides.

2.4 OPERATION

.1 Opening / closing: manual push-up.

2.5 FINISHES

.1 Steel and Galvanized Steel Finishes: Manufacturer's standard powder coat finish consisting of primer and topcoat; colour selected from manufacturer’s complete colour line.

3. Execution

3.1 EXAMINATION

.1 Verify that dimensions are correct and project conditions are in accordance with manufacturer's installation instructions; do not proceed with installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

.1 Install units in accordance with manufacturer's instructions.

.2 Install units plumb and true, free of warp or twist, and within tolerances specified by manufacturer for smooth operation.

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 This Section includes requirements for supply and installation for manually operated side folding grilles intended to function as a security barrier.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Metal Fabrications:	Section 05 50 00
.2	Door Hardware:	Section 08 70 00

1.3 REFERENCE DOCUMENTS

.1 Aluminum Association (AA):

.1	DAF 45-03	Designation System for Aluminum Finishes.

.2 American Architectural Manufacturers Association (AAMA):

.1	AAMA 609.1-85	Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.

1.4 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.2 Product Data: Submit manufacturer's printed product literature, specifications and data sheets for each size of side folding grille and accessory.

.3 Shop Drawings: Submit shop drawings for special components and installations not dimensioned or detailed in manufacturer's standard product literature; indicate assembly and instruction details, dimensions of fabrication, required clearances materials, finishes, and hardware.

.4 Samples for Verification: Submit two (2) samples of each type of exposed finish required, prepared on samples of size indicated below for final verification:

.1 Door Curtain: 300 mm long
.2 End Post: 150 mm long.
.3 Intermediate Post: 150 mm long.
.4 Lead Post: 150 mm long.
.5 Floor Guide: 150 mm long.
.6 Panel Inserts: 300 mm long.

1.5 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for side folding grilles and closures and hardware for incorporation into manual specified in Section 01 78 43 – Operation and Maintenance Data and Manuals.

1.6 QUALITY ASSURANCE

.1 Regulatory Agencies: Provide electrical components, devices and accessories, motors, controls and wiring conforming to CSA Standards and CSA labelled in accordance with requirements of Authority Having Jurisdiction.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Manufacturer: Obtain products listed in this Section from listed manufacturers and that have local distribution for the past two (2) years.

.2 Installers: Use installers that have completed manufacturer's authorized training program and that certified to install and maintain units delivered for this Project.

2. Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar setting systems may be incorporated into the work provided they meet the performance requirements established by the named products.

.2 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:

.1 Cookson Company
.2 Cornell Ironworks
.3 Dynamic Closures Corporation
.4 Dynaflair Corp. Canada Inc.
.5 Kinnear/Wayne-Dalton Corporation
.6 Mobileflex
.7 Overhead Door Corporation

2.2 SIDE FOLDING GRILLES

.1 Curtain:

.1 Top and Bottom of each section fitted with an aluminum panel 102 mm high. Panel consists of aluminum extrusion 1.6 mm thick and composed of modules with a 15° angle between them to facilitate the operation of the closure.

.2 Curtain is constructed of 152 mm wide modules linked together by a continuous aluminum hinge.

.3 Panels: "Self-extinguishing" copolyester panels 140 mm wide and 1.6 mm thick. Each panel is entirely recessed in the aluminum hinge throughout its full height.

.2 Locking:

.1 Lead Post: Hook bolt lock with cylinders each side, and engage a full height wall jamb.

.2 Trailing Post: Self-locking at the top and bottom inside the storage pocket.

.3 Free Floating Intermediate Posts: Located at curves and at recommended intervals of 3000 mm, with self- adjusting spring loaded drop bolts activated from the inside only. Drop bolts engage dustproof stainless steel receptacles

.2 Track: Recessed track, hung from overhead track 33 mm wide by 40 mm high, tempered aluminum alloy 6351-T6. Where required for curves, 356 mm radius standard.

2.3 STACKING POCKET

.1 Provide stacking pocket for grille in closed position. Stacking arrangement suitable for grille layout. Include locking hinged doors on pocket.

2.4 ACCESSORIES

.1 Provide accessories as recommended by Manufacturer for complete installation.

.2 Provide support structure for grille as detailed.

2.5 ALUMINUM FINISHES

.1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

.2 Clear Anodized Finish:

.1 Class I Finish: Architectural Class I, clear coating 0.018 mm or thicker in accordance with AAMA 611.

2.6 OPERATION

.1 Equip grille for operation by:

.1 Hand, install handles.

3. Execution

3.1 INSTALLATION

.1 Install side folding grilles, operating equipment and required hardware, jamb and head moulding strips, anchors, inserts, hangers, and equipment supports in accordance with shop drawings, manufacturer's written instructions and as specified.

.2 Install master keyed cylinder coordinate with Section 08 70 00.

.3 Adjust operating components to ensure smooth opening and closing of side folding grilles and closures.

3.2 CLEANING

.1 Perform cleaning of aluminum components in accordance with: AAMA 609.1 - Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.

.2 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.3 Clean aluminum and stainless steel with damp rag and approved non-abrasive cleaner in accordance with manufacturer's instructions.

.4 Remove traces of primer, caulking materials; clean grilles and frames.

.5 Clean panels materials with approved non-abrasive cleaner.

.5 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

1. General

1.1 SUMMARY

.1 Install operable glass partitions and suspension system in accordance with the contract documents.

1.2 SUBMITTALS

.1 Action Submittals:

.1 Product Data: Submit product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

.2 Shop Drawings: Submit shop drawings shop drawings detailing fabrication and assembly for operable glass partitions and suspension system including plans, elevations, sections, details, and attachments to other work.

.2 Submit Shop Drawings indicating construction and installation details.

1.3 REFERENCE DOCUMENTS

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

.1 ASTM E557 Standard Practice for the Installation of Operable Partitions.

.2 ASTM C1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass

2. Products

2.1 TOP SUPPORTED, INDIVIDUAL GLASS WALL PANEL PARTITION

.1 Panel Description: Top supported, individual, omni-directional, acoustically insulated glass panels.

.1 Dimensions: Nominal 102 mm thick x manufacturer's standard width adjusted to fit between wall assemblies indicated on Drawings.

.2 Glass Face Panel Weight: Sealed double glazed tempered glass unit. Nominal ± 9.9 lbs./ft^2, adjusted to account for manufacturer's assembly. Refer to and coordinate with Section 08 81 00 for glazing. Refer to Section 08 87 00 for glazing film on #3 surface.

.3 Face Construction: factory installed sealed double glazed tempered glass unit with sandblasted finish.

.4 Frames: Manufacturer's standard steel, 1.42 mm thickness, with rust inhibitor coating and integral factory applied aluminum vertical edge and face protection.

.5 Seals: Manufacturer's standard interlocking acoustical seals as follows:

.1 Vertical Panel Seals: Tongue and groove configuration, ensure panel-to-panel alignment and prevent sound leaks between panels.

.2 Top and Bottom Horizontal Seals: Continuous contact, multilayer, vinyl sweep seal, 25 mm. Top seals maintain contact with track and bottom seals maintain contact with floor or other surface along path of wall. Bottom horizontal seal 51 mm fixed, continuous contact multi-layer vinyl sweep.

.2 Suspension System:

.1 Track: Manufacturer's standard duty track fabricated from extruded clear anodized architectural grade extruded aluminum alloy 6063-T6. Connected to structural support pairs 10 mm diameter threaded steel hanger rods. L, T, or X intersections factory assembled and welded.

.2 Each panel supported by two 2-wheeled dual horizontal counter-rotating carriers.

.3 Finishes: aluminum parts clear anodized with matching gaskets.

.4 Operation: Panels manually moved from storage area, positioned in the opening and the seals set.

.5 Acoustical Performance: STC 45 when tested in accordance with ASTM E90.

2.2 TOP SUPPORTED, PAIRED GLASS WALL PANEL PARTITION

.1 Panel Description: Top supported pairs of acoustically insulated glass panels.

.1 Dimensions: Nominal 102 mm thick x manufacturer's standard width adjusted to fit between wall assemblies indicated on Drawings.

.2 Glass Face Panel Weight: Sealed double glazed tempered glass unit. Nominal ± 9.4 lbs./ft^2, adjusted to account for manufacturer's assembly. Refer to and coordinate with Section 08 81 00 for glazing. Refer to Section 08 87 00 for glazing film on #3 surface.

.3 Face Construction: factory installed sealed double glazed tempered glass unit with sandblasted finish.

.4 Frames: Manufacturer's standard steel, 1.42 mm thickness, with rust inhibitor coating and integral factory applied aluminum vertical edge and face protection.

.5 Seals: Manufacturer's standard interlocking acoustical seals as follows:

.3 Vertical Panel Seals: Tongue and groove configuration, ensure panel-to-panel alignment and prevent sound leaks between panels.

.4 Top and Bottom Horizontal Seals: Continuous contact, multilayer, vinyl sweep seal, 25 mm. Top seals maintain contact with track and bottom seals maintain contact with floor or other surface along path of wall. Bottom horizontal seal 51 mm fixed, continuous contact multi-layer vinyl sweep.

.2 Suspension System:

.1 Track: Manufacturer's standard duty track fabricated from extruded clear anodized architectural grade extruded aluminum alloy 6063-T6. Connected to structural support by pairs of 10 mm diameter threaded steel hanger rods.

.2 Each panel supported by one 4-wheeled carrier, wheels hardened steel ball bearings encased with molded polymer tires.

.3 Finishes: aluminum parts clear anodized with matching gaskets.

.4 Operation: Panels manually moved from storage area, positioned in the opening and the closure panel is closed or extended. Lever closure panel with expanding jamb which compensates for minor wall irregularities and provides a minimum of 113.4 kg seal force against the adjacent wall for optimum sound control.

.5 Acoustical Performance: STC 45 when tested in accordance with ASTM E90.

3. Execution

3.1 EXAMINATION

.1 Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of work.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install frame in accordance manufacturer's recommendations and installation instructions. Properly flash and waterproof around the perimeter of the opening.

.2 Installer to provide appropriate anchorage devices and to securely and rigidly fit frame in place, absolutely level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.

.3 Install panels, handles and lock set in accordance with manufacturer's recommendations and installation instructions.

.4 Adjust hardware for proper operation.

3.3 ADJUSTING

.1 Adjust operating hardware for smooth operation in accordance with hardware manufacturers' written instructions.

3.4 PROTECTION

.1 Protect aluminum finishes and glazing during erection against disfiguration, contamination or damage by abuse or harmful materials.

.2 Install protective cover where exposure to damage is critical.

.3 Mark each light with large cross or other symbol to make glass obvious and noticeable to other trades after glass is installed, using substance that will not stain, mark or "shadow" glass either by itself or by reaction with sunlight, moisture or the environment; masking tape is not considered as a suitable material; replace glass units marked with masking tape.

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 This Section specifies requirements for door operators providing the following type of operation, as defined in this Section:

.1 Low energy power operated.

.2 This Section includes supply and installation of the following:

.1 Surface mounted, enclosed, electro-mechanical operator.
.2 Electronic controls.
.3 Activating devices.
.4 Accessories
.5 Mounting rails or posts.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Submittal Procedures	Section 01 33 00.
.2	Shop Drawings, Product Data and Samples	Section 01 33 23.
.3	Metal Fabrications: Mounting rails or posts:	Section 05 50 00.
.4	Joint Sealants: Sealants between frames and building components:	Section 07 92 00.
.5	Hollow Metal Frames	Section 08 12 13,
.6	Hollow Metal Doors	Section 08 13 13.
.7	Hardware:	Section 08 70 00.
.8	Electrical connection:	Division 26.

1.3 REFERENCE DOCUMENTS

.1 American National Standards Institute (ANSI)/Builders Hardware Manufacturers Association Inc. (BHMA):

.1	ANSI/BMHA A156.10	Power Operated pedestrian Doors
.2	ANSI/BHMA A156.19	Power Assist and Low Energy Power Operated Doors

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

.1	ASTM A167-99(R2009)	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
.2	ASTM A653M-09	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

.3 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-1.88-92	Gloss Alkyd Enamel, Air Drying and Baking
.2	CAN/CGSB 1.121-93	Vinyl Pretreatment Coating for Metals (Vinyl Wash Primer)

.4 Canadian Standards Association (CSA):

.1	CAN/CSA-G40.21-04	Structural Quality Steels
.2	CAN/CSA-G164-M92(R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles

.5 National Research Council of Canada (NRCC):

.1	NRCC 22432-83	Measures for Energy Conservation in New Buildings

.6 Underwriters' Laboratories of Canada (ULC):

.1	CAN/ULC S524-06	Installation of Fire Alarm Systems
.2	CAN/ULC S533-08	Egress Door Securing and Releasing Devices

.7 Construction Specifications Canada (CSC):

.1	CSC TEK.AID O8460-91	Automatic Entrance Doors

1.4 DEFINITIONS

.1 Low Energy Power Operated Doors: doors with a power mechanism that opens and closes the door upon receipt of an actuating signal and does not generate more kinetic energy than specified in ANSI/BHMA A156.19. Closing of doors is linked to and integral with power operator mechanism.

.2 Low Energy Power Open Doors: self-closing doors with a power mechanism that opens the door upon receipt of an actuating signal and does not generate more kinetic energy than specified in ANSI/BHMA A156.19. Closing of doors is independent of power operator mechanism.

1.5 PERFORMANCE REQUIREMENTS

.1 Meet or exceed performance requirements of ANSI/BHMA A156.19.

.2 Doors shall operate smoothly, quietly, safely and consistently.

.3 Force required to manually open doors shall not be more than force required in event of operator failure.

.4 Comply with Alberta Building Code requirements for door release hardware at required exits and accessibility signs.

.5 Hold-open Time:

.1 Push Plate/Button Activation: field-adjustable from 5 to 30 seconds.

.2 Door Movement Switch Activation: less than 1 second.

1.6 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings

.1 Submit shop drawings in accordance with Division 01.

.2 Clearly indicate the following:

.1 Components, materials, and finishes.
.2 Dimensions and relationship to surrounding construction, using plan view, elevation views, and section details.
.3 Plan view showing door swing in relation to surrounding construction.
.4 Installation wiring diagrams.

.3 Submit duplicate samples of finishes of exposed system components.

1.7 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data:

.1 Submit operation and maintenance data including the following:

.1 Parts lists referenced to isometric exploded view of door operator.

.2 Schematic wiring diagrams including all components, switching devices and current characteristics.

.3 Manufacturer's recommendations for servicing frequencies, adjustment and operation applicable to each component.

.4 Description of remedial action required to correct possible operational deficiencies.

2. Products

2.1 OPERATORS

.1 Type: electro-mechanical, surface-mounted to door frame header, connected to door with pivoting linkage arm.

.2 Motor: electric, permanent magnet, minimum 1/12 HP (60W) DC motor, equipped with circuit protection, connections for power and control wiring, and suited to building's electrical service at point of installation.

.3 Provide semi-concealed, readily accessible, "on-off" switch.

.4 Gears shall be in an air-tight, gasketed gear box concealed within operator enclosures.

.5 Operators shall be equipped with a clutch mechanism as required to meet performance and regulatory requirements.

2.2 ELECTRONIC CONTROLS

.1 Electronic controls shall be solid state, low voltage.

.2 Provide readily accessible, semi-concealed "on-off" switch.

2.3 ACTIVATING DEVICES

.1 Provide hard-wired push plates and hardwired pushbuttons as indicated on drawings.

.2 Pushplates: 100 mm diameter round or square, stainless steel.

.3 Pushbuttons: red plastic, in 45 mm x 110 mm switch plates.

2.4 OPERATOR ENCLOSURES

.1 Provide manufacturer's standard, surface mounted enclosure, designed to prevent entry of dust.

.2 Enclosure shall allow ready access for adjustments, servicing and maintenance of operator and controls.

.3 Enclosures Finish:

.1 Plastic: colour of finish shall be compatible with adjacent door frame, as determined by Owner.

.2 Aluminum: anodized finish.

2.5 RAILS AND POSTS

.1 Rails and posts shall be designed for concealed mounting of activating devices.

.2 Rails: aluminum, manufacturer's standard profile.

.3 Posts: aluminum, cross-section dimensions 100 x 100 mm.

.4 Materials shall be as follows:

.1 Aluminum Extrusions: to alloy 6063, temper T5.

.2 Galvanized Steel: to CAN/CSA-G40.21, Grade 300W, hot dip galvanized with minimum Z275 coating designation to ASTM A653M.

.3 Stainless Steel: to ASTM A167, Type 304.

.5 Steel Clips, Supports and Reinforcement: to CAN/CSA-G40.21, minimum 6.0 mm thick, hot-dip galvanized to CAN/CSA-G164.

2.6 ACCESSORIES

.1 Provide recessed international symbol of accessibility (ISA) and the following clearly legible wording under ISA's: "PUSH TO OPEN", on push plates where indicated on drawings.

.2 Push plates and identification plates shall be stainless sheet steel, satin finish. Letters on plates shall be recessed, in colour matching symbol of accessibility, in upper case, and helvetica medium font.

.3 Identification plates shall be minimum 100 mm x 100 mm.

.4 Push buttons shall be red, in stainless steel cover plate.

.5 Fasteners:

.1 Materials for Fastening Metals to Metals: aluminum, nonmagnetic stainless steel, or cadmium plated steel, finished to match adjacent material.

.2 Materials for Fastening Metals to Concrete and Masonry: stainless steel or carbon steel, hot dip galvanized to CAN/CSA-G164.

.3 Provide tamper-resistant exposed fasteners for mounting devices and to replace batteries in exterior locations and interior public spaces.

.6 Provide concealed overhead door holder at each door to receive operator, finish to match existing hinges.

.7 Finger Guards: to ANSI/BMHA A156.10.

2.7 FINISHES

.1 Factory finish components.

.2 Hardware: match door hardware.

.3 Stainless Steel: no. 4, satin finish.

.4 Aluminum: manufacturer's standard clear.

.5 Exposed Steel: apply finishes as follows:

.1 Primer: Vinyl Wash Primer to CAN/CGSB 1.121.

.2 Finish Coats: two coats of Quick Drying Gloss Enamel to CAN/CGSB-1.88.

3. Execution

3.1 INSTALLATION

.1 Install components as indicated on drawings to manufacturer's recommendations.

.2 Install door holders to limit doors to opening swing specified.

.3 Install operators on interior side of exterior entrances.

.4 Install rubber dampening devices to sound isolate operators from door frames.

.5 Isolate aluminum surfaces from contact with cementitious materials, using thick coating of bituminous paint. Let paint dry before installation of aluminum component.

.6 Remove existing finger guards at pivot jambs of existing centre-pivoted doors and replace with new finger guards.

.7 Conceal wiring between activating devices and operators. Conceal wiring in as indicated on drawings.

3.2 ADJUSTING

.1 After completing installation, adjust for optimum, smooth operation.

.2 Adjust door hold open time to 5 seconds or as directed by Province.

END OF SECTION

1. General

1.1 SUMMARY

.1 Provide Curtain Wall and Glazed Assemblies in accordance with requirements of the Contract Documents.

1.2 DEFINITIONS

.1 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to produce delegated design submittals and shop drawings to meet the requirements of the Project, and registered in the province of the Work, and who is not the Consultant.

.2 Equal Dimensions: Curtain wall assemblies indicating equal dimensions on the drawings shall be calculated to align with in-place structural elements followed by even division of the space between structural elements. This shall mean that curtain wall materials are evenly spaced between adjacent structural members, not necessarily evenly spaced across the entire wall assembly.

1.3 REFERENCE STANDARDS

.1 Aluminum Association (AA):

.1 Aluminum Design Manual

.2 American Architectural Manufacturer's Association (AAMA):

.1 AAMA 501, Methods of Test for Exterior Walls

.2 AAMA 501.4, Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts

.3 AAMA 501.6, Recommended Dynamic Test Method For Determining The Seismic Drift Causing Glass Fallout From A Wall System

.4 AAMA 611, Voluntary Specification for Architectural Anodized Aluminum

.5 AAMA 1503, Voluntary Test Methof for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

.6 AAMA CW-DG-1, Curtain Wall Design Guide

.7 AAMA CWG-1, Installation of Aluminum Curtain Walls

.8 AAMA CW-RS-1, The Rain Screen Principle and Pressure Equalized Wall Design

.9 AAMA RPC, Rain Penetration Control: Applying Current Knowledge

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

.1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.

.2 ASTM A167, Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.3 ASTM B209/209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

.4 ASTM B221/B221M, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

.5 ASTM B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

.6 ASTM C920 Standard Specification for Elastomeric Joint Sealants.

.7 ASTM E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

.8 ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

.9 ASTM E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

.10 ASTM E997, Standard Test Method for Structural Performance of Glass in Exterior Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Destructive Methods

.11 ASTM E998-, Standard Test Method for Structural Performance of Glass in Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Nondestructive Method

.4 Canadian Standards Association (CSA):

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

.2 CSA W47.1, Certification of Companies for fusion Welding of Steel Structures

.3 CSA W47.2, Aluminum Welding Qualification Code.

.4 CSA W59, Welded Steel Construction (Metal Arc Welding), Metric

.5 CSA W59.2, Welded Aluminum Construction

.5 Canadian Welding Bureau (CWB Group Industry Services):

.1 CWB 112E, 93-1, Welding Symbols Study Guide

.2 CWB 113E, 94-1, Weld Quality and Examination Methods Study Guide

.6 The Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):

.1 Surface Preparation Guidelines:
.1 SSPC-SP COM Surface Preparation Commentary for Steel and Concrete Substrates
.2 SSPC-PS Guide 12.00, Guide to Zinc-Rich Coating Systems

.7 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S702, Standard for Mineral Fibre Thermal Insulation for Buildings.

1.4 SUBMITTALS

.1 Product Data: Submit for Consultant's action. Furnish manufacturer's literature, specifications and installation instructions describing the general properties of each material and accessory to be used in the Work.

.2 Shop Drawings: Submit for Consultant's action. Furnish shop drawings prepared by or under the supervision of the delegated design professional engineer detailing fabrication and installation of the Work. Prepare details at not less than 1:5 minimum scale. Indicate all materials and finishes. Details of curtain wall and adjacent construction to which work of this section will be attached, and adjacent work attached to work of this section, including but not limited to.

.1 Connections and anchor requirements

.2 Type, size and spacing of fastening devices

.3 Design loads

.4 Connections to adjacent air and vapour membranes

.5 Internal drainage

.6 Sealant locations

.7 Seal of a professional engineer registered in the Province of the Work for details requiring structural design for load bearing, or life/health safety.

.3 Samples: Submit for Consultant's action. Label samples to indicate product, characteristics, and locations in the Work. Samples will be reviewed for color and appearance only. Compliance with all other requirements is the exclusive responsibility of the Contractor. Furnish samples for each finish and color required. Furnish sample finishes on the required metal, in 300 mm lengths of extrusion or 300 mm squares of sheet or plate, showing maximum range or variation in color and shade, and matching the Consultant's sample.

.4 Delegated Design Submittals: Submit for Consultant's information. Furnish letters of commitment and compliance as follows.

.1 Provide Letter of Commitment in conjunction with shop drawings, signed and sealed by the professional engineer required by the Work of this Section indicating the following are designed to the intent of the Building Code.
- .1 Curtain wall connections to building structure.
- .2 Curtain wall reinforcement.
- .3 Deflection of members
- .4 Glass thickness as it relates to glass area

.2 Provide Letter of Compliance, signed and sealed by the professional engineer required by the Work of this Section indicating that connections, reinforcement and deflection criteria, and glass thickness of installed system is in compliance with the intent of the Building Code and reviewed shop drawings before declaration of Substantial Performance.

1.5 QUALITY ASSURANCE

.1 Contractor's Quality Control Responsibilities: Contractor is solely responsible for quality control of the Work.

.2 Qualifications:

.1 Firm producing and executing the work in this section shall have a minimum of ten consecutive years experience in work of similar scope and nature to that specified.

.2 Installer shall be prepared to prove to the Owner's satisfaction, that he has adequate facilities and skilled personnel suitable for design, engineering, detailing, fabrication and installation of the glazed wall assembly.

.3 Installer: Installer shall be capable of assuming delegated design engineering responsibility, performing Work of this Section and who is acceptable to manufacturer for the type of work specified.

.4 Delegated Design Professional: Retain a licensed Professional Engineer, registered in the Province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including, but not limited to, the following.
.1 Seal and signature to shop drawings and design submittals.
.2 Site review of installed components.

.3 Certifications: Provide the following during the course of the Work:

.1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction.

.4 Letters of Commitment and Compliance: Provide documents prepared by the delegated design professional engineer as recommended by APEGA's Responsibilities for Engineering Services for Building Projects.

.5 Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations Authorities Having Jurisdiction. Obtain necessary approvals from all such authorities.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 General: Deliver fabricated units and component parts to project site completely identified in accordance with erection diagrams. Store in dry protected location off ground in accordance with manufacturer's instructions. Protect from damage, including from weather and construction activities. Handle and store material in such that no damage will be done to the materials or to the work of other sections. Remove temporary protection after installation. Do not leave coating residue on any surface.

1.7 WARRANTY

.1 Provide manufacturers written warranty, signed and issued in the name of Owner, to replace the following items for defective material and workmanship for the time stated from date of Substantial Performance:

.1 Framing, panels and glazing: Failure of performance requirements specified; 2 years.

.2 Sealed glass units: misting, dusting and seal failure; as indicated in Section 08 81 00.

.3 Joint sealants, caulking: Failure to maintain seal; 2 years.

.4 Aluminum brake shapes: oil-canning and delaminations; 2 years.

.5 Finishes: Failure specified finishes not attributable to normal weathering; 20 years.

2. Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 A & D Prevost Inc.

.2 Alumicor Limited

.3 Desa Glass

.4 Ferguson Glass Western Ltd.(Engineered Aluminum Products Inc. (EAP))

.5 Kawneer Canada Ltd.

.6 US Aluminum/CRL

2.2 DESIGN CRITERIA

.1 Fire Performance: "Class A" classification in accordance with NFPA 101: Life Safety Code and CAN/ULC-S102.2.

.2 System Design: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as calculated in accordance with the Alberta Building Code (ABC) as measured in accordance with ASTM E330.

.3 Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with the Alberta Building Code (ABC).

.4 Size glass units and dimensions to limits established in CAN/CGSB 12.20.

.5 Structural Performance: Provide aluminum-framed systems tested according to ASTM E330 as follows:

.1 Wind Loads: As indicated on Structural Drawings.

.2 Seismic Loads: As indicated on Structural Drawings.

.3 Deflection of Framing Members: in accordance with CAN/CSA S157.

.4 Deflection Normal to Wall Plane: Test pressure shall be wind load indicated on Structural Drawings. Deflection shall not exceed 1/175 of clear span, when subjected to uniform load deflection test.

.5 Deflection Parallel Glazing Plane: Test pressure shall be 1.5 times wind load indicated on Structural Drawings. Deflection of members carrying full dead load shall not exceed amount that will reduce glass bite below 75 percent of design dimension or edge clearance between member and fixed glass or other fixed member above to less than 3 mm. Clearance between the member and operable door or window shall be at least 1.5 mm.

.6 Structural Performance: Provide tests according to ASTM E330 as follows:

.1 When tested at positive and negative wind-load design pressures, system does not evidence deflection exceeding specified limits.

.2 When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.

.3 Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

.6 System Assembly: Accommodate without damage to system, components or deterioration of seals, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads, deflection of structural support framing, tolerance of supporting components, creep of structural members, interstory drift, and a mid-span slab edge deflection of 34 mm nominal. Thermal Resistance of Assembly (Frame and Glass Unit): minimum of R of 4.5.

.7 Air Infiltration: Limit air infiltration through assembly to 0.03 l/s/sq m (0.06 cfm/min/sq ft) at a static air pressure differential of 300 Pa (6.24 psf). as tested in accordance with ASTM E283.

.8 Condensation Resistance Factor: CRF of not less than 85frame and 80glass when measured in accordance with AAMA 1503.

.9 Water Leakage: None at a static air pressure differential of 720 Pa (15 psf) as defined by AAMA 501, when tested in accordance with ASTM E331 and ASTM E 547.

.10 Expansion / Contraction:

.1 System to provide for expansion and contraction within system components caused by a cycling temperature range of 95 degrees C over a 12 hour period without causing detrimental affect to system components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss. Operable units shall function normally over specified range.

.2 No buckling; stress on glass; sealant failure; excess stress on framing, anchors and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

.11 System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

.12 Air and Vapour Seal: Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound. Position thermal insulation on exterior surface of air barrier and vapour retarder.

.13 Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

.14 Tolerances to Specified Characteristics: This specification indicates values as component characteristic tolerance limits. If, upon testing and evaluation, the assembly exceeds maximum limits or fails to meet minimum limits, compensation to the Owner is required to address heating/cooling system adjustments or changes, required re-design and retesting, and the loss of any LEED credits.

.15 Snow-Load Design: Design and size components to withstand dead loads and live loads caused by snow accumulation loads acting normal to the plane of glazing; calculate in accordance with code for snow drifting consideration.

2.3 MATERIALS

.1 Aluminum: Materials recommended by manufacturer for type of use and finish indicated, and as follows:

.1 Sheet and Plate: In accordance with ASTM B209/B209M, and ANSI H35.1 AA1100-H14, or AA5005-H32 or H34, anodizing quality.

.2 Extruded Bars, Rods, Profiles, and Tubes: In accordance with ASTM B221/B221M, and ANSI H35.1 AA6063 T6, anodizing quality.

.3 Extruded Structural Pipe and Tubes: In accordance with ASTM B429, and ANSI H35.1 AA6061-T6 or AA6063-T6, anodizing quality.

.4 Structural Profiles: In accordance with ASTM B308/B308M, anodizing quality.

.5 Welding Rods and Bare Electrodes: CSA W59.2.

.2 Steel Reinforcement: Coat steel with manufacturer's standard corrosion resistant primer applied immediately after surface preparation and pre-treatment, and as follows:

.1 Rolled Sheet or Strip: CSA G40.20/G40.21.

.2 Structural Shapes, Plates and Bars: CSA G40.20/G40.21.

.3 Brackets and Reinforcements: Manufacturer's standard high strength aluminum with non-staining, nonferrous shims for aligning system components.

.4 Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.

.1 Use self locking devices where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration.

.2 Reinforce members as required to receive fastener threads.

.3 Use only concealed fasteners, unless use of exposed fasteners has been accepted in writing by the Consultant.

.4 Exposed fasteners stainless steel unless otherwise indicated.

.5 Finish exposed portions to match framing system.

.6 Use slip joint linings, spacers, and sleeves at movement joints of material and type recommended by manufacturer.

.5 Anti-Rotation Channels: Extruded aluminum anti-rotation channel designed to mechanically retain air seal membrane to the face of the tubular back section.

.6 Anchors: Three way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

.7 Concealed Flashing: Manufacturer's standard corrosion resistant, non-staining, non-bleeding flashing compatible with adjacent materials.

.8 Transition Membranes: Full length mechanically anchored, extruded silicone rubber transition membrane to perimeter of SSG frame profile to provide continuous air/vapour retarder to adjacent wall construction:

.1 Basis-of-Design Materials: Tremco Proglaze ETA Engineered Transition Assembly

.9 Glazing Gaskets: Manufacturer's standard sealed corner pressure glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers; as recommended by manufacturer for joint type.

.10 Thermal Barrier: two parallel, glass reinforced nylon strips forming continuous composite assembly. Basis of Design: Kawneer Isoweb thermal break

2.4 AUXILIARY MATERIALS

.1 Sheet Metal for Metal Air/Vapour Barriers: Galvanized steel, ASTM A653/A653M, minimum 0.84 mm sheet steel, with minimum 380 g/m galvanized coating weight.

.2 Zinc-Rich Primer for Touch-Up / Field Application: Solvent based, zinc rich coating. Minimum 79% zinc content in dried film. Provide for field repair of galvanized surfaces and select for compatibility with other paints used.

.1 W.R. Meadows of Canada Ltd. “Sealtight Galvafroid Zinc Rich Coating”

.2 Sherwin-Williams Company of Canada Ltd “Zinc Clad No. 7 Organic Zinc Rich Primer”

2.5 ENTRANCES

.1 Door Type (Interior Vestibule Door)

.1 Construction: Medium stile, non-thermally broken frame sections and thermally broken.

.2 Dimensions: 88.9 mm vertical stiles, 88.9 mm top, 165.1 mm bottom rail, 44.5 mm deep.

.3 Glazing Method: Bevelled stops for single glazing and Square stops for sealed glazing, with non-removable glazing stops on outside of door.

.4 Basis of Design: To match Kawneer 350 IR Entrance

.2 Door Type (Exterior Entrance Door):

.1 Construction: Medium stile, non-thermally broken frame sections and thermally broken.

.2 Dimensions: 103.2 vertical stile, 103.2 top, 179.4 mm bottom rail, 57.2 mm deep.

.3 Glazing Method: Bevelled stops for single glazing and Square stops for sealed glazing, with non-removable glazing stops on outside of door.

.4 Basis of Design: To match Kawneer 360 Insulclad Thermal Entrance

2.6 FRAMING SYSTEMS

.1 Frame Type: Exterior curtain wall to profiles and thicknesses required to meet performance criteria; but not less than 3 mm thickness, and as follows:

.1 Frame Dimensions: Nominal 50.8 mm wide x 110 mm deep heavy wall back section having a 28 mm glazing throat.

.2 Cover Depth: Nominal 50.8 mm wide x 19 mm deep, square profile.

.3 Basis of Design: To match Kawneer 1602 Curtain Wall Framing

.2 Frame Type (Interior Vestibule Door Frame): Construct frames of aluminum extrusions, 3.0 mm thickness flush stops, screw applied, thermally broken sections.

.1 Vertical mullions shall be continuous. Sills shall be one piece or flush jointed on mullion centreline with alignment spline.

.2 Provide for adequate clearance and shim space at perimeter of opening.

.3 Provide weep holes in horizontal members of exterior frames and screens. Drain weepholes to exterior.

.4 Frame Dimensions: 114.3 mm deep, 44.45 mm sight line

.5 Basis of Design: To match Kawneer Trifab VG 450

2.7 GLAZING SYSTEMS

.1 Glass: Specified in Section 08 81 00.

.2 Glazing Gaskets: Manufacturer's standard sealed corner pressure glazing system of black, resilient elastomeric glazing gaskets, closed cell neoprene sponge, setting blocks, and shims or spacers.

.1 Interior glazing gaskets: black closed cell neoprene sponge in vision area.

.2 Exterior glazing gaskets and interior glazing gaskets at spandrel panel: black EPDM rubber.

.3 Standard Glazing Sealants: As recommended by manufacturer for joint type.

2.8 ACCESSORY MATERIALS

.1 Perimeter Fire Containment Systems: Specified in Section 07 84 00.

.2 Insulating Materials: Specified in Section 07 21 13.

.3 Bituminous Paint: Cold applied asphalt mastic paint in accordance with SSPC-Paint 12 requirements except containing no asbestos, formulated for 0.762 mm thickness per coat.

2.9 FABRICATION

.1 Form aluminum shapes before finishing.

.2 Fabricate components that have the following characteristics when assembled:

.1 Sharp profiles, straight and free of defects or deformations.

.2 Accurately fitted joints with ends coped or mitred.

.3 Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

.4 Physical and thermal isolation of glazing from framing members.

.5 Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances.

.6 Provisions for re-glazing.

.3 Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish; remove weld spatter and welding oxides from exposed surfaces by de-scaling or grinding.

.4 Clearly mark fabricated components to identify their locations in accordance with Shop Drawings.

.5 Door Hardware: Refer to Section 08 71 00.

2.10 DOOR HARDWARE

.1 Manufacturer's heavy duty hardware units in sizes and types as required to meet entrance use as indicated on Drawings, with the following opening force limitations:

.1 Egress Doors: Maximum 135 N to set door in motion and not more than 70 N to open door to minimum required width.

.2 Accessible Interior Doors: Maximum 20 N to operate door through entire range of movement.

.3 Delayed Egress Locks: Lock releases within 15 seconds after applying a force of not more than 70 N for not more than 3 seconds.

.4 Latches and Exit Devices: Not more than 70 N required to release latch.

.2 Provide door hardware in accordance with Section 08 71 00 and requirements of this Section; using products that are recommended and supplied by entrance system manufacturer; in accordance with referenced standards, meeting requirements for description, quality, type, and function listed in hardware schedule.

.3 Hinges:

.1 Pivot Hinges: In accordance with BHMA A156.4, Grade 1, with 3 offset pivots located at top, intermediate and bottom of each door leaf.

.4 Locking Devices: Manufacturer's standard locking mechanism that do not require use of key, tool, or special knowledge for operation, and as follows:

.1 Mortise Auxiliary Locks: Lock body manufactured in accordance with BHMA A156.5, Grade 1, fabricated from corrosion resistant steel to fit into door stile specified and as follows:

.1 Bolt Action: Deadbolt/Latch

.2 Function: Triple Action, deadbolt and latch fully retracted for two way traffic by key; manually retracting latch secure for exiting only with deadbolt retracted; hook type deadbolt engaged for security.

.3 Faceplate Shape: To match profile of leading entrance stile.

.4 Finish: To match adjacent entrance stiles.

.5 Door Operation: Single or Paired swinging door operation.

.6 Basis-of-Design Materials: Adams Rite Manufacturing MS+1890 Series Deadbolt/Latch with armoured strike.

.2 Automatic and Self Latching Flush Bolts: In accordance with BHMA A156.3, Grade 1.

.3 Panic Exit Devices: In accordance with BHMA A156.3, Grade 1, listed and labelled by a testing and inspecting agency acceptable to Authorities Having Jurisdiction for panic protection, type and function as listed in Section 08 71 00.

.4 Keying: Master key system.

.5 Trims:

.1 Strikes: Provide strike with black plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

.2 Operating Trim: In accordance with BHMA A156.6.

.3 Removable Mullions: In accordance with BHMA A156.3 listed and labelled by testing and inspecting agency acceptable to Authorities Having Jurisdiction for panic protection using exit devices supplied for Project.

.4 Closers: In accordance with BHMA A156.4, Grade 1, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet site conditions and requirements for opening force; having accessories required for complete installation.

.5 Concealed Overhead Holders: In accordance with BHMA A156.8, Grade 1.

.6 Surface Mounted Holders: In accordance with BHMA A156.16, Grade 1.

.7 Door Stops: In accordance with BHMA A156.16, Grade 1, floor or wall mounted as appropriate for door location indicated with integral rubber bumper.

.8 Weather Stripping: Manufacturer's standard replaceable components, and as follows:

.1 Compression Type: Moulded neoprene meeting ASTM D2000 or moulded PVC meeting ASTM D 2287.

.2 Sliding Type: Wool, polypropylene, or nylon woven pile with nylon fabric or aluminum-strip backing meeting AAMA 701.

.9 Weather Sweeps: Manufacturer's standard exterior door bottom sweep with concealed fasteners on mounting strip.

.10 Silencers: In accordance with BHMA A156.16, Grade 1.

.11 Thresholds: Raised thresholds bevelled with a slope of not more than 1:2, with maximum height of 13 mm; in accordance with BHMA A156.21.

.12 Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge jamb at center pivoted doors.

.6 Glazing Sealants: As recommended by manufacturer for joint type and as follows:

.1 Weather Seal Sealant:

.3 ASTM C920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other system components with which it comes in contact; and recommended by structural and weather seal sealant and curtain wall manufacturers for this use.

.4 Joint Movement Capability: Accommodate 50% increase or decrease in joint width at time of application when measured according to ASTM C719.

.5 Colour: Matching structural sealant.

.6 Acceptable Materials:

- General Electrical SSG4000.
- Dow-Corning 995.
- Tremco Spectrum 2.

2.11 ALUMINUM FINISHES

.1 Clear Anodized Finish:

.1 Class I Finish (Exterior Application): Architectural Class I, clear coating 0.018 mm or thicker in accordance with AAMA 611.

.2 Class II Finish (Interior Application): Architectural Class II, clear coating 0.010 mm or thicker in accordance with AAMA 611.

3. Execution

3.1 EXAMINATION

.1 Verification of Conditions: Examine the areas to receive the Work and the conditions under which the Work would be performed. Remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

.2 Report immediately in writing to the consultant all discrepancies in accuracy and suitability which will adversely affect the work of this section. Report surfaces left unacceptable by other trades to the consultant before commencing installation.

3.2 PREPARATION

.1 Supply anchorage devices and insects to the appropriate trades where required for building in or casting-in-place and instruct as to proper location and position

.2 Ensure that masonry and concrete surfaces to receive sealants are dry, firm, sound, smooth, suitable for bond, and free from loose material, projections, ice, frost, slick, grease, oil and other matter detrimental to bond.

3.3 INSTALLATION

.1 Install in accordance with manufacturer's written instructions.

.2 Install components free from damage or irregularities.

.3 Fit joints to produce hairline joints free of burrs and distortion.

.4 Rigidly secure non-movement joints.

.5 Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

.6 Weld components in concealed locations to minimize distortion or discoloration of finish:

.1 Protect glazing surfaces from welding.

.2 Protect work of other sections from welding.

.7 Seal joints watertight, except where manufacturer's standard details indicate a requirement for open joints.

.8 Metal Protection:

.1 Protect aluminum against galvanic action by painting contact surfaces with primer, by applying sealant or tape, or installing nonconductive spacers where aluminum contacts dissimilar metals.

.2 Protect aluminum against corrosion by painting contact surfaces with bituminous paint where aluminum contacts concrete or masonry.

.9 Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

.10 Install components plumb and true in alignment with established lines and grades.

.11 Install glass in accordance with manufacturer's standard glazing recommendations.

.12 Install sealants in accordance with Section 07 92 00.

.13 Install insulation materials in accordance with manufacturer's standard practices.

.14 Install perimeter fire containment systems as specified in Section 07 84 00.

.15 Erection Tolerances: Install glazed aluminum curtain wall systems in accordance with the following maximum tolerances:

.1 Plumb: 3 mm in 3050 mm; 6 mm in 12 m cumulative.

.2 Level: 3 mm in 3050 mm; 6 mm in 12 m cumulative.

.3 Alignment:
.1 Limit offset from true alignment to 1.5 mm where surfaces abut in line or are separated by reveal or protruding element up to 13 mm wide,
.2 Limit offset from true alignment to 3 mm where surfaces are separated by reveal or protruding element from 13 mm to 25 mm wide,
.3 Limit offset from true alignment to 6 mm where surfaces are separated by reveal or protruding element of 25 mm wide or greater.

.4 Location: Limit variation from plane to 3 mm in 3660 mm; 13 mm over total length.

.16 Snap covers, profiles as indicated, and pressure plates shall be continuous from top to bottom of frame, with horizontals abutting between. Deep mullion caps to be corner mitred with horizontal shallow cap abutting deep mullion cap. All 19 mm and 50 mm deep caps, unless noted otherwise. Mechanically fasten glazing caps to pressure plates, one fastener for each section.

3.4 CLEANING

.1 General: Wash to remove mortar, plaster, fireproofing and any other deleterious material from finished surfaces immediately. Cleaning and protective methods shall be carefully selected, applied and maintained so that finishes will not become uneven or otherwise impaired as a result of unequal exposure to light and weathering conditions.

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 This Section specifies aluminum window systems, of the following type, installed in exterior walls:

.1 Composite with fixed and operable lites.

.2 Some components of aluminum window systems are specified in related sections.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Submittal Procedures	Section 01 33 00.
.2	Shop Drawings, Product Data and Samples	Section 01 33 23.
.3	Waste Management and Disposal	Section 01 74 19.
.4	Spare Parts and Maintenance Materials	Section 01 78 43.
.5	Equipment and Systems Demonstration and Instruction	Section 01 79 00.
.6	Sheet Membrane Air and Vapour Seal	Section 07 26 00.
.7	Sealants:	Section 07 92 00.
.8	Glass and Glazing General Requirements:	Section 08 81 00.

1.3 REFERENCE DOCUMENTS

.1 Aluminum Association (AA):

.1 Designation System for Aluminum Finishes (2000)

.2 American Architectural Manufacturers Association (AAMA):

.1	AAMA 603.8-94	Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum
.2	AAMA 605.2-92	Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels

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

.1	ASTM A653M-09	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
.2	ASTM E283-04	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

.4 Canadian General Standards Board (CGSB):

.1	CAN/CGSB 1.40-97	Anticorrosive Structural Steel Alkyd Primer
.2	CAN/CGSB 79.1-M91	Insect Screens

.5 Canadian Standards Association (CSA):

.1	CSA A440-00/A440.1-00	A440-00, Windows / Special Publication A440.1-00, User Selection Guide to CSA Standard A440, Windows
.2	CAN/CSA G164-M92(R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
.3	CAN/CSA-G40.21-04	Structural Quality Steels
.4	CAN/CSA-G164-M92(R2003)	Hot Dip Galvanizing of Irregularly Shaped Articles
.5	CAN/CSA Z91-02(R2008)	Health and Safety Code for Suspended Equipment Operations

1.4 DEFINITIONS

.1 Composite Window: a window consisting of two or more lites in one main frame. Composite windows may consist of fixed or operable windows, or a combination of both.

1.5 DESIGN CRITERIA

.1 Frame and sash profiles detailed on drawings indicate basic design intent.

.2 Provide products designed to meet specified performance requirements.

.3 Design frames to equalize pressure between outside air and:

.1 cavities surrounding glass units, and

.2 cavities surrounding operable sash.

.4 Provide drainage from all spaces around insulating glass units, including each horizontal space created by setting blocks.

.5 Provide baffles or other protection at drainage openings to prevent direct entrance of wind-driven rain.

.6 Provide frames and sash designed to provide mechanical key for glazing splines and gaskets.

.7 Provide window anchorage to withstand 1:50 year wind load in accordance with the Alberta Building Code and to distribute wind load along frames to window manufacturer's recommendations.

.8 Design components to accommodate thermally induced movement.

1.6 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's for:

.1 Sealant materials during application and curing.

.2 Shop Drawings:

.1 Comply with requirements of Division 01.

.2 Submit detailed and complete description of differences between windows tested for conformance to this specification, and windows intended for this project. Include elevations and full scale details to show physical differences.

.3 Provide elevation views. Indicate components, materials, finishes, and locations of anchorage.

.4 Clearly indicate, in large scale, the following:

.1 Sections details showing all window perimeter conditions.

.2 Mullion and muntin details and frame corner connections.

.3 Sill flashing terminations, in isometric view, including coordination with wall cladding materials.

.4 Frame anchorage details.

.5 Details showing sealing techniques within and around perimeter of framing and operable sash.

.6 Connection to building sheet membrane air and vapour seal.

.7 Required sizes and tolerances of openings.

.3 Samples:

.1 Comply with requirements of Division 01.

.2 Submit duplicate 200 mm x 200 mm sample of fabrication of the following:

.1 Window frame corners at sills.

.2 Typical anchoring devices and connection to frame.

.3 Mullion intersecting head and sill frame.

.4 Operable sash installed in typical frame.

.5 Insect screens, in sash.

.6 Non-standard conditions.

.3 Submit five 100 mm long samples of anodized aluminum to indicate maximum range of anodized colour variation for project.

.4 Submit duplicate samples of aluminum finished to indicate colour, gloss and type of paint finishes specified.

.5 Submit samples of latching devices and exposed hardware to indicate style and finish.

.3 Test and Evaluation Reports:

.1 Comply with requirements of Division 01.

.2 Submit test reports from an independent testing agency acceptable to the Province, indicating windows to be supplied for project meet specified requirements.

.3 Include complete description of windows tested.

1.7 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data:

.1 Provide operation and maintenance data for hardware for incorporation into manual specified in Section 01 78 23 – Operation and Maintenance Data and Manuals.

.2 Submit the following:

.1 Window type and location.

.2 Names of products under each window type, including manufacturer's name and identification of framing components, components of sealed units, weather-stripping, glazing materials, and sealants.

.3 Submit as-built drawings, using reviewed shop drawings, modified to as-built condition.

.4 Submit maintenance instructions for glass and aluminum finishes.

1.8 QUALITY ASSURANCE

.1 Qualifications:

.1 Testing By Province:

.1 Province will appoint and pay for the services of an independent testing agency to inspect and test windows.

.2 Windows to be tested will be taken at random from manufacturer's fabricating facility. Notify Province when window fabrication is completed.

.3 Tests for condensation resistance will be performed on each separate lite of combination and composite windows. The lowest temperature index calculated will apply.

.2 Mock-Ups:

.1 After approval of shop drawings and samples, construct one full size window unit complete with glass and hardware.

.2 Install mock-up window unit in building window opening, complete with flashing and sealed to building air and vapour seal. Obtain approval of mock-up prior to installation of the work of this Section.

2. Products

2.1 MATERIALS

.1 Aluminum: Aluminum Association (AA) alloy 6063-T5 or 6063-T6 for extrusions and AA 1100, anodizing quality, for sheet.

.2 Steel: to CAN/CSA-G40.21, hot dip galvanized to CAN/CSA-G164.

.3 Sheet Steel: to ASTM A653M, hot dip galvanized to Z275 coating designation.

2.2 SINGLE UNIT OPERABLE WINDOWS

.1 Windows shall meet or exceed requirements of CAN/CSA-A440, and the following performance ratings:

.1 Air Tightness: A3.

.2 Water Tightness: B3.

.3 Wind Load Resistance: C3.

.4 Minimum Temperature Index: 56.

.5 Sash Strength and Stiffness of Casement Windows: maximum deflection of 5 mm.

.6 Sash Strength and Stiffness of Projecting Windows: maximum deflection of 18.0 mm.

.7 Pass test for resistance to forced entry.

.8 Screens: aluminum mesh with extruded aluminum sash and four retainers per side, standard. Mesh and sash finishing material shall match window frame.

2.3 COMPOSITE WINDOWS

.1 Meet or exceed requirements of CAN/CSA-A440 for combination and composite windows.

.2 Unless specified otherwise, performance requirements for fixed and operable portions of composite windows shall meet or exceed requirements specified for separate fixed and operable single window units respectively.

.3 Air tightness of crack length along frames mulled together and where lites within one main frame join, shall meet or exceed requirement for fixed windows.

2.4 GLASS AND GLAZING ACCESSORIES

.1 Provide glass for aluminum windows as scheduled in Glass Schedule at end of this Section, and as specified in Section 08 81 00.

.2 Provide glazing materials designed to maintain adequate pressure against glass through full design temperature range experienced through warranty period, regardless of installation temperatures.

.3 Setting Blocks: neoprene, 80 durometer hardness, 100 mm long x width equal to thickness of supported glass unit x 6 mm high.

.4 Spacer Shims: neoprene, 80 durometer hardness, 75 mm long x minimum 6 mm thick. Do not use lead, plastic, or wood shims.

.5 Glazing Splines and Gaskets: manufacturer's standard dry glazing splines and gaskets profiled for glazing stops and glazing retaining devices. Profiles shall mechanically key into glazing retaining devices. Except where otherwise specified, colour shall match frame colour.

2.5 HARDWARE

.1 Provide manufacturer's standard hardware in type specified for operable sash, in finish to match window frame.

.2 Equip operable windows with hardware as follows:

.1 Top Hung, Opening Out: Anderberg friction arms and underscreen stay bar assembly hinges and roto operator with locking handle.

2.6 EXTERIOR SILLS

.1 Material: extruded aluminum.

.2 Shape and Size: as detailed on drawings, with minimum 2% drainage slope to exterior unless detailed otherwise on drawings.

.3 Thickness: minimum 1.3 mm thick.

.4 Accessories: joint covers, jamb drip deflectors, chairs, anchors.

.5 Finish: same as adjacent window frame.

2.7 INTERIOR SILLS

.1 Material: extruded aluminum.

.2 Type and Size: as detailed on drawings.

.3 Thickness: minimum 3 mm.

.4 Accessories: joint covers.

.5 Finish: same as adjacent window frame.

2.8 INFILL CLADDING

.1 Material: extruded aluminum.

.2 Type and Size: as detailed on drawings.

.3 Thickness: minimum 3 mm.

.4 Finish: same as adjacent window frame.

2.9 ACCESSORIES

.1 Steel Clips, Supports and Reinforcement: minimum 2.0 mm bare sheet thickness, hot-dip galvanized to CAN/CSA-G164. Provide anchors that permit sufficient adjustment for accurate alignment.

.2 Joint Sealants: as specified in Section 07 92 00.

.3 Flexible Joint Membrane: membrane as specified in Section 07 26 00 - Sheet Membrane Air and Vapour Seal.

2.10 FABRICATION

.1 Fabricate window units square and true with maximum tolerance of plus or minus 1.5 mm for units with a diagonal measurement of 1800 mm or less and 3 mm for units with a diagonal measurement over 1800 mm.

.2 Seal framing joints with butyl-polyisobutylene or silicone sealant.

.3 Arrange components to prevent abrupt variation in colour.

.4 Provide glazing retaining devices secured with threaded fasteners.

2.11 ANODIZED FINISHES

.1 Provide surface preparation and anodized finish on exposed aluminum surfaces to Aluminum Association Architectural designation, with even distribution of approved colour variation, as follows:

.1 Clear Anodized Coating: to AA M12C22A31, 10-18 micrometre thick, Architectural Class II designation.

3. Execution

3.1 WINDOW INSTALLATION

.1 Erect and secure window units in prepared openings, plumb and square, free from warp, twist or superimposed loads.

.2 Secure work accurately to structure and in a manner not restricting thermal movement of materials.

.3 Provide shims under sill frame at setting block locations, and as recommended by window frame manufacturer.

.4 Conceal all anchors and fitments. Exposed heads of fasteners not permitted.

.5 Mechanically fasten flexible membrane air and vapour seal to window frame with continuous aluminum channel as detailed on drawings.

.6 Maintain dimensional tolerances after installation. Maintain alignment with adjacent work.

.7 Isolate aluminum surfaces from cementitious materials adjacent after installation, using coating of bituminous paint.

.8 Seal framing joints with butyl-polyisobutylene or silicone sealant.

3.2 SILL INSTALLATION

.1 Set exterior sills with uniform design drainage slope to exterior, level in length. Extend sills past jambs.

.2 Secure sills in place with anchoring devices located at ends and joints and evenly spaced at maximum 600 mm between.

.3 Provide one piece sill flashing where practicable. Where joints are required, locate to provide equal sill lengths and provide backup flashing at joints as detailed. Do not caulk joints.

.4 Provide adequate space between butt ends of sill lengths to allow for thermal expansion. For sills over 1200 mm in length, maintain 3 to 5 mm expansion space at each end.

3.3 GLAZING

.1 Refer to Section 08 81 00 - Glass and Glazing for general requirements for glazing.

.2 Install glazing splines and gaskets uniformly, with accurately formed corners and bevels. Ensure that proper contact is made with glass and rabbet interfaces.

.3 Continuously and uniformly compress glazing splines and gaskets 38-50 mm per 1200 mm during installation.

3.4 SEALANT APPLICATION

.1 Install sealant and related materials in accordance with Section 07 92 00 and as detailed on drawings.

3.5 ADJUSTING

.1 Adjust ventilators and hardware to operate smoothly. Lubricate moving parts. Lock settings after alignment.

3.6 CLEANING

.1 Wash down exposed interior metal surfaces using a solution of mild domestic detergent in warm water, applied with soft clean wiping cloths.

.2 Clean exposed exterior non-metal surfaces as recommended by manufacturer of the material.

.3 Clean interior and exterior surfaces as soon as adjacent construction which might soil surfaces, is completed.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Submittal Procedures	Section 01 33 00.
.2	Shop Drawings, Product Data and Samples	Section 01 33 23.
.4	Waste Management and Disposal	Section 01 74 19.
.5	Spare Parts and Maintenance Materials	Section 01 78 43.
.6	Equipment and Systems Demonstration and Instruction	Section 01 79 00.
.7	Preparation of wood door frames:	Section 06 20 00.
.8	Cabinet hardware:	Section 06 40 00.
.9	Preparation of hollow metal frames:	Section 08 12 13.
.10	Preparation of hollow metal doors:	Section 08 13 13.
.11	Preparation of wood doors:	Section 08 14 16.
.12	Connections for electrical hardware:	Division 26.

1.2 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

.1 Supply following products for installation under other Sections:

.1 Cylinders for aluminum doors, installed under Section 08 44 13.

.2 Cylinders for hollow metal doors and wood doors, installed under this Section

1.3 REFERENCE DOCUMENTS

.1 Canadian Steel Door and Frame Manufacturer's Association:

.1 Standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction)

.2 American National Standards Institute (ANSI/BHMA):

.1	ANSI/BHMA A156.2-2003	Bored and Preassembled Locks and Latches
.2	ANSI/BHMA A156.1-2006	Butts and Hinges
.3	ANSI/BHMA A156.3-2008	Exit Devices
.4	ANSI/BHMA A156.4-2008	Door Controls - Closers
.5	ANSI/BHMA A156.5-2001	Auxiliary Locks and Associated Products
.6	ANSI/BHMA A156.6-2005	Architectural Door Trim
.7	ANSI/BHMA	Door Controls – Overhead Stops and Holders

	A156.8-2005	
.8	ANSI/BHMA A156.12-2005	Interconnected Locks and Latches
.9	ANSI/BHMA A156.13-2005	Mortise Locks and Latches, Series 1000
.10	ANSI/BHMA A156.15-2006	Release Devices – Closer Holder, Electromagnetic and Electromechanical
.11	ANSI/BHMA A156.16-2008	Auxiliary Hardware
.12	ANSI/BHMA A156.17-2004	Self Closing Hinges and Pivots
.13	ANSI/BHMA A156.18-2006	Materials and Finishes
.14	ANSI/BHMA A156.21-2009	Thresholds

.3 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD):

.1	SCAQMD Rule 1113-04	Architectural Coatings
.2	SCAQMD Rule 1168-05	Adhesives and Sealants Applications

1.4 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Section 01 62 00 for requirements pertaining to product options and substitutions.

.2 The following applies to hardware where reuse of existing doors is specified.

.1 Only lock and latch sets and exit devices that fit existing cut-outs are acceptable for use.

.2 Only closers that cover existing fastener holes or match up to existing thru-bolt penetrations are acceptable for use.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Sequencing:

.1 Deliver hardware required for shop application in ample time so as not to impede the progress of the Work.

.2 Scheduling:

.1 Acceptance of keys:

.1 For security reasons, forward all keys by hand to the following individual only:

Mike Herauf, Plant Operations Coordinator
Holy Spirit Catholic Schools
Lethbridge, Alberta
T1H 2L7

1.6 SUBMITTALS

.1 Product Data:

.1 Comply with requirements of Division 01.

.2 Shop Drawings:

.1 Hardware Schedule:

.1 Submit a detailed hardware schedule indicating the following:

.1 Door and frame types, sizes, door swings.

.2 Type, style, function, size and finish of each hardware item.

.3 Mounting heights, fastenings and other pertinent information.

.4 Name and manufacturer of each item.

.5 Location of all hardware items cross-referenced to door numbers indicated on floor plans and in door and frame schedule.

.6 Explanation of all abbreviations, symbols and codes contained in schedule.

.2 Keying Schedule:

.1 Submit a separate detailed schedule clearly indicating how Province's instructions on keying requirements have been fulfilled.

.3 Certificates:

.1 After completion of all construction work, certify on a form acceptable to the Province, that all items of finish hardware have been adjusted and are working properly and that all hardware on fire rated [labeled] doors conforms to the requirements of (ULC) Underwriters Laboratories of Canada.

.4 Test and Evaluation Reports:

.1 If requested by Province, submit test reports confirming specification compliance. Include description of testing methodology and apparatus with each test report.

.5 Manufacturers' Instructions:

.1 Include, with each item of hardware the following:

.1 Installation instructions.

.2 Deliver finish hardware with all items in individual packages, legibly marked and adequately labelled indicating the part of the work for which it is intended.

1.7 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data:

.1 Comply with requirements of Division 01.

.2 Provide the following:

.1 One copy of manufacturer's key bitting list. Forward by hand, together with keys.

.2 Manufacturer's maintenance instructions.

.3 Complete parts lists.

.4 Manufacturer's installation and operation instructions for all operable hardware.

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Spare Parts:

.1 Comply with requirements of Division 01.

.2 Supply following additional quantities of hardware items. Deliver to site and store as directed by the Province.

.1	Hinges:	2 pairs of each different type.
.2	Closers:	2 of each different type.
.3	Lock/Latch Sets:	2 of each different function.
.4	Exit Devices:	2 of each different type and function.
.5	Push/Pull Devices:	2 of each different type or size.

.2 Tools:

.1 Provide two sets of wrenches for door closers, lock and latch sets and exit devices.

.2 Provide special tools required for installation.

1.9 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Handling Requirements:

.1 Provide a locked storage room with adequate shelving and bin space to properly receive and stock hardware prior to installation.

.2 Protect knobs, handles, push plates and pulls with adhesive release paper, of type that is easily removed without marring finish.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Management and Disposal.

2. Products

2.1 PROVIDE HARDWARE AS LISTED IN THE HARDWARE GROUP SCHEDULE.

2.2 FASTENINGS

.1 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.2 Match exposed fastening devices to finish of hardware.

.3 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.4 Use fasteners compatible with material through which they pass.

.5 Use sex nuts and bolts for doors without special reinforcing for closers.

2.3 KEYING

.1 Provide keying as outlined in the hardware group schedule in regards to specific keyways And instructions from the school board on the key system.

.2 Provide two change keys for each lock except where otherwise required. Provide all other keys as required to meet keying system requirements.

2.4 KEY CONTROL SYSTEM

.1 Provide and install where directed, a steel cabinet complete with index control system, key tags, and key envelopes.

.2 Provide adequate capacity to contain all keys, plus approximately 50% additional capacity with tags.

3. Execution

3.1 INSTALLATION

.1 Provide metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.

.2 Install all hardware items to manufacturer's instructions and recommendations.

.3 Where hardware items are required to be installed onto or into surfaces that are to be later painted or finished, install hardware completely to ensure proper fit, remove and store until finishing is complete, and then re-install.

.4 Drill and countersink units which are pre-prepared for anchorage of fasteners. Space fasteners and anchors to manufacturer's recommendations. Use only fasteners supplied by hardware manufacturers

.5 Install hardware to heights and centres as indicated in hardware schedule, as reviewed by the Province.

.6 Protect doors and frames from damage due to installation of hardware.

3.2 INSTRUCTION

.1 Instruct user's personnel in:

.1 Proper care, cleaning and general maintenance of hardware.

.2 Operation of key control system. Make periodic checks during warranty period to ensure functional efficiency of the system.

3.3 HARDWARE SCHEDULE

.1 Door Hardware Schedule and Door Schedule as follows:

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ST.PATRICKS SCHOOL
HARDWARE GROUPS
NOV.27,2016 REVISED DEC 02 2016 REVISED FEB.27 2017 , REVISED MAR. 02 2017, REVISED MAR 27 2017

Notes:

1 CONFIRM MOUNTING HEIGHTS WITH SCHOOL BOARD PRIOR TO PREPPING DOORS AND MOUNTING HARDWARE.

2 LOCKSETS AND CYLINDERS TO BE PROVIDED IN SCHOOL BOARD KEYWAY. ALLOW FOR 9G EVEREST 29 KEYWAY FOR EXTERIOR AND S145 INTERIOR

3 CONSULT SCHOOL BOARD FOR SPECIFIC KEYING REQUIREMEMTS ALLOW FOR GRAND MASTER KEY SYSTEM C/W CONSTRUCTION KEYING

4 HARDWARE SUPPLIER TO PROVIDE ALL WIRING, POINT TO POINT ELEVATIONS AND DIAGRAMS FOR CORRECT INSTALLATION. THESE DOCUMENTS MUST ACCOMPANY THE HARDWARE SHOP DRAWING SUBMITTAL.

5 CO-ORDINATE LOCK DOWN FEATURE AND FOB ACCESS CONTROL WITH DIVISION 26

6 PROVIDE 3 CYLINDERS (20-001) FOR THE KEY SWITCHES THAT WILL CONTROL THE LOCK DOWN FEATURE.

7 SIZE KICKPLATES AS PER DHI STANDARD PRACTICE FOR SINGLES AND PAIRS USING LATEST DOOR SCHEDULE.

8 SIZE WEATHERSTRIP AND SEALS ACCORDING TO LATEST DOOR SCHEDULE

GRP-1	2	CONT/HINGES	A110 X DH X EPT PREP	628
	1	REM MULLION	KR4954 X DH X 20-001	600
	2	POWER TRANSFERS	EPT-10	626
	1	EXIT DEVICE	QEL98NL-990NL	626
	1	EXIT DEVICE	QEL98DT-990DT	626
	1	CYLINDERS	20-021	
	1	DR OPERATOR	ED100 X TJ X 120V	689
	2	HC BUTTONS	950HP45	630
	1	OH STOP	1023	630
	2	KICKPLATES	K10A 250 X DW	630
	1	DR CLOSER	4040XP-SPR-CUSH	689
	1	THRESHOLD	CT-10 X 2/DW	
	1	W/STRIP	W-25 2/DW X 2/DH	
	2	DR SWEEPS	W-35-1 X DW	
	2	DR CONTACTS	GE1076	
	1	FOB READER	BY ACCESS CONTROL	
	1	KEYPAD	BY ACCESS CONTROL	
	1	POWER SUPPLY	PS-902-2RS	
		METHOD OF OPERATION		
		PULL SIDE	FOB READER ACTIVATES QEL LATCH RETRACTION EXIT DEVICES FOR ENTRY. QEL LATCHES ARE SET IN PUSH/PULL MODE DURING SCHOOL HOURS OF OPERATION ALLOWING HC BUTTONS TO CYCLE HC OPERATOR DOORS ARE RELOCKED WHEN KEYPAD RELEASES QEL LATCHES OR LOCKDOWN FEATURE IS ACTIVATED	
		PUSH SIDE	EXIT BY PUSHING ON PUSHPAD OR HC BUTTON TO CYCLE OPERATOR CONFIRM AND CO-ORDINATE DOOR FUNCTION WITH DIVISION 26 ALL CONDUIT RUNS AND WIRING BY DIVISION 26.	

GRP-2	2	CONT/HINGES	A110 X DH	628
	2	PUSH/PULL SETS	3012-2 X 6000-2 X #2/#5 X DW	630
	1	DR CLOSER	4040XP-SPR-CUSH	689
	1	DR OPERATOR	ED100 TJ X 120V	689
	1	OH STOP	1023	630
	2	KICKPLATES	K10A 250 X DW	630
	2	HC BUTTON	950HP45	
	2	EL MAG LOCKS	8310 SCS - 12/24 VDC	
	1	POWER SUPPLY	BY DIVISON 26	
		METHOD OF OPERATION		
		DR D01.B	EL MAG LOCKS REQUIRED FOR LOCK DOWN OPERATION. THE LOCK DOWN EVENT WILL POWER THE EL MAG LOCKS AND SECURE THIS DOOR. EL MAG LOCKS ARE CONNECTED TO THE FIRE ALARM SYSTEM SO THEY CAN DROP OUT DURING AN ALARM. CO-ORDINATE WITH ACCESS CONTROL PROVIDER	
GRP-2A	2	CONT/HINGES	A110 X DH	628
	2	PUSH/PULL SETS	3012-2 X 6000-2 X #2/#5 X DW	630
	1	DR CLOSER	4040XP-SPR-CUSH	689
	1	DR OPERATOR	ED100 TJ X 120V	689
	2	KICKPLATES	K10A 250 X DW	630
	1	OH STOP	1023	630
	2	HC BUTTON	950HP45	
GRP-3	2	CONT/HINGE	A110 X DH	628
	1	EXIT DEVICE	9827L-996L -LBR X 20-021	630
	1	EXIT DEVCE	9827EO-LBR	630
	2	DR CLOSERS	4040XP-REG	689
	2	KICKPLATES	K10X 250 X DW	630
	2	EL MAG HOLD OPEN	EM504-ER2 24120	689
	2	EL MAG LOCKS	DE8310S - 24VDC	628
	1	POWER SUPPLY	10-1 - PDM-4	
	1	KEY SWITCH	960N-MA-96DMA(LOCATE PUSHSIDE OF FRAME)	
	1	CYLINDER	20-001	626
		METHOD OF OPERATION		
			DOORS ARE HELD OPEN BY EL HO MAGNETS WHEN THERE IS AN EVENT HELD IN THE GYM THE SCHOOL HAS THE OPTION TO CLOSE AND LOCK THESE DOORS BY RELEASING THE EL HO MAGS AND ACTIVATING THE EL MAG LOCKS USING THE 2 POSITION MAINTAINED KEY SWITCH 1 POSTION CONTROLS THE EL HO MAGNETS OPPOSITE POSITION CONTROLS THE EL MAG LOCKS DOORS CAN BE PUT BACK ON HOLD OPEN POSITION BY RELEASING THE EL MAGS USING THE KEY SWITCH. AND PUSH THE DOORS TO CONNECT WITH EL HO MAGS EL MAG LOCKS ARE DELAYED EGRESS THAT AFTER A 15 SEC DELAY WILL RELEASE FOR EGRESS FROM CORRIDOR 04. CONDUIT AND WIRING BY DIVISION 26.	

GRP-4	3	HINGES	CB179 114 X 101	652
	1	LOCKSET	ND73PD-SPA	626
	1	FL STOP	S102L	626
	1	KICKPLATE	K10A 250 X DW	630
	1	THRESHOLD	411 X DW	AL
	1	SOUND SEAL	107S 1/DW X 2/DH	
	1	DR BOTTOM	220SA X DW	
GRP-5		NOT USED		
GRP-6	3	HINGES	CB168 114 X 114	652
	1	LOCKSET	ND70PD-SPA	626
	1	DR CLOSER	4040XP-SPR CUSH	689
	1	DR CLOSER	4040XP-SPR-H-CUSH (DR. D35.A)	689
	1	KICKPLATE	K10A 250 X DW	630
GRP-7		HARDWARE COMPLETE BY DOOR SUPPLIER		
GRP-8	6	HINGES	CB168 114 X 114	652
	2	FL/BOLTS	F65UL X 305	626
	1	LOCKSET	L9080P - LESS OUTSIDE TRIM X H401 FLUSH RING PULL	626
	1	PUSH PLATE	K11A 125 X 500	630
	1	DR CLOSER	4040-SPR-CUSH	689
	1	OH STOP	9022A	630
	2	KICKPLATES	K10A 250 X DW	630
GRP-9	3	HINGES	CB168 114 X 114	652
	1	LOCKSET	L9080P - LESS OUTSIDE TRIM X H401 FLUSH RING PULL	626
	1	PUSH PLATE	K11A 125 X 500	630
	1	DR CLOSER	4040XP-SPR- CUSH	689
	1	KICKPLATE	K10A 250 X DW	630

GRP-10	6	HINGES	CB191 114 X 101 NRP	626
	2	FL/BOLTS	F65 X 305	626
	1	LOCKSET	ND80PD-SPA- 3/4 LATCH	626
	1	DR CLOSER	4040-SPR-H-CUSH	689
	1	OH STOP	9012A	630
	2	KICKPLATES	K10A 250 X DW	
	2	DR CONTACTS	GE1076	
	1	THRESHOLD	CT-10 X 2/DW	
	1	W/STRIP	W-25 2/DW X 2/DH	
	2	DR SWEEPS	W-35-1 X DW	
	1	ASTRAGAL STRIP	W-25 X 2/DH	
GRP-11	3	HINGES	CB179 114 X 101	652
	1	LATCHSET	ND10S-SPA	626
	1	INDICATOR BOLT	D871-2 3/4	626
	1	KICKPLATE	K10A 250 X DW	630
	1	FLOOR STOP	S102L	626
GRP-12	3	HINGES	CB179 114 X 101	652
	1	LOCKSET	ND80PD-SPA	626
	1	DR CLOSER	4040XP-REG	689
	1	KICKPLATE	K10A 250 X DW	630
	1	FLOOR STOP	S102L	626
GRP-13	3	HINGES	CB179 114 X 101	652
	1	LOCKSET	ND53PD-SPA	626
	1	KICKPLATE	K10A 250 X DW	630
	1	FLOOR STOP	S102L	626
GRP-14	3	HINGES	CB179 114 X 101	652
	1	LOCKSET	ND73PD-SPA	626
	1	KICKPLATE	K10A 250 X DW	
	1	FLOOR STOP	S102L	626
GRP-15	1	BI-FOLD KIT	CF-115-4 DR	
	2	PULLS	M91	626
GRP-16	6	HINGES	CB168 114 X 114	652
	1	DEADBOLT	B563P	626
	1	DR PULL	2412-1 X 100 X 400	630
	1	PUSHPLATE	K11A 125 X 500	630
	1	DR CLOSER	4040XP-SPR-CUSH-DEL	689
	1	KICKPLATE	K10A 250 X DW	

GRP-17	6	HINGES	CB191 114 X 101 NRP	626
	1	REM MULLION	KR4954 X DH	600
	1	CYLINDER	20-001 (MULLION)	626
	2	EXIT DEVICES	CD98EO	626
	2	CYLINDERS	20-001 (CYL DOGGING)	
	2	DR CLOSERS	4040XP-SPR-CUSH	689
	2	KICKPLATES	K10A 250 X DW	630
	1	THRESHOLD	CT-10 X 2/DW	
	1	W/STRIP	W-25 2/DW X 2/DH	
	2	DR SWEEPS	W-35-1 X DW	
GRP-18	6	HINGES	CB191 114 X 101 NRP	626
	1	REM MULLION	KR4954 X DH	600
	1	CYLINDER	20-001 (MULLION)	626
	1	EXIT DEVICE	CD98EO	626
	1	EXIT DEVICE	CD99NL-990NL	626
	2	CYLINDERS	20-001 (CYL DOGGING)	626
	1	CYLINDER	20-021 (EXIT DEVICE TRIM	626
	2	DR CLOSERS	4040XP-SPR-CUSH	689
	2	KICKPLATES	K10A 250 X DW	630
	1	THRESHOLD	CT-10 X 2/DW	
	1	W/STRIP	W-25 2/DW X 2/DH	
	2	DR SWEEPS	W-35-1 X DW	
GRP-19	2	CONT/HINGES	A110 X DH	628
	1	REM MULLION	KR4954 X DH X 20-001	600
	1	EXIT DEVICE	CD98NL-990NL	626
	1	EXIT DEVICE	CD98DT-990DT	626
	2	CYLINDERS	20-001 (CYLINDER DOGGING)	
	1	CYLINDERS	20-021 (ED TRIM)	
	2	KICKPLATES	K10A 250 X DW	630
	2	DR CLOSER	4040XP-SPR-CUSH	689
	1	THRESHOLD	CT-10 X 2/DW	
	1	W/STRIP	W-25 2/DW X 2/DH	
	2	DR SWEEPS	W-35-1 X DW	
	2	DR CONTACTS	GE1076	
GRP-20	2	CONT/HINGES	A110 X DH	628
	2	PUSH/PULL SETS	3012-2 X 6000-2 X #2/#5 X DW	630
	2	DR CLOSER	4040XP-SPR-CUSH	689
	2	KICKPLATES	K10A 250 X DW	630
GRP-21	3	HINGES	CB191 114 X 101 NRP	626
	1	EXIT DEVICE	CD98EO	626
	1	CYLINDER	20-001 (CYL DOGGING)	
	1	DR CLOSER	4040XP-SPR-CUSH	689
	1	KICKPLATE	K10A 250 X DW	630
	1	THRESHOLD	CT-10 X DW	
	1	W/STRIP	W-25 1/DW X 2/DH	
	1	DR SWEEP	W-35-1 X DW	

DOOR SCHEDULE

REV	DOOR								FRAME				LABEL	HARDWARE	GLAZING		NOTES
	NUMBER	SIZE			THK	FACE MATL	CORE MATL	FINISH	MATL	TYPE	PROFILE	FINISH			DOOR	FRAME	
		TYPE	WD	HT													
	D01.A	HH	1830	2150	45	AL	INS	ANOD	AL	5	9	ANOD		1	21	YES	1,2,4
	D01.B	HH	1830	2150	45	HMT	INS	PT	PST	2	9	PT		2	21	YES	1,2
	D02	DD	1830	2150	45	HM	HC	PT	PS	2	2	PT	--	3	2	NONE	8
	D03.A	EXISTING	1830	2150	45	HMT	INS	PT	PST	2	--	PT	-	1	--	NONE	1,6,10
	D03.B	EXISTING	1830	2150	45	HMT	INS	PT	PST	2	--	PT	-	2A	--	NONE	1.6,10
	D05	DD	1830	2150	45	HM	HC	PT	PS	2	2	PT	--	3	2	NONE	8
	D06.A	EXISTING	1830	2150	45	HMT	INS	PT	PST	2	--	PT	-	19	--	NONE	6,10
	D06.B	EXISTING	1830	2150	45	HMT	INS	PT	PST	2	--	PT	-	20	--	NONE	6,10
	D07	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D08.A	C	900	2150	45	WD	HC	ST	PS	1	2	PT		4	2	NONE	5
	D08.B	C	900	2150	45	WD	HC	ST	PS	1	1	PT		4	2	NONE	5
	D09.A	C	900	2150	45	WD	HC	ST	PS	1	2	PT		4	2	NONE	5
	D09.B	C	900	2150	45	WD	HC	ST	PS	1	1	PT		4	2	NONE	5
	D10	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D11	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D12	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D13.A	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D13.B	EXISTING	1830	2150	45	HMT	INS	PT	PST	2	--	PT	-	18	--	NONE	6,10
	D14.A	D	900	2150	45	HM	HC	PT	PS	1	2	PT	-	16	2	NONE	11
	D14.B	D	900	2150	45	HM	HC	PT	PS	1	2	PT	-	16	2	NONE	11
	D14.C	AA	1830	2150	45	HMT	INS	PT	PST	2	4	PT	-	17	NONE	NONE	2
	D14.D	A	900	2150	45	HMT	INS	PT	PST	1	4	PT	-	21	NONE	NONE	
	D15.A	D	900	2150	45	HM	HC	PT	PS	1	2	PT	-	6	2	NONE	
	D15.B	J	1600	920									--	7			7
	D15.C	J	1600	920									--	7			7
	D16	AA	1800	2150	45	HM	HC	PT	PS	3	2	PT	45 MIN.	8	NONE	NONE	8
	D17	A	900	2150	45	HM	HC	PT	PS	1	2	PT	45 MIN.	9	NONE	NONE	
	D18	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D19.A	A	900	2150	45	HM	HC	PT	PS	1	2	PT	45 MIN.	9	NONE	NONE	11
	D19.B	AA	1830	2150	45	HMT	INS	PT	PST	2	4	PT	-	10	NONE	NONE	
	D20	A	900	2150	45	WD	SC	ST	PS	1	2	PT	-	11	NONE	NONE	1,3
	D21	A	900	2150	45	HM	HC	PT	PS	1	2	PT	45 MIN.	9	NONE	NONE	
	D23.A	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D23.B	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D24	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D25	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D28	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
	D29	A	900	2150	45	WD	SC	ST	PS	1	2	PT	-	11	NONE	NONE	3
	D30	A	900	2150	45	WD	SC	ST	PS	1	2	PT	-	11	NONE	NONE	3
	D31	A	900	2150	45	WD	SC	ST	PS	1	2	PT	-	12	NONE	NONE	
	D32	A	900	2150	45	WD	SC	ST	PS	1	2	PT	45 MIN.	12	NONE	NONE	
	D33	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	12
	D35.A	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	6	2	NONE	5

D35.B	J	1600	920									--	7			7
D36.A	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	13	2	NONE	5
D36.B	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	13	2	NONE	5
D37	A	900	2150	45	WD	SC	ST	PS	1	1	PT	-	12	NONE	NONE	5
D38	A	900	2150	45	WD	SC	ST	PS	1	1	PT	-	11	NONE	NONE	3,5
D39	A	900	2150	45	WD	SC	ST	PS	1	1	PT	-	11	NONE	NONE	3,5
D40	C	900	2150	45	WD	SC	ST	PS	1	1	PT	-	13	2	NONE	5
D41	A	900	2150	45	WD	SC	ST	PS	1	2	PT	45 MIN.	12	NONE	NONE	5
D42	C	900	2150	45	WD	SC	ST	PS	1	1	PT	-	13	2	NONE	5
D43.A	A	900	2150	45	WD	SC	ST	PS	1	2	PT	-	6	NONE	NONE	5
D43.B	A	900	2150	45	WD	SC	ST	PS	1	1	PT	-	14	NONE	NONE	5
D44	A	1220	2150	44	WD	SC	ST			1	PT		15			9
D47	A	900	2150	45	WD	SC	ST	PS	1	2	PT	-	11	NONE	NONE	3
D48	A	900	2150	45	WD	SC	ST	PS	1	2	PT	-	11	NONE	NONE	3
D49	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5
D50.A	C	900	2150	45	WD	HC	ST	PS	1	1	PT		4	2	NONE	5
D50.B	C	900	2150	45	WD	HC	ST	PS	1	2	PT		4	2	NONE	5
D51.A	C	900	2150	45	WD	HC	ST	PS	1	1	PT		4	2	NONE	5
D51.B	C	900	2150	45	WD	HC	ST	PS	1	2	PT		4	2	NONE	5
D52	C	900	2150	45	WD	SC	ST	PS	1	2	PT	-	4	2	NONE	5

1. General

1.1 INTENT

.1 This Section specifies:

.1 General requirements common to site installed glass and glazing work.
.2 Glass and glazing products.

.2 Read this Section in conjunction with other Sections which specify glass installation in specific components.

.3 This Section is intended to be used as a reference Section; it is not a "section of work". Refer to other Sections for application of requirements specified herein.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Submittal Procedures	Section 01 33 00.
.2	Shop Drawings, Product Data and Samples	Section 01 33 23.
.3	Waste Management and Disposal	Section 01 74 19.
.4	Spare Parts and Maintenance Materials	Section 01 78 43.
.5	Aluminum Windows:	Section 08 51 13.
.6	Glazing:	Section 08 81 05.
.7	Mirror Glass:	Section 08 83 13.

1.3 REFERENCE DOCUMENTS

.1 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-12.1	Tempered or Laminated Safety Glass
.2	CAN/CGSB-12.3	Flat, Clear Float Glass
.3	CAN/CGSB-12.4	Heat Absorbing Glass
.4	CAN/CGSB-12.8	Insulating Glass Units
.5	CAN-CGSB-12.10	Glass, Light and Heat Reflecting
.6	CAN/CGSB-19.13	Sealing Compound, One-Component, Elastomeric, Chemical Curing
.7	CAN/CGSB 19-GP-14M	Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing
.8	CAN/CGSB-19.24	Multicomponent, Chemical-Curing Sealing Compound

.3 Canadian Standards Association (CSA):

.1	CSA A440.2	Fenestration Energy Performance
.2	CSA Certification Program for Windows and Doors	

.4 Flat Glass Manufacturers Association (FGMA):

.1 FGMA Glazing Manual -

.5 Laminators Safety Glass Association (LSGA):

.1 LSGA Laminated Glass Design Guide

1.4 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.5 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer’s printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures.

.2 Samples:

.1 Submit 300 mm x 300 mm sized samples of each type of glass, clearly labelled with manufacturer's name and glass type. Reference glass types to those scheduled and specified herein.

.3 Test and Evaluation Reports:

.1 Prepare a stress analysis on all tinted heat/absorbing glass and light and heat reflecting glass. Submit prior to ordering glass.

1.6 QUALITY ASSURANCE

.1 Certifications:

.1 Insulating glass units shall be certified by the Insulated Glass Manufacturers Alliance (IGMA)

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Handling Requirements:

.1 Suitably protect glass products to prevent damage from weather and breakage. Individually wrap accessory materials to protect them from damage.

.2 Store glass vertically, off the ground, on "A" frames, braced or blocked to prevent racking, twisting, or sagging.

.3 Take special care to protect edges of insulating glass units from damage but do not apply tape or other materials to edges.

.4 Protect glass products from exposure to moisture or condensation prior to installation.

2. Products

2.1 CLEAR FLOAT GLASS

.1 Product: to CAN/CGSB-12.3, glazing quality.

2.2 TINTED/HEAT ABSORBING GLASS

1. Shall comply with ASTM C1036 Standard Specification for Flat Glass, Type 1, Class 1 (clear) or Class 2 (tinted, heat-absorbing and light reducing) and Quality q3

2. ASTM C 1048 Heat Treated Flat Glass, Kind HS or FT (remove ASTM Standard C 1048 if annealed glass), Condition A (uncoated), B (spandrel glass, one surface coated), or C (other coated glass

   .1 Heat Treated Flat Glass to be by horizontal (roller hearth) process with inherent rollerwave distortion parallel to the bottom edge of the glass as installed.
   .2 Maximum peak to valley rollerwave 0.003” (0.08mm) in the central area and 0.008” (0.20mm) within 10.5” (267mm) of the leading and trailing edge
   .3 For clear or low-iron glass 1/4” to 3/8” thick without ceramic frit or ink, maximum + or – 100 mD (millidiopter) over 95% of the glass surface.
   .4 Maximum bow and warp 1/32” per lineal foot (0.79mm).
   .5 All tempered architectural safety glass shall conform with ANSI Z97.1 and CPSC 16 CFR 1201.
   .6 For all fully tempered glass, provide heat soak testing conforming to EN14179 which includes a 2 hour dwell at 290°C±10°C.

2.3 CLEAR LAMINATED SAFETY GLASS

.1 Product: to CAN/CGSB-12.1 and as follows:

   .1 Type: 1 - Laminated.
   .2 Class: B - Float glass, annealed.
   .3 Colour: as indicated as coloured glass on Drawings, to match:
      .1 Viracon Light Green Vanceva 0242
      .2 Viracon Dark Green Vanceva 3466

.2 Laminated Glass:

   1. Shall comply with ASTM 1172 Standard Specification for Laminated Architectural Flat Glass.

   2. All laminated architectural safety glass shall conform with ANSI Z97.1 and CPSC 16 CFR 1201.

3. Laminated Glass products to be fabricated free of foreign substances and air or glass pockets in autoclave with heat plus pressure.

2.4 CLEAR TEMPERED SAFETY GLASS

.1 Product: to CAN/CGSB-12.1 and as follows:

.1 Type: 2 - Tempered.

.2 Class: B - Float Glass.

.3 Category: II - 540 J impact resistance.

2.5 LOW EMISSIVITY (LOW E) GLASS

.1 Where so indicated in the Insulating Glass Schedule or elsewhere in the Contract Documents, provide primary glass products with a low emissivity coating as follows:

.1 Type of Metallic Coating: Soft, sputtered.

.2 Coated Vision Glass:

1. Shall comply with ASTM C 1376 Standard for Pyrolytic and Vacuum Deposition Coatings on Glass

2. Coated products to be magnetically sputtered vacuum deposition (MSVD)

3. Edge Deletion – When low-e coatings are used within an insulating unit, coating shall be edge deleted to completely seal the coating within the unit.

.1 The edge deletion should be uniform in appearance (visually straight) and remove 95% of the coating.

2.6 INSULATING GLASS UNITS

.1 Insulating Glass:

1. Shall comply with ASTM E 2190 Standard Specification for Insulating Glass Unit Performance and Evaluation.

.1 Units shall be certified for compliance by the IGCC in accordance with the above ASTM test method.

2. The unit overall thickness tolerance shall be -1.59 mm / +0.79 mm for a 1” two ply insulating unit. Unit constructed with patterned or laminated glass shall be +/- 1.59 mm.

3. Shall comply with ASTM E 546 Standard Test Method for Frost Point of Sealed Insulating Glass Units
4. Shall comply with ASTM E 576 Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position
5. Sealed Insulating Glass Units to be double sealed with a primary seal of polyisobutylene and a secondary seal of silicone.

    .1 The minimum thickness of the secondary seal shall be 1.59 mm.
    .2 The target width of the primary seal shall be 3.97 mm.
    .3 There shall be no voids or skips in the primary seal.
    .4 Up to a maximum of 3/32" of the spacer may be visible above the primary polyisobutylene sealant.
    .5 Gaps or skips between primary and secondary sealant are permitted to a maximum width of 1.59 mm by maximum length of 51 mm with gaps separated by at least 457 mm. Continuous contact between the primary seal and the secondary seal is desired.

6. To provide a hermetically sealed and dehydrated space, lites shall be separated by a spacer with bent corners and straight butyl injected zinc plated steel straight key joints.

.2 Provide sealed insulating glass units in accordance with CAN/CGSB-12.8, in configurations indicated in Insulating Glass Schedule, and as specified herein.

.3 Manufacture sealed insulating glass units without edge channels or tape, that is, with bare glass edges.

.4 Use two stage seal method of manufacture, as follows:

    .1 Primary Seal: polyisobutylene sealing compound between glass and metal spacer/separator, super spacer bar or TDSE Intercept.

    .2 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.

.5 Spacer/separator to provide continuous vapour barrier between interior of sealed unit and secondary seal.

.6 Sealants for Insulating Glass Units:

    .1 Butyl-polyisobutylene Sealants: one component, polymer base, solvent curing, to CGSB 19-GP-14M, colour to match frame colour.

    .2 Polysulphide Base and Polyurethane Base Sealants: to CAN/CGSB-19.24, multi-component, chemical curing, and as follows:

        .1 Type: 2 - non-sag.

.2 Class: A - glazing.
.3 Movement Capability: plus and minus 25%.
.4 Colour: grey

.3 Silicone Base Sealants: to CAN/CGSB-19.13, one component, elastomeric, chemical curing, and as follows:

.1 Rheological Properties: Class 2 - non-sag.
.2 Substrate Class: G - Glass.
.3 Glazing Suitability: Class A - resists ultraviolet through glass.
.4 Temperature Class: L - low temperature
.5 Movement Class: 40.
.6 Colour: Grey

.4 Do not use polyurethane sealants for insulating glass units having laminated glass with a polyvinyl butyrate interlayer.

2.7 GLAZING ACCESSORIES

.1 Setting Blocks: neoprene, 80 durometer hardness, 100 mm long x 6 mm thick x width required to support full glass thickness for single glazing and full thickness of thermal units.

.2 Spacer Shims: neoprene, 80 durometer hardness, 75 mm long x minimum 6 mm thick. Do not use metal, plastic, or wood shims.

.3 Glazing Splines and Gaskets: manufacturer's standard dry neoprene glazing splines and gaskets. Provide keyed type for fixed glazing stops and keyed or roll-in type for removable glazing retaining devices. Except where otherwise specified, colour shall match frame colour.

.4 Glazing Tape: 100% polybutalene vehicle. Extruded in ribbon form with paper separator. Tape shall have an integral shim strip where required.

3. Execution

3.1 GLAZING GENERAL REQUIREMENTS

.1 Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying tapes, splines or gaskets. Use solvents and cleaning agents recommended by manufacturer of sealing materials.

.2 Install glazing tapes, splines and gaskets uniformly with accurately formed corners and bevels. Ensure that proper contact is made with glass and rabbet interfaces.

.3 Continuously and uniformly compress length of dry glazing splines and gaskets 38-50 mm per 1200 mm during installation.

.4 Set glass on setting blocks, spaced as recommended by glass manufacturer. Provide at least one setting block at quarter points from each corner.

.5 Centre glass in glazing rabbet to maintain required clearances at perimeter on all four sides.

.6 Use spacers and shims in accordance with glass manufacturer's recommendations.

3.2 CLEANING

.1 Remove dirt, scum, plaster, paint spatter and other harmful or deleterious matter from glass promptly and completely, before they establish tight adhesion.

.2 Use clean water or proprietary glass cleaning solutions that will not damage glass surfaces. Avoid using abrasives, steel wool, razor blades, solvents, alkaline or other harsh cleaning agents.

3.3 PROTECTION

.1 Identify glazed openings immediately following glass installation, using liquid shoe wax in a sponge topped bottle or similar easy-to-remove product.

.2 Protect glass against scratches, pitting and other surface damage.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with:

.1 Glass and Glazing General Requirements: Section 08 81 00.

1.2 SECTION INCLUDES

.1 This Section includes requirements for the following:

.1 Glazing of hollow metal doors.
.2 Glazing of hollow metal frames.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Waste Management and Disposal	Section 01 74 19.
.2	Aluminum Entrances and Storefronts:	Section 08 41 13.
.3	Aluminum Windows:	Section 08 51 13.
.4	Glass and Glazing General Requirements	Section 08 81 00.
.5	Mirror Glass:	Section 08 83 13.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures.

2. Products

2.1 GLASS PRODUCTS

.1 Glass, Glazing and Sealing Compounds, and Glazing Accessories: as specified in Section 08 81 00.

3. Execution

3.1 GLAZING

.1 Glaze components required to be glazed under the work of this Section in accordance with general requirements for glazing specified in Section 08 81 00 and detailed requirements specified herein. Refer to Door Schedule on drawings.

.2 Glaze interior and exterior hollow metal doors as follows:

.1 Apply butyl tape to fixed stop, back 2 mm from sight line.

.2 Remove release tape and press glass into place.

.3 Apply butyl tape to removable stop, remove release tape and secure stops in place.

.4 Ensure adequate thicknesses of glazing tape to secure glass in place and prevent glass from rattling.

.3 Glaze interior and exterior hollow metal frames as follows:

.1 Same as hollow metal doors.

.4 Monumental Aluminum Framed Folding/Paired Panel: Sealed double glazed tempered glass unit with glazing film on #3 surface.

.5 Exterior glazing

.1 Laminated Glass:

1. 9/16” Clear Laminated Glass as manufactured by Viracon.

.1 Exterior Glass Ply: ¼” Clear Heat Treatment - HS

.2 Interlayer: 0.060 OA {Type – 0.015 Clear PVB, 0.015 (2) Blue 78%, 0.015 (4) Yellow 78%, 0.015 (2) Blue 78%}

.3 Interior Glass Ply: ¼” Clear Heat Treatment - HS

.2 Laminated Glass:

1. 9/16” Clear Laminated Glass as manufactured by Viracon.

.1 Exterior Glass Ply: ¼” Clear Heat Treatment - HS

.2 Interlayer: 0.060 OA {Type – 0.015 (1) Red 78%, 0.015 (4) Yellow 78%, 0.015 (4) Yellow 78%, 0.015 (6) Blue 50%}

.3 Interior Glass Ply: ¼” Clear eat Treatment - HS

.3 Laminated Glass:

1. 9/16" Clear Laminated Glass as manufactured by Viracon.

.1 Exterior Glass Ply: ¼" Clear Heat Treatment - HS

.2 Interlayer: 0.060 OA {Type – 0.015 (3) Black 78%, 0.015 (4) Yellow 78%, 0.015 (6) Blue 78%, 0.015 (6) Blue 50%}

.3 Interior Glass Ply: ¼" Clear Heat Treatment - HS

.4 Laminated Glass:

1. 9/16" Clear Laminated Glass as manufactured by Viracon.

.1 Exterior Glass Ply: ¼" Clear Heat Treatment - HS

.2 Interlayer: 0.060 OA {Type – 0.015 (6) Blue 50%, 0.015 (7) Black 50%, 0.015 (7) Black 50%, 0.015 (8) Yellow 86%}

.3 Interior Glass Ply: ¼" Clear Heat Treatment - HS

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 This section includes requirements for supply and installation of wall mounted, unframed, fully silvered glass mirror units.

1.2 RELATED SECTIONS

.1	Glass and Glazing General Requirements:	Section 08 81 00.
.2	Light and heat reflecting glass:	Section 08 81 00.
.3	Transparent, one way mirrored glass:	Section 08 81 00.
.4	Glazing:	Section 08 81 05.

1.2 REFERENCE DOCUMENTS

.1 Canadian General Standards Board (CGSB):

.1	CAN/CGSB 12.3-M91	Flat, Clear Float Glass
.2	CAN/CGSB 12.1-M90	Tempered or Laminated Safety Glass

.2 Environmental Choice Program (ECP):

.1	CCD 045-95	Sealants and Caulking

.3 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD):

.1	SCAQMD Rule 1168 June 2006	Adhesives and Sealants Applications

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Comply with requirements of Section 08 81 00.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Management and Disposal.

2. Products

2.1 MIRROR GLASS

.1 Mirrors, Silvered: to CAN/CGSB-12.5 and as follows:

.1 Type: 3A - Float glass, tempered.

.2 Tint: Clear.

.3 Edges: Flat polished edge. Seal edges to prevent chemical or atmospheric penetration of backing.

2.2 INSTALLATION MATERIALS

.1 Mirror Mastic: Adhesive setting compound produced specifically for setting of mirrors by spot application, compatible with glass coating and as recommended by mirror manufacturer.

3. Execution

3.1 INSTALLATION

.1 Wall Mounted Mirror Installation, Generally:

.1 Install mirrors in accordance with mirror manufacturer's instructions.

.2 Mount mirrors in-place to avoid distorting reflected images.

.2 Mastic Installation:

.1 Inspect surface over which mirror is to be mounted. Comply with mastic manufacturer's installation directions for preparation of mounting surface including coating with mastic manufacturer's special bond coating where applicable.

.2 Apply mastic in spots to comply with mastic manufacturers directions for coverage and to allow air circulation between back of mirror and mounting surface.

.3 Hardware Installation:

.1 Provide permanent means of structural support at bottom edge of mirror.

.2 Attach mirror hardware securely to mounting surface with mechanical fasteners with anchors or inserts.

.3 Place a felt or plastic pad between mirror and metal or plastic clips to prevent spalling of mirror edges.

.4 Mirror Installation:

.1 After mastic is applied, align mirror and press into place while at the same time maintaining a minimum air space of 4 mm for air circulation between back of mirror and mounting surface.

.2 Install clips along top of mirror during mastic curing period.

3.2 CLEANING

.1 Wash mirrors using water or glass cleaners free from substances capable of damaging mirror edges or backing.

3.3 PROTECTION

.1 Protect mirror glass from breakage and contaminating substances resulting from construction operations.

.2 Do not permit edges of mirror to be exposed to standing water.

.3 Maintain environmental conditions which will prevent mirror from being exposed to moisture from condensation or other sources for continuous periods of time.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Glass and Glazing — Section 08 81 00

1.2 REFERENCE DOCUMENTS

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

.1 ASTM D1004-03 — Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

.2 American National Standards Institute (ANSI):

.1 ANSI Z97.1-2001 — Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

1.3 SUBMITTALS

.1 Comply with requirements of Division 01.

.2 Provide 300 x 300 mm (12" x 12") sample of each type of film to the Consultant.

.3 Field Sample:

.1 Install a field sample of materials representative of the actual materials to be installed.

.2 Sample will be reviewed by the Consultant, and when accepted, may form a permanent part of the Work and will form the basis for acceptance for the remainder of the project.

.3 Materials found not acceptable shall be repaired or replaced at no cost to the Owner or Consultant.

.4 Submit two copies of manufacturer's literature for products furnished, including application instruction appropriate Material Safety Data Sheets (MSDS) and use requirements.

.5 Submit two copies of warranty to be issued including conditions and limitations

.6 Submit maintenance and cleaning instructions describing proper cleaning procedures and proper cleaning solutions to use.

1.4 QUALITY ASSURANCE

.1 Fabricator/Applicator: Company experience and trained in laminating film to glass on-site and in shop for 5 years minimum.

1.5 WARRANTY

.1 Provide a warranty for materials and labour from the film manufacturer against discoloration and loss of solar properties for 10 years and against thermal glass breakage for 1 year.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver and store packaged materials in their original containers with manufacturer's labels and seals intact.

.2 Store as recommended by manufacturer in a weatherproof enclosure.

1.7 SITE CONDITIONS

.1 Coordinate the Work of this Section with the installation of glazing.

2. Products

2.1 GLAZING FILMS

.1 Translucent Glazing Film: Glazing film, 0.5 mm thick dusted etched, translucent, matte film with permanent adhesive.

1. Location: Movable glass partitions required ½ height frosting (50%). Frosting to occur on #3 glazing surface. Maximum panel size of 1220 mm. Refer to Drawings for layout and patterns.

3. Execution

3.1 PREPARATION

.1 Prepare glass surface clean and free of obstructions, and ready to receive glazing film.

3.2 INSTALLATION

.1 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, and level over clean glazing.

.2 Do not glaze when ambient or surface temperatures are less than 4°C. Glass shall be dry, free from ice, frost slick, grease, oil, dust, rust, or other matter detrimental to adhesion of tape, glazing compounds and sealant.

.3 Installation of glass shall be by workmen skilled in this trade in strict accordance with manufacturer's directions, to produce a first-class installation.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Environmental Procedures	Section 01 35 20.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Wind Bearing Metal Stud Systems:	Section 05 41 00.
.4	Custom Metal fabrications:	Section 05 50 00.
.5	Rough Carpentry:	Section 06 10 00.
.6	Fibrous batt insulation:	Section 07 21 16.
.7	Firestopping:	Section 07 84 00.
.8	Ceramic Tile:	Section 09 30 13.
.9	Air/vapour seals at electrical boxes	Section 26 05 33.

1.2 REFERNCE DOCUMENTS

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

.1	ASTM C645-08a	Standard Specification for Nonstructural Steel Framing Members
.2	ASTM C754-08	Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
.3	ASTM C840-08	Standard Specification for Application and Finishing of Gypsum Board (Provide copy on site.)
.4	ASTM C1002-07	Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
.5	ASTM C1047-05	Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
.6	ASTM C1278/C1278 M-07a	Standard Specification for Fibre-Reinforced Gypsum Panel
.7	ASTM C1280-07	Standard Specification for Application of Gypsum Sheathing (Provide copy on site.)
.8	ASTM C1288-99(2004)e1	Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets
.9	ASTM C1396/C1396 M-06a	Standard Specification for Gypsum Board

.2 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-51.34-M86 AMEND	Vapor Barrier, Polyethylene Sheet for Use in Building Construction.

.3 Canadian Standards Association (CSA):

.1 CAN/CSA B111-1974(R2003) Wire Nails, Spikes and Staples.

.4 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD):

.1 SCAQMD Rule 1168, June 2006, Adhesives and Sealants Applications

.5 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S101-07 Fire Endurance Tests of Building Construction and Materials.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs.

.2 Samples:

.1 Comply with requirements of Division 01.

.2 Submit duplicate 300 mm x 300 mm samples of vinyl faced gypsum board.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Management and Disposal.

2. Products

2.1 GYPSUM BOARD

.1 Gypsum board products shall meet or exceed requirements of ASTM C1396M unless specified otherwise.

.1 Gypsum board products shall be 1220 mm wide x maximum practical length for application, unless specified otherwise.

.2 Fire Rated board and other board specified with Fire Rated core shall be labeled in accordance with a certification program accredited by the Standards Council of Canada

.2 Standard Gypsum Board: Meeting requirements of ASTM C1396M with long edges tapered, and ends square cut.

.3 Fire Rated Gypsum Board: Meeting requirements of ASTM C1396M with long edges tapered and ends square cut.

.4 Water Resistant Gypsum Board: standard core and fire rated where indicated, fibreglass mat faced, ends square cut, tapered edges.

.5 Abuse Board: Impact Resistant Gypsum/Cellulose Fibre Board: Manufactured to produce superior resistance to surface indentation and through penetration than standard gypsum panels; gypsum panels with cellulose fibre reinforced facers and glass fibre reinforced core, tapered edges, minimum 13.7 kg/m^2, 13 mm thickness, Type X ULC fire rating, conforming to ASTM C1629.

.6 Gypsum Sheathing: moisture resistant and fire resistant type with treated and nontreated core as indicated, maximum available size in place, ends and edges square cut.

.7 Gypsum Core Board: maximum available size in place, ends square cut, square edges.

2.2 FIBRE REINFORCED PANELS

.1 Fibre reinforced gypsum panel products shall meet or exceed requirements of ASTM C1278M.

.2 Fibre reinforced gypsum panel products shall be 1220 mm wide x maximum practical length for application, unless specified otherwise.

.3 Panels specified with Fire Rated core shall be labeled in accordance with a certification program accredited by the Standards Council of Canada

.4 Interior Fibre Reinforced Gypsum Panels: ends square cut, tapered edges.

.5 Water-Resistant Fibre Reinforced Gypsum Backing Panels: ends square cut, tapered edges.

.6 Water-Resistant Exterior Fibre Reinforced Gypsum Sheathing Panels: ends square cut, tapered edges.

.7 Cementitious Wallboard: to ASTM C1288, high density, glass fibre reinforced.

2.3 FRAMING MEMBERS

.1 Studs and Tracks: to ASTM C645, metal thickness as specified in Steel Stud Height Schedule for appropriate height and as specified elsewhere, galvanized to ASTM A653/A653M, Z180 zinc coating. Use minimum 0.88 mm studding for fibre-reinforced gypsum board.

.2 Furring: 0.48 mm thick galvanized sheet steel to ASTM A653M-00, Z180 zinc coating, sizes as indicated on drawings.

.3 Resilient Furring: 0.48 mm thick galvanized sheet steel to ASTM A653M-00, Z180 zinc coating, pre-punched, 35 mm face width, 16 mm high.

.4 Shaft Wall Framing: meet or exceed requirements of applicable ULC or WHC design.

2.4 SUSPENDED CEILING AND SOFFIT SYSTEM COMPONENTS

.1 Carrying Channels: Cold rolled steel to ASTM C645, galvanized.

.2 Tie Wire: to ASTM C754.

.3 Hangers: to ASTM C754, galvanized.

.4 Hanger Anchoring Devices:

.1 Size devices to develop full strength of hangers, but not less than three times the calculated hanger loading, except size direct pull-out concrete inserts for five times calculated hanger loading.

.2 Powder-actuated fasteners to underside of concrete structure **not** permitted.

.3 Metal decking tabs and clips **not** permitted.

.4 Devices shall be hot-dip galvanized steel screws, bolts, cast-in-place concrete inserts or other devices appropriate for anchorage to the structure indicated.

.5 Suitability of devices shall have been proven through standard construction practices or certified test data.

2.5 ACCESSORIES

.1 Accessories shall meet or exceed requirements of ASTM C1047 unless otherwise required for conformance to fire-rated assemblies.

.2 Screws: to ASTM C1002, and modified as required for fastening to 1.22 mm and thicker steel studs.

.3 Nails: to CAN/CSA B111, annular ring type, galvanized.

.4 Adhesive for bonding gypsum board or panels to wood framing: to ASTM C557, waterproof, organic type, gun applied having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.

.5 Adhesive for laminating gypsum board or panel to gypsum board or panel: as recommended by gypsum board or panel manufacturer, as applicable and having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.

.6 Corner Beads: galvanized sheet steel to ASTM A653M, Z180 zinc coating, beaded angle, knurled and perforated, 32 mm wide flanges, for joint compound filling.

.7 Casing Beads: galvanized sheet steel to ASTM A653M, Z180 zinc coating, beaded edge, knurled and perforated flange 32 mm wide, for joint compound filling.

.8 Control Joints: pre-formed galvanized metal or plastic "V" type, perforated flanges.

.9 Joint treatment material, joint tape and topping compound: to ASTM C475.

.10 Joint tape for cementitious wallboard: coated glass fibre tape, 50 mm wide.

2.6 ACOUSTIC TREATMENT MATERIALS

.1 Acoustic Sealant: non-hardening, non-skinning, permanently flexible and having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.

.2 Acoustic Insulation: to ASTM C665, Type I, non-combustible, mineral fibre, unfaced batts, friction fit, thickness as indicated on drawings.

3. Execution

3.1 INSTALLATION, GENERALLY

.1 Meet or exceed the requirements of ASTM C840 for gypsum board and ASTM C1280 for gypsum sheathing.

.2 Materials and installation of fire-rated assemblies shall conform to assemblies that have achieved the specified rating when tested to CAN/ULC-S101.

3.2 INSTALLATION OF METAL FRAMING

.1 Meet or exceed the requirements of ASTM C754.

.2 Provide double studs at partition openings, door and interior window jambs. First stud adjacent to openings shall be minimum 0.88 mm material thickness.

.3 Provide concealed bracing as required to construct rigid installation. Provide bracing to building structure for partitions extended above ceilings.

.4 Provide extra length top track flanges to maintain clearance between structure and top of studs, to avoid transmission of structural loads to studs.

.5 Screw attach studs to top and bottom tracks of partitions less than ceiling height.

.6 Install 92 mm steel stud track with 0.88 mm material thickness backing as detailed for support of fixtures, heavy trim, washroom accessories, wall cabinets and similar construction. Position stud track web to face gypsum board or panel, bend web at ends and screw to stud webs with two screws per connection.

.7 Frame openings for firestopping and around structural components, cabinets, access panels, and other built-in equipment, on four sides. Extend framing into recesses. Check clearances with respective equipment suppliers.

3.3 FURRING

.1 Furr to form bulkheads between ceilings at different levels. Furr for beams, columns, pipes, and around exposed services, except as otherwise indicated.

.2 Frame perimeter of openings to support access panels, light fixtures, diffusers, grilles and similar components.

.3 Install 150 mm continuous strip of 13 mm gypsum board or panel along base of partitions where resilient furring is installed.

3.4 INSTALLATION OF METAL FRAMED SUSPENDED CEILINGS AND SOFFITS

.1 Verify suitability of substrate for hanger anchoring devices.

.2 Install suspension system to meet or exceed requirements of ASTM C754. Coordinate location of hangers with other work.

.3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at 600 mm maximum around perimeter of fixture.

.4 Do not suspend ceiling from metal decking.

.5 Provide carrying channels at interruptions of continuity and at changes in direction of suspension system.

.6 Exterior Soffits:

.1 Brace suspension over whole area to prevent movement due to wind pressure.
.2 Install galvanized drips continuously along edges.

.7 Maximum deviation of framing from horizontal shall be 3 mm in 3.5 m, non-cumulative.

3.5 ACOUSTIC TREATMENT

.1 Install acoustic insulation between studs in acoustically rated partitions.

.2 Ensure acoustic insulation fills spaces between studs, full height of walls, and is continuous over door frames and around openings and corners.

.3 Ensure insulation is packed around cut openings in board and panels, behind outlet boxes, around plumbing, heating or structural items passing through the system and at abutting walls.

.4 Unless indicated otherwise on drawings, apply 15 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to acoustically seal gypsum board and panel junction with abutting fixed building components. Seal full perimeter of cutouts around electrical boxes, ducts, piping, etc.

.5 Apply sealant in accordance with manufacturer's directions.

.6 Apply two, 10 mm diameter beads of acoustic sealant between stud framing and fixed building components, around periphery of acoustically rated partitions.

3.6 APPLICATION OF BOARDS AND PANELS

.1 Do not apply gypsum board and panels until framing, blocking, mechanical and electrical work have been inspected and approved by Province.

.2 Erect gypsum board and panels vertically for walls unless horizontal application results in fewer end joints. Locate end joints over framing members.

.3 Cut holes for penetrating items to minimize gaps between items and board and panels.

.4 Keep end joints away from prominent locations and central portions of ceilings.

.5 Locate vertical joints at least 300 mm from jamb lines of doors, windows and other openings.

.6 Erect ceiling gypsum board and panels with long dimensions perpendicular to framing members.

.7 Where applicable, adhere boards and panels directly to interior walls as follows:

.1 Ensure substrate is dry and free from efflorescence.
.2 Mix and apply adhesive to manufacturer's directions.
.3 Temporarily secure aligned board and panels in place. Avoid impact or movement of boards and panels until adhesive sets firmly.

3.7 INSTALLATION OF ACCESSORIES

.1 Provide control joints as follows:

.1 where indicated.

.2 Install expansion joints at all building expansion joints.

.3 Erect beads and joints straight and rigid. Use full length pieces only. Mitre and fit corners accurately.

.4 Install corner beads at external angles. Secure to substrate.

.5 Install casing beads where gypsum board and panel materials terminate against surface having no trim concealing the junction and where indicated on drawings.

3.8 TAPING AND FINISHING

.1 Meet or exceed requirements of ASTM C840.

.2 Provide the finish level, specified in ASTM C840, for the following surfaces:
.1 Level 1: plenum areas above ceilings and other concealed areas.
.2 Level 2: surfaces that are to receive ceramic tile.
.3 Level 3: surfaces that are to receive heavy spray or trowel applied finishes.
.4 Level 4: surfaces to receive wallcoverings, flat paints or light textures.

.3 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and topping compound.

.4 Apply joint system according to manufacturer's directions. Feather out onto board and panel faces.

.5 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of topping compound feathered out 300 mm onto board and panel faces.

.6 Fill each screw and nail head depression individually with joint and topping compounds to bring flush with adjacent surfaces of gypsum board and panels so as to be invisible after painting is completed.

.7 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surfaces of boards and panels.

.8 Use minimum #120 grit sandpaper for first and second sandings. Use minimum #150 grit sandpaper for final sanding.

.9 Completed installation shall be smooth, level or plumb, free from waves and other defects, ready for painting.

3.9 SKIM COATING

.1 Provide finish level 5 as specified in ASTM C840.

.2 Mix joint compound slightly thinner than for joint taping.

.3 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations and tool marks.

.4 Allow skim coat to dry completely.

.5 Remove ridges by light sanding or wiping with damp cloth.

3.10 CUTTING AND PATCHING

.1 Do all cutting, patching and making good as required to provide a satisfactory finish.

.2 When prime coat has become sufficiently dry, examine surfaces for any final patching that may be required. Use colour tinted patching compound for later visual examination and approval by Province before final prime and paint coats.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Environmental Procedures	Section 01 35 20.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Finishing of concrete floor:	Section 03 35 10.
.4	Caulking and sealing:	Section 07 92 00.
.5	Gypsum wallboard:	Section 09 29 00.
.6	Quarry tile flooring:	Section 09 30 16.
.7	Resilient flooring:	Section 09 65 00.
.8	Non-ceramic washroom accessories:	Section 10 28 13.

1.2 REFERNCE DOCUMENTS

.1 American National Standards Institute (ANSI/CTI):

.1	ANSI/CTI (Ceramic) A108/A118/A136.1-2005	Specification for the Installation of Ceramic Tile - A Collection of 20 ANSI/CTI A108 Series Standards on Ceramic Tile Installation: A108.1A-C, 108.4 -.13, A118.1-.10, ANSI A136.1

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

.1	ASTM C207 06	Standard Specification for Hydrated Lime for Masonry Purposes
.2	ASTM C847-06	Standard Specification for Metal Lath

.3 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-51.33-M89	Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction
.2	CGSB 71 GP 22M	Adhesive, Organic, for Installation of Ceramic Wall Tile
.3	CAN/CGSB-75.1-M88	Tile, Ceramic

.4 Canadian Standards Association (CSA):

.1	CAN/CSA-A8/A5/A362-93	Portland Cement / Masonry Cement / Blended Hydraulic Cement
.2	CSA A82.5-M1978 (R1998)	Structural Clay Non-Load-Bearing Tile
.3	CSA A123.3-05	Asphalt Saturated Organic Roofing Felt

.5 Terrazzo, Tile & Marble Association of Canada (TTMAC):

.1 TTMAC, Specification Guide 09 30 00, Tile Installation Manual 2009-2010

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures.

.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs.

.2 Shop Drawings:

.1 Submit shop drawings of ceramic tile work in accordance with Division 01.

.2 Clearly show layout, pattern and relationship of tile joints to washroom and other fixed accessories and project-formed details.

1.5 QUALITY ASSURANCE

.1 Installation:

.1 Tile work in accordance with 2009-2010 Specification Guide 09 30 00 Tile Installation Manual, produced by Terrazzo Tile and Marble Association of Canada TTMAC, except where specified otherwise.

.2 Mock-Ups:

.1 Provide mock-up of the following components to site:

.1 Tile flooring, as indicated.

.2 Keep approved mock-up on site.

.3 Approved mock-up shall establish minimum standard and may be incorporated into finished work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver packaged materials in original unopened containers.

.2 Storage and Handling Requirements:

.1 Keep delivered material dry and free from stains. Store cementitious material off damp surfaces.

1.7 SITE CONDITIONS

.1 Ambient Conditions:

.1 Maintain minimum 13°C air temperature at tile installation area for 24 hours prior to, during and after installation.

2. Products

2.1 MATERIALS

.1 Floor Tile (PorT1): Refer to Interior Materials Legend on Drawing A005.
- .1 Water Absorption ISO 10545-3 < 0.5% Conforms
- .2 Dynamic C.O.F. ANSI A137.1-2012 > 0.42 Conforms
- .3 Bending / Breaking Strength ISO 10545-4 >1300N Conforms
- .4 Modulus of Rupture ISO 10545-4 >35 N/mm² Conforms
- .5 Deep Abrasion Resistance ISO 10545-6 <175 mm³ Conforms
- .6 Chemical Resistance ISO 10545-13 min. UB Conforms
- .7 Frost Resistance ISO 10545-12 Required Conforms
- .8 Stain Resistance ISO 10545-14 > Class 3 Conforms

.2 Wall Tile (WT1): to CAN/CGSB-75.1, Type 5, Class MR4, faces glazed, cushioned edges on all 4 sides, refer to Interior Materials Legend on Drawing A005.

.3 Wall Tile: Refer to Interior Materials Legend on Drawing A005.

.4 Cement: grey to CAN/CSA-A5.

.5 Sand: to CSA A82.5.

.6 Water: potable.

.7 Dry-Set Mortar: to ANSI A118.1.

.8 Grout (G1): Refer to Interior Materials Legend on Drawing A005. Seal grout.

.9 Hydrated Lime: to ASTM C207 Type S.

.10 Cleavage Plane: polyethylene film to CAN/CGSB-51.33-M89, Type 2

.11 Provide tile trim shapes and profiles to match colour and finish of adjoining site tile.
.1 Transition Strips as indicated on Drawings and as follows:

.1 Straight Edge: Extruded clear satin anodized aluminum edge strips, 3 mm wide at top edge; height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material.

.2 Transition Edge Strips: Extruded clear satin anodized aluminum edge strips; height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material and sloped transition.

.12 Washroom Accessories: Refer to Section 10 28 13.

3. Execution

3.1 WORKMANSHIP

.1 Apply tile or backing coats to non-frozen frost free surfaces.

.2 Fit tile units around corners, fitments, fixtures, drains and other built-in objects to maintain uniform joint appearance. Make cut edges smooth, even and free from chipping. Edges resulting from splitting not acceptable.

.3 Make joints between tiles uniform and approximately 1.5 mm, plumb, straight, true, even and with adjacent tile flush. Ensure sheet layout not visible after installation.

.4 Install transition strips to exposed edges of tile, and where indicated on Drawings, in accordance with manufacturers written instructions. Seal with clear sealant, refer to Section 07 92 00.

.5 Seal grout.

.6 Align patterns.

.7 Lay out tiles so that perimeter tiles are minimum 1/2 size.

.8 Sound tiles after setting and replace hollow sounding units to obtain full bond.

.9 Clean installed tile surfaces after installation cured.

.10 Maintain building expansion joints. Keep free of mortar or grout.

.11 Locate ceramic accessories evenly spaced and centered on joint layout. Rigidly install accessories.

.12 Make internal angles square, external angles bullnosed. Use bullnose edged tiles to achieve bullnose effect.

.13 Use bullnose edged or trim tiles at termination of tile panels except where panel butts a projecting surface or differing plane.

3.2 INSTALLATION

.1 Install tile Over Masonry or Concrete Walls – Thin-Set Method to TTMAC details 303W.

.2 Install tile Over Gypsum Board – Thin-Set Method Dry Areas Only to TTMAC Details 304W

.3 Install tile on Interior/Exterior Walls on Cement Mortar over Wood or Metal Studs to TTMAC Details 308W.

.4 Install Tile on Concrete Slab Thin-Set Method to TTMAC detail 311F.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Environmental Procedures	Section 01 35 20.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Rough Carpentry:	Section 06 10 00.

1.2 REFERNCE DOCUMENTS

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

.1	ASTM C423-09a	Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
.2	ASTM E1264-08	Standard Classification for Acoustical Ceiling Products
.3	ASTM D1779-98 (2004)	Standard Specification for Adhesive for Acoustical Materials
.4	ASTM C636/C636M-08	Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

.2 Canadian Standards Association (CSA):

.1	CSA B111-1974 (R2003)	Wire Nails, Spikes and Staples

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 1 for requirements pertaining to product options and substitutions.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures.

.2 Samples:

.1 Submit duplicate samples of each component of acoustical systems for approval. Include accessories and mitered interior and exterior corners of wall mouldings.

.2 Install sample panel and components including suspension system at a location designated by the Province.

2. Products

2.1 MATERIAL

.1 Acoustic Units (ACT1): mineral base panels conforming to ASTM E1264.

Pattern: C D
Type: III
Form: 2
Flame Spread Index 25 or less. Smoke Developed Index 50 or less (UL labeled), Class A rated
Size: 610 mm x 1220 mm x 19 mm thick Square edge, white colour

Specify as minimum:

NRC-Noise Reduction Coefficient Range of 0.70
CAC-Ceiling Attenuation Class of 40
LRC-Light Reflectance Coefficient of 0.85

.2 Acoustic Units (MACT1): Clean room application, mineral base panels conforming to ASTM E1264.

Pattern: G H
Type: IV
Form: 2
Flame Spread Index 25 or less. Smoke Developed Index 50 or less (UL labeled), Class A rated
Size: 610 mm x 1220 mm x 19 mm thick Square edge, white colour

Specify as minimum:

NRC-Noise Reduction Coefficient Range of 0.55
CAC-Ceiling Attenuation Class of 35
LRC-Light Reflectance Coefficient of 0.79

.3 Acoustic Panels:
- .1 Surface Texture: Fine
- .2 Composition: Fiberglass
- .3 Surface finish: DuraBrite acoustically transparent membrane on all sides and edges
- .4 Colour: White
- .5 Size: 1220 mm x 1220 mm
- .6 Thickness: 22.23 mm
- .7 Edge Detail: Square edge
- .8 Layout: As detailed on Drawings.
- .9 Shape: Square
- .10 Flame Spread: (ASTM E 84), Class A
- .11 Sabin: 1.49

.12 Light Reflectance: (LR): (ASTM E 1477), Minimum 0.90 (white only)
.13 Acoustical Absorption: (ASTM C423), Minimum 30 Sabin/panel
.14 Mold/Mildew Inhibitor: The surface and back of the product have been treated with BioBlock, a paint that contains a special biocide that inhibits or retards the growth of mold and mildew, ASTM D3273.
.15 Sustainability: The canopies are eligible for reclamation.
.16 Basis of Design: Armstrong Soundscapes Shapes 5440

.4 Adhesive: conforming to ASTM D1779 having VOC content less than the VOC limits of State of California's South Coast Air Quality Management District Rule #1168, June 2006.

.5 Staples, nails and screws: conforming to CSA B111.

.6 Suspension System: Non-fire rated exposed tee bar grid including wall moulding.

.7 Suspension System (TBG): Fire rating as indicated on Drawings, exposed T bar grid including wall mounting, blue steel retainer clips.

.8 Suspension System, Clean Room Application: Provide suspension system as recommended by ceiling tile manufacturer (MACT1) for clean room application and provide appropriate accessories.

.9 Suspension System Components: commercial quality cold rolled steel zinc coated die cut interlocking components main and cross tee of double web with rectangular bulb depth governed by span all components 25 mm exposed face.

.10 Hangers: 2.6 mm steel wire galvanized.

.11 Suspension Accessories: Splices, clips, retainers, etc. to complement suspension system components.

3. Execution

3.1 JOB ENVIRONMENT

.1 Commence installation after building enclosed and dust generating activities completed.

.2 Permit wet work to dry prior to commencement of installation.

.3 Maintain uniform minimum temperature of 15°C and humidity of 20-40% prior to, during and after installation.

3.2 INSTALLATION

.1 Ensure substrate surface is level to within ±3 mm in 3 m.

.2 Install adhesive bonded acoustic units to clean, dry, firm and level surface.

.3 Ensure suspended system is coordinated with location of related components.

.4 Install acoustic units parallel to building lines with edge unit not less than 50% of unit width. Refer to reflected ceiling plan.

.5 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

.6 Support suspension system main runners at 1.2 m on centre maximum with hanger wire from building structural system. Completed assembly to support all superimposed loads. Maximum permissible deflection is 1/360 of span.

.7 Interlock cross member to main runner to provide rigid assembly.

.8 Install suspension assembly to manufacturers written instructions.

.9 Install flush edge moulding at junction of acoustic unit ceiling and other materials around entire length of joint. Secure to construction. Butt joints neatly, square and true in alignment.

.10 Install framed access panels supplied under Divisions 26.

.11 Seal vertical air plenum closure and acoustical ceiling where ventilating ceiling occurs. Use vinyl tape and 100 micrometre polyethylene to make positive, continuous seal.

.12 Electrical fixtures shall be supported by the main runners and cross runners, but in addition to this the acoustical Subcontractor shall supply and install to each and every fixture a 2.6 mm galvanized soft annealed mild steel wire hangers within 150 mm of each corner. Fixtures exceeding 610 mm x 1220 mm shall be supported by other Subcontractors responsible to the General Contractor.

.13 Runners supporting ceiling fixtures shall remain horizontal across their width within 2 degrees after the fixture loads are imposed.

.14 Do not install acoustic units until work above suspension system is complete and has been inspected by Province.

3.3 EXPANSION JOINTS

.1 Erect two main runners parallel, 25 mm apart, on building expansion joint line. Lay in strip of acoustic tile/board, painted black, 25% narrower than tight fit.

.2 Supply and install "U" shaped metal trim pieces at each side of expansion joint. Design to accommodate ±25 mm movement and maintain visual closure. Finish metal components to match adjacent metal trim. Provide backing plates behind butt joints.

3.4 CLEANING

.1 Keep acoustic installation and all components clean. Remove blemishes immediately.

END OF SECTION

1. General

1.1 SUMMARY

.1 Provide wood flooring refinishing in accordance with requirements of the Contract Documents.

1.2 ADMINISTRATION REQUIREMENTS

.1 Pre-Construction Meeting: Arrange a pre-construction meeting attended by Contractor and flooring refinisher to discuss coordination issues and floor preparation requirements.

1.3 SUBMITTALS

.1 Product Data: Submit for Consultant's action. Furnish each type of product and accessories to be used in the Work; before starting work of this section.

.2 Product Data: Submit product data including construction details, material descriptions, stain sample and clear coat samples for floor refinishing.

.3 Samples: Submit for Consultant's action. Submit samples prior to starting work of this section as follows; accepted samples will form the standard of acceptance for the remainder of the work:

.4 Initial Selection: Submit samples and manufacturer's colour charts showing colours and glosses available for initial selection for the following:

.1 Floor finish

1.4 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Refinisher: Use only experienced hardwood refinishers; who has complete refinishes similar in material, design, and extent to that indicated for this project and whose work has resulted in installations with a record of successful in service performance for a minimum of five (5) years.

2. Products

2.1 MATERIALS

.1 Existing hardwood flooring as indicated on Drawings. Patch wood floor to match existing in areas of Mechanical System repairs.

.2 Thresholds: Refer to Section 08 70 00. Provide metal transition between wood floor and concrete floor as recommended by flooring manufacturer.

.3 Floor Finish System: Sealer and finishing system comprised of compatible components recommended in writing by flooring manufacturer and meeting requirements for MFMA Group 5 two component, heavy traffic duty gymnasium clear floor finish; multi-coat application and as follows:

.1 Game Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturer of finish coats and paint for this use. Refer to Drawings for game lines and colours.

.2 Chemical Components: Provide products meeting requirements of 40 CFR 59, Subpart D (EPA Method 24) as follows:
- .1 Floor Sealers and Finish Coats: 350 g/L maximum VOC content. Refer to Section 09 91 00.
- .2 Game Line and Marker Paint: 150 g/L maximum VOC content.

.3 Acceptable Materials:
- .1 Betco Corporation, Sports Zone SS Gym Coat System
- .2 BonaKemi USA Inc., Bona SportSuper Floor Finish System
- .3 Hillyard Inc., 350 Gym Finish System
- .4 Spartan Chemical Corporation, AquaSport 2-Part Wood Floor Finish System

3. Execution

3.1 SANDING AND FINISHING

.1 Remove all dirt, debris, foot marks, etc., sweep floor broom clean.

.2 Sand existing floor to remove existing finish. Review floor after sanding with Consultant to decide if a stain is required, based on the condition of the floor. Fill large gouges and cracks with wood filler, colour to match floor.

.3 Sand floor using power drum sanders working in direction of grain:

.1 1st sanding: No. 2 (36) paper.

.2 2nd sanding: No. 1/2 (60) paper.

.3 3rd sanding: No. 00 (100) paper.

.4 Clean floor after each sanding.

.4 After final sanding, touch-up to remove scratches, irregularities, blemishes.

.5 Tack rag floor after sanding to remove dust particles from sanding.

.6 Sweep and vacuum floor thoroughly.

.7 Refer to Section 09 91 00 for system for refinishing floors and above.

.8 Apply floor sealer in accordance with manufacturers written instructions.

.9 During finishing and drying time, floor must be free of dust and dirt. Avoid air currents that could carry dust and dirt. Maintain temperature of room and material and allow for adequate ventilation for proper curing.

.10 Sealing: apply sealer using straight even strokes. Work first against grain, then smooth out with grain. Avoid puddles of sealer on the floor. After first coat of sealer is dry, sand. Vacuum.

.11 Apply second coat of sealer, when dry sand and vacuum.

.12 Inspect for blemishes and repair.

3.2 PROTECTION

.1 Protect sports floors during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Substantial Performance.

.2 Do not cover sports floors after finishing until finish reaches full cure, and not before seven (7) days after applying last finish coat.

.3 Do not move heavy and sharp objects directly over sports floors.

.4 Protect fully cured floor finishes and surfaces with plywood or hardboard panels to prevent damage from storing or moving objects over sports floors.

3.3 TRAINING AND DEMONSTRATION

.1 Train the Owner's maintenance staff on the proper care and maintenance of finished wood athletic flooring.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Environmental Procedures	Section 01 35 20
.2	Waste Management and Disposal	Section 01 74 19.
.3	Finishing of concrete floor:	Section 03 35 10.

1.2 REFERENCE DOCUMENTS

.1 American Society for Testing and Materials (ASTM)

.1	ASTM F1066-04	Standard Specification for Vinyl Composition Floor Tile.
.2	ASTM F1303-03	Standard Specification for Sheet Vinyl Floor Covering with Backing.
.3	ASTM F1344-04	Standard Specification for Rubber Floor Tile.
.4	ASTM F1700-04	Standard Specification for Solid Vinyl Floor Tile.
.5	ASTM F1861-08	Standard Specification for Resilient Wall Base.
.6	ASTM F1913-04	Standard Specification for Vinyl Sheet Floor Covering Without Backing.
.7	ASTM F2034-08	Standard Specification for Sheet Linoleum Floor Covering.

.2 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-4.129-97	Carpets for Commercial Use

.3 South Coast Air Quality Management District (SCAQMD), California State

.1	SCAQMD Rule 1168 June 2006	Adhesives and Sealants Applications.

.4 Underwriters Laboratories of Canada (ULC):

.1	CAN/ULC-S102-07	Surface Burning Characteristics of Building Materials and Assemblies.
.2	CAN/ULC-S102.2-07	Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies.

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Comply with requirements of Division 01.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures.

.2 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health Canada for flooring adhesive and seam welding. Indicate VOC content.

.2 Samples:

.1 Submit duplicate tile in size specified required for this project, for Province's approval.

.3 Test and Evaluation Reports:

.1 Submit results of moisture content testing of concrete subfloor prior to installation of flooring. Results shall include evidence of flooring manufacturer representative's attendance and agreement.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's printed recommendations for installation of products. Where applicable, include detailed recommendations for seaming resilient sheet flooring.

.2 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions and guidelines for use of waxes and other protective coatings and appearance enhancers in accordance with Section 01 78 23 – Operation and Maintenance Data and Manuals.

.5 Extra Stock:

.1 Deliver 5 m^2 of factory width sheet flooring and 1 box of each colour and pattern specified for future maintenance.

.2 Maintenance materials shall be same product run as installed products.

.3 Clearly identify each box and roll. Store in location indicated by Province.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver packaged materials in original unopened containers.

.2 Storage and Handling Requirements:

.1 Keep delivered material dry and free from stains.

.2 Store flooring materials in area of flooring installation for 3 days prior to installation. Store roll goods vertically. Protect edges from damage.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Management and Disposal.

.2 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

1.6 SITE CONDITIONS

.1 Ambient Conditions:

.1 Maintain minimum 20°C air temperature and design relative humidity at flooring installation area for 3 days prior to, during, and for 24 hours after installation.

2. Products

2.1 FLOORING TYPES

.1 Resilient Sheet Flooring (RS1, RS2, and RS3): Refer to Interior Materials Legend on Drawing A005.

.2 Safety Flooring (SF1) with integral base: Refer to Interior Materials Legend on Drawing A005.

.3 Static Dissipative Flooring (SD1): Refer to Interior Materials Legend on Drawing A005.

2.2 RESILIENT BASE

.1 Resilient Base (RCB1): to ASTM F1861, refer to Interior Materials Legend on Drawing A005 and as follows:

.1 Type: TP - rubber, thermoplastic.
.2 Group: 1, solid.
.3 Style: B, cove.
.4 Thickness: 2.03 mm.
.5 Height: 100 mm.
.6 Length: 1220 mm lengths.
.7 End Stops and External Corners: premoulded.
.8 Colour: colour will be selected by Province.

2.3 ACCESSORY COMPONENTS

.1 Feature Strips: of same material and thickness as adjacent work, standard colour will be selected by Province.

.2 Edge Strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

.3 Cap Strips: extruded aluminum, smooth, mill finish with lip to extend under coved floor finish and profile to cover top of coved sheet flooring.

.4 Cove Support Strip: wood or vinyl, minimum 22 mm x 22 mm, designed to support covered sheet vinyl flooring.

.5 Grounding Strips: as recommended by manufacturer for application.

2.4 ACCESSORY MATERIALS

.1 Sub-Floor Filler: white premix latex requiring water only to produce cementitious paste. Refer to Section 03 35 10 for self-levelling concrete and for Floor Flatness requirements.

.2 Primers: as recommended by flooring manufacturer for specific material on applicable substrate, above, on or below grade.

.3 Adhesives: as recommended by flooring manufacturer for each flooring material on applicable substrate, above, on or below grade.

.4 Sealer and Wax: as recommended by flooring manufacturer for flooring type and location.

3. Execution

3.1 CONDITION OF SUBSTRATES

.1 Ensure floor surfaces are smooth and flat to plus or minus 3 mm over 3 m or as indicated in Section 03 35 10. Coordinate substrate preparation with Section 03 35 10.

.2 Ensure concrete floors have maximum 2.5% moisture content, exhibit normal alkalinity and no carbonization or dusting.

3.2 SUBSTRATE PREPARATION

.1 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.

.2 Trowel and float sub-floor filler to leave smooth, flat, hard surface. Prohibit traffic until filler cured.

.3 Prime concrete slab to flooring manufacturer's printed instructions.

.4 Clean filled substrate for application of adhesive.

3.3 INSTALLATION, GENERALLY

.1 Apply adhesive as recommended by manufacturer. Ensure adhesion over entire area of installation.

.2 Set flooring in place, press with minimum 45 kg roller to ensure full adhesion.

.3 Terminate resilient flooring at centerline of door in door openings where adjacent floor finish is dissimilar.

.4 Install flooring in pan type floor access covers. Maintain floor pattern.

.5 Continue flooring, without interrupting floor pattern, throughout areas to receive demountable partitions.

3.4 INSTALLATION OF FLOOR TILE

.1 Lay tile with joints parallel to building lines to produce a symmetrical tile pattern.

.2 Install tile flooring with minimum tile width 1/2 full size, to pattern as indicated on Drawings.

.3 Scribe flooring to produce tight joints to walls, columns, cabinets, floor outlets and other appurtenances.

3.5 INSTALLATION OF SHEET FLOORING

.1 Lay sheet flooring with seams parallel to building lines to produce a minimum number of seams, with pattern running parallel to longest dimension of the room, unless otherwise indicated on Drawings. Where applicable, locate seams at centerline of door in door openings.

.2 Install sheet flooring with minimum sheet width 1/3 full material width and with sheet parallel to length of room, unless otherwise indicated on Drawings. Machine cut flooring curves as recommended by manufacturer, hand cut will not be accepted.

.3 Provide seams in strict accordance with manufacturer's recommendations. Net fit seams in accordance with manufacturer's recommendations.

.4 Seams in corridors shall run perpendicular to walls. Longitudinal seams in corridors are not acceptable.

.5 Cove sheet flooring to walls, columns, cabinets, floor outlets and other appurtenances.

.6 Top of coved sheet flooring shall be straight and level to F3 Finish: Floors having an overall F-number of FF 30 x FL 25. Refer to Section 03 35 10.

3.6 INSTALLATION OF RESILIENT BASE

.1 Fit joints tight and vertical. Joints along one plane shall be at minimum 7 m spacing, at inconspicuous locations.

.2 Miter internal corners. Use premoulded sections for external corners and exposed ends.

.3 Scribe and fit to door, frames and other obstructions.

.4 Install straight and level to variation of plus or minus 3 mm over 3 m straight edge.

.5 Install base on solid backing. Adhere tightly to wall with toe snug to floor surfaces.

.6 Roll base using hand roller to ensure full adhesion.

3.7 INSTALLATION OF ACCESSORY COMPONENTS

.1 Install feature strips and floor markings where indicated. Fit joints tightly.

.2 Install metal edge strips at unprotected and exposed edges where flooring terminates.

.3 Install cove support strips continuously where sheet flooring is to be coved to vertical surfaces.

.4 Install cap strips continuously to cover top edge of coved sheet flooring. Mitre corners. Top of cap strip shall be straight and level to variation of plus or minus 3 mm over 3 m straight edge.

3.8 CLEANING, SEALING AND WAXING

.1 Remove excess adhesive from floor, base and wall surfaces without damage.

.2 Apply acrylic sealer over linoleum flooring as soon as possible after completed installation.

.3 Clean, seal and wax floor and base surfaces to manufacturer's written instructions.

3.9 PROTECTION OF COMPLETED WORK

.1 Protect new floors with 150 micrometre polyethylene cover from time of final set of adhesive until just before final inspection.

.2 Prohibit traffic from floor finish for 48 hours after installation.

END OF SECTION

1. General

1.1 SUMMARY

.1 This section includes requirements for the supply and install of carpet tile with all necessary trims and accessories required for a complete installation.

1.2 RELATED SECTIONS

.1	Resilient Flooring	Section 09 65 00
.2	Concrete Floor Finishing	Section 03 35 00

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-4.129-93: Carpet for Commercial Use;
- .2 CAN/CGSB-4-GP-156: Direct Glue-Down Carpet, Guide to Selection and Installation.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM E648 Class 1 (glue down) – Standard test method for critical radiant flux of floor-covering systems using a radiant heat Energy Source;
- .2 ASTM E-662 Less than 450 – Standard test method for Specific optical density of smoke generated by solid materials;
- .3 ASTM D5252 – Standard practice for the operation of the Hexapod Tumble Drum Tester;
- .4 ASTM F710-03, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring;
- .5 ASTM F1869-03, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride;
- .6 ASTM- F2170, Situ Probe rH Test Method.

.3 Carpet and Rug Institute (CRI):
- .1 CRI 104-2002, Standard for Installation of Commercial Carpet;
- .2 CRI Indoor Air Quality Carpet Testing Program.

.4 American Association of Textile Chemists and Colorists:
- .1 Color Fastness to Lightfastness ASTCC 16-E;

.5 American Association of Textile Chemists and Colorists (AATCC):
- .1 Electrostatic Propensity of Carpet, AATCC -134 under 3.5KV;

.6 Underwriters' Laboratories of Canada (ULC):
- .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies;

1.4 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to Section 01 62 00 Product Options and Substitutions.

1.5 SUBMITTALS (TILE LAYOUT DRAWINGS AND SAMPLES)

.1 Comply with submittal requirements of Division 01, Section 01 33 23 Shop Drawings, Product Data and Samples, Section 01 33 00 Submittal Procedures.

.2 Submit two sets of tile layout drawings, complete with carpet tile schedule and room designation consistent with construction drawings.

.3 Submit two complete sets of carpet tile manufacturer's running line range. Ensure each set is labeled with the following:
- .1 Manufacturer’s name
- .2 Pattern (Collection Series)
- .3 Color
- .4 Fiber
- .5 Dye method
- .6 Oz. weight
- .7 Manufacturers Installation Options

.4 Upon selection of colour and pattern, submit two full size carpet tile samples in selected color and pattern.

.5 Submit maintenance data in accordance with Division 01, Section 01 78 23 Operation and Maintenance Data Manuals.

.6 Site visit to inspect for special procedures and perimeter conditions.

1.6 MAINTENANCE MATERIALS

.1 Submit and comply with requirements in accordance with Division 01, Section 01 78 43 Spare Parts and Maintenance Materials. Provide one (1) box of each colour and pattern for extra stock.

.2 Prior to installation, provide extra materials as described below. Extra materials to be packaged with protective covering for storage. Identify extra materials with labels describing contents.

.3 Maintenance materials to be from the same product run as installation materials.

1.7 ENVIRONMENTAL REQUIREMENTS (CONDITIONS)

.1 Maintain minimum temperature of 18°C in installation areas for a minimum of 48 hours prior to, during and 48 hours after installation.

.2 Operate ventilation fans of appropriate size, at maximum capacity during carpet tile and adhesive removal and during and for at least 72 hours after glue-down installation.

1.8 REMOVAL OF EXISTING CARPET TILE, ADHESIVE AND WASTE REMOVAL

.1 Refer to Division 01 for requirements pertaining to noise and dust control and use of premises.

.2 Use vacuum equipped with power head/sweeper to vacuum existing carpet tile prior to removal.

.3 Apply fine mist water spray to carpet tile to minimize dust generation during removal. Avoid spraying near electrical outlets.

.4 Remove from site existing carpet tile as indicated.

.5 Vacuum floor after existing carpet tile has been removed.

.6 Remove existing carpet tile accessories and wall base from areas indicated to receive new flooring materials.

.7 Inspect substrate for smooth finish. Remove adhesive remaining on substrate.

1.9 PRODUCT HANDLING, DELIVERY AND STORAGE

.1 Deliver carpet tile and other accessories in original cartons or packaging clearly marked with the manufacturer's name, material description, colour, pattern, size, type, dye lot and quantity.

.2 Store under cover and away from moisture. Keep dry at all times.

.3 Deliver carpet tile in portions, as required, to perform the Work.

.1 Coordinate delivery with the Province.

.4 Extra stock will be stored as directed by the Province.

1.10 PROJECT CONDITIONS

.1 Do not install carpet tiles until wet work in spaces is complete and dry and that ambient temperature and humidity conditions are maintained at the levels when space will be

occupied for its intended use.

.2 Do not install carpet tile over concrete subfloor until slabs have cured and are sufficiently dry to bond with adhesive and concrete subfloor have pH range recommended by carpet manufacturer.

1.11 COORDINATION

.1 Install carpet tile prior to installation of:
- .1 Partitions
- .2 Furniture.
- .3 Telephone and electrical power pedestal outlets.
- .4 Covered resilient base.

2. Products

2.1 ACCEPTABLE MATERIALS

.1 Basis-of-Design: Patcraft, Mid Century Colour Block.

2.2 MATERIAL COMPONENTS

.1 Carpet tile, indicated as CPT1 on Interior Materials Legend on Drawings, construction must meet or exceed the following:
- .1 Fibre Content: 100% nylon, bulk continuous filament, and permanently conductive fibres to control electrostatic propensity.
- .2 Dye Method: 100% Solution Dyed.
- .3 Pile Characteristics: Multi-level pattern loop.
- .4 Tufted Weight: 16 oz. minimum.
- .5 Gauge: 1/10” minimum.
- .6 Stitches per inch: 10.3 minimum.
- .7 Pile Density: 5818oz./cy minimum.
- .8 Tile size: 24” x 24” (610mm x610mm).
- .9 Backing System: Non-Woven Synthetic
- .10 Color and Pattern: Refer to Interior Materials Legend on Drawing A005.
- .11 Carpet tiles: installation pattern as indicated on Drawings.
- .12 Inherent Static Control less than 3.0 Kilovolts at 21°C and 20% relative humidity.
- .13 Delimitation to ASTM D3936 to min 2.5 Lbs/in.
- .14 Soil/Stain protection.

2.3 ACCESSORIES

.1 Cementitious Underlayment: self-leveling and trowel grade, pre-mixed, polymer-modified, containing no gypsum, not softened by water after final set. Minimum compressive strength 10 MPa at 24 hours and 20 Mpa at 7 days. Suitable for floor covering installation not more than 12 or 4 hours after application.

.2 Releasable pressure sensitive type adhesive: adhesive must be water-based and allow for removal of carpet tile at any time without damager to carpet and have “zero” calculated Volatile Organic Compounds (VOCs).

.3 Carpet tile Edge Guard: as follows:
.1 Type: non-metallic, extruded or molded heavy-duty rubber "T" shaped cap insert and minimum 50 mm wide extruded aluminum anchorage flange, profiled to accept cap.
.2 Colour: selected by the Province from manufacturer's standard range.

2.4 RESILIENT BASE

.1 Resilient Base: Refer to Section 09 65 00.

3. Execution

3.1 EXAMINATION (CONDITION OF SUBSTRATE)

.1 Examine substrates, areas, and conditions, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerance and other conditions that may affect the performance of the carpet tile.
.2 Refer to Section 03 35 10 for self levelling concrete topping. Refer to Section 03 35 10 for floor flatness requirements.

3.2 PREPARATION

.1 Comply with CRI 104, Site conditions: Floor Preparation and Carpet Manufacturers written installation instructions for preparing substrates indicated to receive carpet installation.

.2 Use trowelable leveling and patching compounds, according to manufacturer’s written instructions, to fill cracks, holes, depressions and protrusions in the substrate. Fill or level cracks, holes and depressions 3mm wide or wider and protrusions more than 0.8mm, unless more stringent requirements are identified in the carpet tile manufacturer’s written instructions.

.3 Trowel and float to produce a smooth, flat surface. Allow to cure properly.

.4 Remove coatings, including curing compounds and other substances from concrete subfloor that are not compatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents using mechanical methods recommended in writing by the carpet tile manufacturer.

.5 Broom and vacuum clean substrate to remove dust and other small particles. Cover prior to installing carpet tile.

.6 Substrate to have acceptable level of absorbency as per manufacturer's written instructions. After cleaning, examine substrates for acceptable levels of moisture, alkaline salts, carbonation, or dust before proceeding with installation.

.7 When underlayment has cured, clean substrate surface and allow to dry.

.8 To ensure requirements are achieved test cementitious substrate for porosity, moisture content and alkalinity.

3.3 INSTALLATION

.1 Install carpet tile using a minimum number of pieces of carpet tile.

.2 Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

.3 Comply with CRI 104, Section 8, direct Glue-Down Installation or as per carpet tile manufacturer written instructions; install every carpet tile with full spread, releasable, pressure sensitive adhesive as per manufacturers written instructions.

.4 Ensure product and substrate temperature is 18 degrees Celsius minimum for direct glue-down installation,. Adhesives to be applied in accordance with manufacturers written instructions.

.5 Install carpet tile pattern parallel to walls and boarders and as indicated in Finish Schedule.

.6 Install carpet tile smooth and free of bubbles, puckers and defect. Confirm carpet tile type, color and pattern prior to installation. Maintain dye lot integrity. Do not mix dye lots in same area.

.7 Carpet tile cuts to be a "clean cut". Fit carpet tile tight to intersection with vertical surfaces without gaps.

.8 All edge transition strips to be installed completely, conceal all exposed edges.

.9 Do not bridge building expansion joints with carpet tile.

.10 Install seams in accordance with carpet tile manufacturer's written instructions for seam locations and direction of carpet tile.

.11 Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

.12 Bind or seal cut edges as per carpet tile manufacturer written instructions.

.13 Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

.14 Maintain all reference markers, openings and holes that are in place or marked for future cutting.

.15 Roll carpet tile for complete contact of carpet tile with adhesive and substrate.

3.4 INSTALLATION AT OUTLET BOXES/FLOOR ACCESS PANELS

.1 Locate and cut carpet tile to fit over access panels.

.2 Carefully apply a continuous bead of seaming adhesive to base of pile of field carpet tile and patches.

.3 Fully adhere carpet tile to panels and carpet tile to adjacent subfloor.

3.5 INSTALLATION OF RESILIENT BASE

.1 Install resilient base in accordance with Section 09 65 00 Resilient Base.

.2 Fit joints tight and vertical.

.3 Mitre internal corners.

.4 Install base on solid backing. Adhere tightly to wall and floor surfaces.

.5 Scribe and fit to door, frames and other obstructions.

.6 Install straight and level to variation of plus or minus 3 mm over 3 m straight edge.

3.6 CLEANING AND PROTECTION

.1 Use protection and cleaning procedures and / or methods as per manufacturers written instructions.

.2 After installing carpet tile:

- .1 Remove excess adhesive, seam sealer and other surface blemishes using cleaner recommended by carpet tile manufacturer and as per manufacturers written instructions.
- .2 Remove yarns that protrude from carpet tile surface.
- .3 Vacuum carpet tile.

.3 Protect installed carpet tile from damage and soiling from construction operations and placement of equipment and fixtures during the remainder of the construction period

3.7 TRAINING

.1 Provide qualified representative from carpet tile manufacturer to instruct building maintenance staff in proper methods for installing, maintaining carpet tile, including environmental friendly cleaning and stain removal products and procedures as per manufacturer's written maintenance review.

.2 Allow two hours for training.

END OF SECTION

1. General

1.1 SUMMARY

.1 Related Requirements:

.1	Environmental Procedures	Section 01 35 20
.2	Waste Management and Disposal	Section 01 74 19
.3	Rough Carpentry	Section 06 10 00
.4	Finish Carpentry	Section 06 20 00
.5	Gypsum Board	Section 09 29 00
.6	Acoustic Unit Ceilings	Section 09 51 13
.7	Vinyl Coated Fabric Wall Coverings	Section 09 72 16
.8	Painting and Finishing General Requirements	Section 09 91 05

1.2 REFERENCES

.1 Reference Standards:

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

.1 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

.2 ASTM D1779-98 (2011), Standard Specification for Adhesive for Acoustical Materials

.3 ASTM E-84-10b, Standard Test Method for Surface Burning Characteristics for Building Materials

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA A247-M86(R1996), Insulating Fibreboard

.2 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

.3 CAN/ULC S109-03, Flame Tests of Flame Resistant Fabrics and Films

.4 CAN/ULC S702-09, Standard for Thermal Insulation Mineral Fibre for Buildings.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures. Submittal must include a statement verifying that fibreboard product does not contain any added urea-formaldehyde.

.2 Samples:

.1 Submit 300 mm x 300 mm samples of each style of acoustical blade for approval. Mount samples to 12. 5 mm thick painted plywood substrate.

1.4 CLOSEOUT SUBMITTALS

.1 Submit fabric cleaning instructions for insertion into the Operation and Maintenance Manual in accordance with Section 01 78 23 Operation and Maintenance Data and Manuals.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Provide acoustical blade with the following surface burning characteristics as determined by testing identical products in accordance with CAN/ULC S102, CAN/ULC S102.1, CAN/ULC S109, ASTM E84 or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical blade with appropriate markings of applicable testing and inspecting agency, for the following criteria:

.1 Flame Spread: 25 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Deliver to site and store in warm, dry location and in accordance with manufacturer's written recommendations. Cover blades with protective cover until ready for installation.

1.7 SITE CONDITIONS

.1 Ambient Conditions: Install acoustical blades only when building is fully enclosed and HVAC system is operational; maintain manufacturer's recommended temperature and humidity conditions in the area of installation for 24 hours before, during and after installation.

.2 Do not install acoustical blades until the following conditions have been met:

.1 Wet work is complete and dry.
.2 Painting, flooring and wall base has been installed.

.3 Adjacent work including, in part Architectural Woodwork, Masonry, Doors and Frames, Hardware, Gypsum Drywall, Plastering, Wall Covering, Painting, Ceiling Grid, and Electrical Work is complete.

.4 Permanent lighting is in place and operational.

1.8 WARRANTY

.1 Provide manufacturer's warranty for a two year period following Substantial Performance of the Work for defects in materials, workmanship and/or sagging.

2. Products

2.1 ACOUSTIC BLADES

.1 Blades (LAP1):

.1 Surface Texture: Smooth

.2 Composition: Fiberglass

.3 Surface finish: DuraBrite acoustically transparent membrane on all sides and edges

.4 Colour: White

.5 Size: Blades vertical panel waves, size as indicated on Drawings.

.6 Thickness: 51 mm

.7 Edge Detail: Square edge

.8 Blade Layout: Staggered Layout

.9 Flame Spread: (ASTM E 84), Class A

.10 Sabins: 1.38 sabins/ft^2

.11 Light Reflectance: (LR): (ASTM E 1477), Minimum 0.90 (white only)

.12 Acoustical Absorption: (ASTM C423), Minimum 30 Sabin/panel

.13 Mold/Mildew Inhibitor: The surface and back of the product have been treated with BioBlock, a paint that contains a special biocide that inhibits or retards the growth of mold and mildew, ASTM D3273.

.14 Sustainability: The canopies are eligible for reclamation.

.15 Basis of Design: Armstrong Soundscapes Shapes 5440

2.2 ATTACHMENT SYSTEM

.1 Installation Hardware

.1 Hardware: 4 Point hanging hardware, as recommended by manufacturer.

.2 Cables and components for attachment to support are available to coordinate with the blade package.

3. Execution

3.1 PREPARATION

.1 Measure each ceiling area and establish layout of canopies. Comply with reflected ceiling plans. Coordinate blade layout with mechanical, electrical and sprinkler fixtures.

3.2 INSTALLATION

.1 Install blades in accordance with the manufacturer's instructions and in compliance with the authorities having jurisdiction.

3.3 ADJUSTING AND CLEANING

.1 Replace damaged and broken blades.

.2 Clean exposed surfaces of canopies per manufacturer's instructions.

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies general requirements for all painting and finishing work to be performed on site.

.2 Read this Section in conjunction with the following Sections containing more detailed requirements for site painting and finishing:

.1	Exterior Repainting and Refinishing Schedule:	Section 09 91 15.
.2	Interior Repainting and Refinishing Schedule:	Section 09 91 25.
.3	Painting of Mechanical and Electrical Work:	Section 09 91 30.

1.2 RELATED SECTIONS

.1	Environmental Procedures	Section 01 35 20]
.2	Waste Management and Disposal	Section 01 74 19.
.3	Architectural Woodwork:	Section 06 40 00.
.4	Pavement Markings:	Section 32 17 23.

1.3 REFERENCE DOCUMENTS

.1 Canadian General Standards Board (CGSB):

.1	CGSB 1-GP-71 Set of 3 Standards 2003	Methods of Testing Paints and Pigments - Set includes 1-GP-71 No. 5-96, 1-GP-71 No. 38-96 and 1-GP-71 No. 73-96

.2 Master Painters Institute (MPI)

.1 The painting and finishing specifications for new, not previously painted or finished, substrates are based on and make reference to the "Architectural Painting Specification Manual", November 2007 issue, including the latest edition of the "Approved Products Lists", published by the Master Painters Institute (MPI).

.2 The painting and finishing specifications for previously painted or finished substrates are based on and make reference to the "Maintenance Repainting Manual", August 2004 edition, including the latest edition of the "Approved Products Lists", published by the Master Painters Institute (MPI).

.3 The reference documents are available from:

Master Painters Institute (HQ)	**or**	**Alberta Painting Contractors Association**
4090 Graveley St. Burnaby, BC V5C 3T6 tel: 888-674-8937 toll free fax: 888-211-8708 toll free www.paintinfo.com		2725 - 12th Street N.E. Calgary, AB T2E 7J2 Tel: 403-250-0903 Fax: 403-291-9562

1.4 ADMINISTRATIVE REQUIREMENTS:

.1 Sequencing:

.1 Where exposed exterior wood substrates are to receive a transparent finish, plan and schedule work to immediately follow installation of wood to prevent water staining and weathering of such substrates.

1.5 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.

.2 Samples:

.1 Comply with requirements of Division 01.

.2 Prepare and submit 300 mm x 300 mm sized samples.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

.1 Leave on premises not less than 4 litres of new material of each colour and finish sheen used.

.2 Provide maintenance materials in new containers, full, tightly sealed and clearly labelled. Remnants of used materials are not acceptable.

1.7 QUALITY ASSURANCE

.1 Installation:

.1 The following requirements establish the standard of acceptance for the Work, when viewed using the final lighting source.

.1 Vertical surfaces: No defects visible from a distance of 1 metre at 90 degrees to surface.

.2 Horizontal surfaces: No defects visible from a distance of 1 metre at 45 degrees to surface.

.3 Ceilings: No defects visible from floor at 45 degrees to surface.

.4 Final coat shall exhibit uniformity of sheen across full surface area.

.2 Defects include brush marks, streaks, runs, laps, drips, heavy stippling, pile up of paints, roller tracking, inadequate hiding of substrate, skipped or missed areas, and foreign materials in paint.

.2 Mock-ups:

.1 Finish, with all required coats, a three square meter minimum sized surface of each major substrate and colour scheme, to show selected colours, finish textures, gloss levels, and workmanship. Where surface is less than three square meters, finish the entire surface.

.2 Obtain Province's approval before proceeding with remainder of the work. Approved sample area shall serve as the standard to be met or exceeded in the remainder of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver materials in sealed original labelled containers bearing manufacturer's name, type of material, brand name, colour designation, and where applicable, instructions for mixing and reducing.

.2 Storage and Handling Requirements:

.1 Store paint and other materials in a single heated and well ventilated area with a minimum ambient temperature of 7°C.

.2 Take precautionary measures to prevent fire hazards or spontaneous combustion.

.3 Waste Management and Disposal:

.1 Separate for reuse and recycling and place in designated containers Steel waste in accordance with Waste Management Plan (WMP).

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.4 Ensure emptied containers are sealed and stored safely.

.5 Unused paint materials must be disposed of at official hazardous material collections site as approved by Province.

.6 Paint, stain and wood preservative finishes and related materials (thinners and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.7 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.8 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.9 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.10 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.11 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection by employees, individuals or organizations for verifiable re-use or re-manufacturing.

1.9 SITE CONDITIONS

.1 Ambient Conditions:

.1 Interior Conditions:

.1 Temperature: Maintain temperature at minimum 10°C for at least 24 hours before and during application and until coatings have cured.

.2 Ventilation: Adequately ventilate areas where coatings are being applied and maintain a reasonably dust free atmosphere.

.3 Lighting: Maintain bright and uniform levels of lighting in areas where coatings are being applied.

.2 Exterior Conditions:

.1 Temperature: Apply coatings only when temperature is above 10°C.

.2 Precipitation: Do not apply coatings during periods of precipitation nor when precipitation is imminent.

.3 Wind: Do not apply coatings under high wind conditions resulting in wind blown dust and debris.

2. Products

2.1 MATERIALS

.1 Refer to Schedule Sections for required finishing systems.
.2 Provide products that meet or exceed the following requirements as follows:
.1 For architectural paints, coating and primers applied to interior walls and ceilings.
.2 For anti-corrosive and anti-rust paints applied to interior ferrous metal substrates.
.3 For clear wood finishes, floor coatings, stains, and shellacs applied to interior elements.

.3 Use only MPI approved products from the MPI Approved Product Lists corresponding to the specified finishing systems.

.4 Thinners: Odorless paint thinner, pure and clean with no deleterious material.

.5 Patching compounds: Spackling compound or oil base putty for substrates receiving a paint finish. Oil base putty, coloured to match finish, for substrates receiving a transparent finish.

2.2 MIXING

.1 Except as otherwise specified, paint shall be ready mixed. Re-mix prior to application to ensure colour and gloss uniformity. Materials in paste or powder form, or to be field-catalyzed, shall be field mixed in accordance with manufacturer's directions. Perform colour tinting operations prior to delivery to site.

.2 Thinning of materials to extent permitted by paint manufacturer will be permitted only where specified herein or upon Province's approval. Do not use solvent for thinning.

.3 Strain materials thoroughly prior to application.

.4 Accent colours and deep tints shall have factory added colour pigments wherever possible.

2.3 COLOURS

.1 Colour Schedule (PT1, PT2, PT3, and PT4): Refer to Interior Materials Legend on Drawing A005.

2.4 GLOSS LEVELS

.1 Specified gloss levels are based on the MPI standard, which is as follows:

.1 Level G1 – Matte or Flat: gloss rating of 0 to 5 units at 60 degrees and sheen rating of a maximum of 10 units at 85 degrees.

.2 Level G2 - Velvet: gloss rating of 0 to 10 units at 60 degrees and a sheen rating of 10 to 35 units at 85 degrees.

.3 Level G3 - Eggshell: gloss rating of 10 to 25 units at 60 degrees and a sheen rating of 10 to 35 units at 85 degrees.

.4 Level G4 - Satin: gloss rating of 20 to 35 units at 60 degrees and a sheen rating of 35 units minimum at 85 degrees.

.5 Level G5 - Semi-gloss: gloss rating of 35 to 70 units at 60 degrees.

.6 Level G6 - Gloss: gloss rating of 70 to 85 units at 60 degrees.

.7 Level G7 – High-gloss: gloss rating of more than 85 units at 60 degrees.

.2 Where gloss level is not specified, confirm required gloss level with Province prior to proceeding with finish coats.

.3 Where gloss level is not specified, confirm required gloss level with Province prior to proceeding with finish coats.

3. Execution

3.1 VERIFICATION OF CONDITIONS

.1 Ensure all dust generating activities have been terminated and dust removed.

.2 Prior to commencement of painting and finishing work, thoroughly examine substrates scheduled to receive coatings.

.3 Do not apply coatings to substrates whose condition will adversely affect execution, permanence, or quality of work and which cannot be put into an acceptable condition through preparatory work specified herein.

.4 Ensure that site applied paints and finishes are compatible with primers or other finishes applied in the shop or factory.

.5 Verify compatibility of any previously applied coatings with specified coatings.

.6 Notify Province of any incompatibilities.

3.2 PROTECTION OF EXISTING SURFACES

.1 Protect adjacent surfaces from spray, splashings, and droppings.

.2 Remove electrical plates, surface hardware, fittings and fastenings prior to painting and finishing operations. Carefully store and replace these items on completion of work in each area.

.3 Keep sprinkler heads and smoke detectors free of paint. Replace those that do receive paint.

3.3 CONDITION OF SUBSTRATES

.1 Substrates shall be sound, non-dusting, and free of grease, oil, dirt and other matter detrimental to adhesion and appearance of coatings.

.2 Temperature: minimum 8°C.

.3 Test moisture content using electronic moisture meter. Maximum moisture content as follows:

.1 Plaster and wallboard: 12%
.2 Concrete: 12%
.3 Concrete block and brick: 12%
.4 Wood: 15%

.4 Alkalinity: test cementitious substrates for alkalinity using litmus paper test. If greater than 7, refer to manufacturer's requirements.

3.4 PREPARATION OF NEW/UNFINISHED SUBSTRATES

.1 Prepare substrates in accordance with requirements of the MPI Manual, Chapter 2 and 3, Section 3-Surface Preparation, and as specified herein.

.2 All Substrates: thoroughly broom, vacuum and wipe clean as required to produce acceptable surface. Sand lightly and dust prior to application of each coat. Use recommended type and grade of sandpaper to avoid scratching or gouging of surfaces.

.3 Wood Generally: clean soiled surfaces, sand smooth and dust. Fill nail holes, splits, scratches, small joints and other minor imperfections with patching compound after paint prime coat or first varnish coat has been applied and dried. Apply putty with putty knife, press firmly in place, and finish flush with surface.

.4 Wood for Paint Finish: clean knots, pitch streaks, and sappy sections of residue and seal such areas with shellac or knot sealer before applying prime coat.

.5 Wood for Transparent Finish: clean knots, pitch streaks, and sappy sections of residue and seal with sanding sealer or shellac after applying stain, if stain is required. Sand between coats using minimum #400 grit wet and dry sandpaper.

.6 Bare Ferrous Metal: Prepare in accordance with MPI 5.1 requirements for the system specified.

.7 Previously Primed Metal: remove loose shop primer and rust; make good shop coat, feather out edges of touch-up.

.8 Zinc Coated Metal: Prepare in accordance with MPI 5.3 requirements for the system specified.

.9 Unit Masonry and Concrete: fill minor cracks, holes and fissures with cement grout and smooth to a flush surface. Include bonding agent in cement grout mix.

.10 Gypsum Board and Plaster: fill minor cracks, holes, and imperfections with tinted patching compound after prime coat has been applied and dried. Allow patching compound to dry, sand smooth and remove dust. Use minimum #150 grit sandpaper.

.11 Alkaline Surfaces: wash and neutralize using recommended type of solution compatible with paint to be used.

3.5 PREPARATION OF PREVIOUSLY COATED SUBSTRATES

.1 Thoroughly inspect existing conditions to verify the degree of surface deterioration (DSD) of each previously coated substrate required to be repainted or refinished. Degrees of surface deterioration shall be as defined in the "Maintenance Repainting Manual" (MR Manual), Chapter 2 and 3, Section 3 - Surface Preparation.

.2 Prepare substrates using surface preparation procedures in Chapter 6 Section 2, including cleaning and removal systems, specified for the degree of surface deterioration.

3.6 APPLICATION OF COATINGS, GENERALLY

.1 Applied and cured coatings shall be uniform in thickness, sheen, colour, and texture and be free of defects detrimental to appearance and performance. Edges of paint adjoining other materials shall be clean and sharp with no overlapping.

.2 Use rollers that will produce the least possible stipple effect; maximum 10 mm pile for smooth substrates. Heavier pile rollers may be permitted for use on rough substrates, subject to Province's approval.

.3 Back roll airless spray application.

.4 Use a single manufacturer's products for all coats required for each finish system.

.5 Vary slightly the colour of successive coats to visibly differentiate between coats.

.6 Allow each coat to dry hard before succeeding coats are applied with a minimum of 24 hours between coats, except where manufacturer's instructions state otherwise.

.7 For woodwork to receive a stain finish, apply paste wood filler to open grain wood followed by uniform coats of stain and wipe off if required. Wood shall have a uniform shade. Match stain so that dissimilar woods have uniform finished appearance.

.8 For open grain woods to receive a clear finish, tint paste wood filler to match wood. Work filler well into grain and before it sets, wipe off excess to provide a clean surface.

3.7 FINISHING OF NEW/UNFINISHED SUBSTRATES

.1 Site paint or finish all work and substrates indicated as requiring site painting or finishing in Schedules, Drawings, or Specifications.

.2 Site apply all prime and finish coats as scheduled, whether or not factory prime coats have been applied.

3.8 FINISHING OF PREVIOUSLY COATED SUBSTRATES

.1 Repaint or refinish all work and substrates indicated as requiring repainting or refinishing in Schedules, Drawings, or Specifications.

3.9 BACK-PRIMING INTERIOR WOOD

.1 Except for architectural woodwork having factory applied finishes as specified in Section 06 40 00, back prime following concealed surfaces of interior wood components, prior to their installation:

.1 Surfaces in contact with concrete or masonry.
.2 Surfaces in contact with any floors or floor finishes.
.3 Cut-outs for sinks, drains and other mechanical services.
.4 Underside of front edges of countertops and toe-spaces.
.5 Other surfaces which may be subjected to moisture during normal use or cleaning operations.
.6 Backboards for mechanical and electrical equipment.

.2 Use white alkyd wood primer for components scheduled to receive paint finish.

.3 Use semi-transparent stain for components scheduled to receive solid or semi-transparent stain finish.

.4 Use gloss varnish, reduced 25% with thinner, for components scheduled to receive varnish finish.

3.10 FINISHING NEW/UNFINISHED DOORS AND FRAMES

.1 Finish edges of doors in accordance with specified finish system. For top and bottom edges, final coat may be omitted.

.2 Finish wood doors after doors have been hung and adjusted. Refinish tops, bottoms and edges after fitting.

.3 Apply finishes specified for exterior doors to both door faces and edges.

.4 Finish unfinished vertical edges of prefinished wood doors to match door faces.

3.11 FINISHING MISCELLANEOUS SUBSTRATES

.1 Paint substrates behind surface mounted fixtures, wall mounted heating units and unbacked cabinet work with specified finish systems, including specified number of coats.

.2 Finish shelving tops, bottoms and edges with specified finish systems, including specified number of coats.

3.12 PATCHING OF COMPLETED WORK

.1 Repair, touch-up, and refinish damaged finishes and finishes unsatisfactory to Province.

.2 Refinish entire wall or area where deemed necessary by Province.

3.13 CLEANING

.1 Place cotton waste, cloths and other material that may constitute a fire hazard in metal containers and remove from site daily.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 09 91 05 - Painting and Finishing General Requirements.

2. Products

.1 (Not used).

3. Execution

3.1 EXTERIOR PAINTING AND FINISHING SCHEDULE

.1 The following systems with codes numbers, finishing system description, gloss levels, coats and product descriptions are derived from the MPI Maintenance Repainting Manual and the MPI Approved Products List.

.2 Prime substrate, referencing the 1st coat, for the Degree of Surface Deterioration codes as recommended by the MPI Maintenance Repainting Manual and as follows:

.1 DSD 1: Touch-up.
.2 DSD 2: Spot prime.
.3 DSD 3: Full prime coat.

.3 Where the finishing system requires different product for first coats, DSD 1, 2 or 3, the MPI product numbers will be noted in the finishing system description.

Code Number	Finishing System Description	Coat	Product Description
REX 2.1 – ASPHALT SURFACES			
REX 2.1B	Alkyd Zone / Traffic Marking Exterior Traffic Marking Paint		Alkyd Zone/Traffic Marking Paint, Apply in strict accordance with manufacturer's instructions.
REX 5.1 – STRUCTURAL STEEL & METAL FABRICATIONS			
REX 5.1E High Traffic Areas	Epoxy, Water Based (DSD 2 or 3 – MPI # 107)	1st 2nd 3rd	DSD 2 W. B. Epoxy W. B. Epoxy
REX 5.2 – STEEL – HIGH HEAT			
REX 5.2A	Heat Resistant Enamel Maximum 205°C (400°F)		Heat Resistant Enamel, Apply in strict accordance with Manufacturer's Instructions
REX 5.2B	Heat Resistant Enamel, Aluminum Maximum 427°C (800°F)		Aluminum Heat Resistant Enamel, Apply in strict accordance with Manufacturer's Instructions
REX 5.2C	Inorganic Zinc Rich Coating Maximum 400°C (750°F)		Inorganic Zinc Rich Coating, Apply in strict accordance with Manufacturer's Instructions
REX 5.2D	High Heat Resistant Coating Maximum 593°C (1100°F)		High Heat Resistant Coating, Apply in strict accordance with Manufacturer's Instructions
REX 5.3 – GALVANIZED METAL			
REX 5.3D	Polyurethane, Pigmented (high contact / traffic) (DSD 2 or 3 – MPI # 101)	1st 2nd 3rd	DSD 1 Polyurethane Polyurethane
REX 5.3E	Bituminous (low contact / traffic)	1st 2nd	DSD 1 Bituminous

END OF SECTION

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Code Number	Finishing System Description	Coat	Product Description

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 09 91 05 - Painting and Finishing General Requirements.

2. Products

.1 (Not used).

3. Execution

3.1 INTERIOR PAINTING AND FINISHING SCHEDULE

.1 The following systems with codes numbers, finishing system description, gloss levels, coats and product descriptions are derived from the MPI Maintenance Repainting Manual and the MPI Approved Products List.

.2 Applies to existing surfaces which have been finished previously: Prime substrate, referencing the 1st coat, for the Degree of Surface Deterioration codes as recommended by the MPI Maintenance Repainting Manual and as follows:

.1 DSD 1: Touch-up.
.2 DSD 2: Spot prime.
.3 DSD 3: Full prime coat.

.3 Where the finishing system requires different product for first coat, DSD 1, 2 or 3, the MPI product numbers will be noted in the finishing system description.

.4 New surfaces to be painted shall receive full prime coat.

.1 Masonry walls in corridors and high-use areas:
New concrete masonry: INT 4.2 C – Alkyd, gloss 3.
Exist. Concrete masonry: RIN 4.2 C – Alkyd, gloss 3. DSD 2 and 3.

.2 Masonry walls in Offices, classrooms:
New concrete masonry: INT. 4.2C – Alkyd, gloss 3.
Exist. Concrete masonry: RIN. 4.2D – H.P. Architectural Latex, gloss 3. DSD 2 and 3.

Code Number	Finishing System Description	Coat	Product Description

.3 Gypsum Board walls bulkheads and ceilings in corridors and student areas (high use):
New gypsum board: INT 9.2 C – Alkyd, gloss 3.
Exist. Gypsum board: RIN. 9.2C – Alkyd, gloss 3. DSD 2 and 3.

.4 Gypsum Board walls, bulkheads and ceilings in offices, staff areas:
New Gypsum Board: INT. 9.2B – H.P Architectural Latex. Gloss 2.
Existing gypsum board: RIN. 9.2B - H.P. Architectural Latex. Gloss 2.
DSD 2 and 3.

.5 Exposed roof structure, steel deck and framing:
New steel joists, trusses, decking: INT. 5.1DD – Alkyd Dry Fall, gloss 2, over shop applied primer.
Existing steel roof structures: RIN. 5.1D - Alkyd Dry Fall, gloss 2. DSD 2.

.6 Concrete floors:
New, steel trowelled, concrete floor slab:
INT. 3.2L – Epoxy Floor Paint (WB) – Custom Grade.
Existing concrete floor slab: RIN. 3.2B – Alkyd Floor Paint, gloss 4.
DSD 2 or 3.

.7 HM Doors and PS frames:
New HM doors and PS frames: INT. 5.3C – Alkyd, gloss 5
Existing HM doors and PS frames: RIN. 5.3C – Alkyd, gloss 5. DSD 3.

.8 Structural & Metal Fabrications: other than exposed roof structures and exposed to view.
New steel columns, steel framing and fabrications: INT 5.1E – Alkyd, gloss 5.
Existing structural steel items: RIN. 5.1E – Alkyd, gloss 5. DSD 3.

.9 Clear Finish Wood in Gymnasium:
RIN. 6.1C – Alkyd, varnish. DSD 3.

.10 Exterior Traffic Marking Paint:
EXT 2.1B Alkyd Zone

.11 Exterior Doors, Down Spouts, Exposed Columns:

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies requirements for site painting of mechanical and electrical work only.

.2 Read this Section in conjunction with Section 09 91 05 - Painting and Finishing General Requirements.

1.2 RELATED SECTIONS

.1 Mechanical Identification: Section 20 05 43.
.2 Electrical Identification: Section 26 05 53.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate work specified in this Section with work specified in Section 20 05 43 to ensure correct colour selections.

.2 Coordinate work specified in this Section with work specified in Section 26 05 53 to ensure correct colour coding.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 Submittal Procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.4 Ensure emptied containers are sealed and stored safely.

.5 Unused paint materials must be disposed of at official hazardous material collections site as approved by Province.

.6 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.7 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.8 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.9 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

2. Products

2.1 PAINT

.1 Refer to finish systems schedules at the end of this Section for product descriptions and product numbers. Product numbers are from the MPI Approved Product Lists.

.2 Use products suitable for anticipated surface temperatures of substrates while in service.

.3 Paint Materials:

.1 Refer to Schedule Sections for required finishing systems.

.2 Use only MPI approved products from the MPI Approved Product Lists corresponding to the specified finishing systems.

.4 Thinners: Odorless paint thinner, pure and clean with no deleterious material.

3. Execution

3.1 PREPARATION OF SUBSTRATES

.1 Comply with applicable requirements specified in Section 09 91 05.

.2 Clean and sand between coats using minimum #150 grit sand paper.

3.2 SUBSTRATES

.1 Painting is required on substrates specified below, at locations and by methods indicated in "Painting Schedule" in this Section.

.2 Mechanical Piping: Includes insulated and non-insulated pipe surfaces, pipe hangers, hanger rods and supports, valves, fittings and related components, located either on building interior or exterior surfaces.

.3 Mechanical Equipment: Includes the following items, whether or not factory coatings have been applied. Refer to Section 20 05 43 for colours.

.1 Interior:

.1 Heat Exchangers.
.2 Hot water storage tanks.
.3 Cold water storage tanks.

.2 Exterior colour as per Finishing Schedule.

.1 Louvers and grilles.
.2 Air handling units.
.3 Natural gas piping.

.4 Mechanical Ductwork: Includes the following:

.1 Interior: All ductwork surfaces, including hangers, hanger rods, and supports where exposed to sight.

.2 Exterior:

.1 Metal chimney stacks.
.2 Goosenecks.
.3 Roof jacks.
.4 Roof vents.
.5 Ducts.

.5 Electrical Conduit and Cable: Includes interior and exterior conduit and cable where exposed to sight.

.6 Other Electrical Work: Includes all interior and exterior electrical work except:

.1 Conduit and cable.
.2 Electrical equipment which is required to be prefinished in coded colours in accordance with Alberta Government Colour Code for Mechanical and Electrical Identification.
.3 Refer to Section 26 05 53, Identification for Electrical Systems.

3.3 LOCATIONS

.1 Painting is required at locations specified below, on substrates and by methods indicated in "Painting Schedule" in this Section.

.2 Exposed in Services Areas, as indicated.

.3 Exposed in Unfinished Areas, as indicated.

.4 Exposed in Finished Areas: Includes all other rooms not listed above.

.5 Semi-Concealed Spaces: Includes all non-exposed but accessible spaces behind ceilings, walls and floors, including exposed spaces which will be semi-concealed at some future time.

.6 Permanently Concealed Spaces: Includes all non-exposed and permanently inaccessible spaces behind ceilings, walls and floors, including exposed spaces which will be permanently concealed at some future time.

.7 Exposed to Exterior: Includes all exposed exterior locations.

3.4 METHODS

.1 Painting by methods specified below, are required on substrates and at locations indicated in "Painting Schedule" in this Section.

.2 Method 'P1' - Full Colour for Mechanical Piping and Equipment:

.1 Primary Colour Coding: Paint substrates in their entirety in required primary colour for mechanical equipment. Use applicable 3 coat finish system.

.3 Method 'P2' - Full Painting in Un-coded Colours:

.1 Paint substrates in their entirety. Use applicable 3 coat finish system.

.2 Colours shall be the same as wall or ceiling background colours.

.4 Method 'P3' - No Painting:

.1 Painting mechanical equipment and piping not required.

3.5 PAINTING MISCELLANEOUS ITEMS

.1 Paint inside of ducts at grilles and diffusers back approximately 600 mm so that duct interior is not visible when grilles and diffusers are installed. Apply one coat Cementitious Primer and one coat Alkyd Enamel, flat, black colour, before grilles and diffusers are installed.

.2 Paint concrete machine and equipment bases in coded colours and with 100 mm wide diagonal stripes as detailed in Infrastructure Colour Coding Requirements. Do not paint spring isolators.

.3 Do not paint sprinkler heads.

.4 Back-prime and paint surfaces and edges of plywood backboards for electrical and telephone equipment with one coat Alkyd Wood Primer, white colour, and two coats Alkyd Porch and Floor Enamel, grey colour, applied before backboards are installed.

3.6 MECHANICAL AND ELECTRICAL WORK PAINTING SCHEDULE

	Substrates				
Locations	Mech. Piping	Mech. Equipment	Mech. Ductwork	Elect. Conduit and Cable	Other Elect. Work
Exposed in service areas	P1	P1	n/a	P3	P2
Exposed in unfinished areas	P3	n/a	n/a	P3	P3
Exposed in finished areas	P2	n/a	P2	P2	P2
Semi-concealed spaces	P3	n/a	P3	P3	P3
Permanently concealed spaces	P3	n/a	P3	P3	P3
Exposed to exterior	P1	P2	P2	P2	P2

Key: P1 - Full Painting in Coded Colours for Mechanical Piping and Equipment
P2 - Full Painting in Un-coded Colours
P3 - No Painting in Coded or Un-coded Colours.

Refer to articles 3.2, 3.3 and 3.4 of this Section for detailed descriptions of substrates, locations and methods.

3.7 FINISH SYSTEMS SCHEDULE FOR MECHANICAL AND ELECTRICAL WORK

Substrate	Finish System And Description		MPI Product No.
Iron and Steel Piping and Equipment	EXT 5.1D Alkyd, Gloss Level G6 - Gloss		
	1st Coat:	Alkyd Anti-corrosive Metal Primer	79
	2nd Coat:	Alkyd	9
	3rd Coat:	Alkyd	9
Galvanized Metal Piping, Ductwork, Conduit, and Equipment	EXT 5.3B Alkyd, Gloss Level G6 - Gloss		
	1st Coat:	Cementitious Primer	26
	2nd Coat:	Alkyd	9
	3rd Coat:	Alkyd	9
Aluminum Jacketed Piping, Conduit, and Equipment (Exposed aluminum)	EXT 5.4A Alkyd, Gloss Level G6 - Gloss		
	1st Coat:	Vinyl Wash Primer	80
	2nd Coat:	Quick Dry Primer	9
	3rd Coat:	Alkyd	9
	4th Coat	Alkyd	
Copper Piping	EXT 5.5A Alkyd, Gloss Level G6 - Gloss		
	1st Coat:	Vinyl Wash Primer	80
	2nd Coat:	Alkyd	9
	3rd Coat:	Alkyd	9
Canvas and Cotton Insulated Piping, Ductwork, and Equipment	INT 10.2B Modified, Alkyd, Gloss Level G5 - Semi-gloss		
	1st Coat:	Latex Primer Sealer and Latex Block Filler, 50/50 mix, white	50 & 4
	2nd Coat:	Alkyd	47
	3rd Coat:	Alkyd	47
Concrete Machine Bases and Curbs	INT 3.1D Alkyd, Gloss Level G5 - Semi-gloss		
	1st Coat:	Latex Primer Sealer	50
	2nd Coat:	Alkyd	47
	3rd Coat:	Alkyd	47

Substrate	Finish System And Description		MPI Product No.
Iron and Steel Piping and Equipment	INT 5.1E Alkyd Finish, Gloss Level 5 - Semi-gloss		
	1st Coat:	Alkyd Metal Primer	79
	2nd Coat:	Alkyd	47
	3rd Coat:	Alkyd	47
Brine Tanks	INT 5.1P Modified, High Build Epoxy		
	1st Coat:	Epoxy Primer	101
	2nd Coat:	Two Component Epoxy	98
	3rd Coat:	Two Component Epoxy	98
Galvanized Metal Piping, Ductwork, Conduit, and Equipment	INT 5.3C Alkyd, Gloss Level G5 - Semi-gloss		
	1st Coat:	Cementitious Primer	26
	2nd Coat:	Alkyd	47
	3rd Coat:	Alkyd	47
High Heat Steel, Boilers, Breeching, Furnace Fronts, Piping, Flues, Heat Exchangers, etc.	INT 5.2B Heat Resistant Enamel, Aluminum, Maximum 800°F (427°C)		
	See note	Heat Resistant Aluminum	2
	Note - No. of coats and application procedures in accordance with manufacturer's recommendations		
	INT 5.2D High Heat Resistant Coating, Maximum 1100°F (593°C)		
	See note	High Heat Resistant Coating	22
	Note - No. of coats and application procedures in accordance with manufacturer's recommendations		
Aluminum Jacketed Piping, Conduit, and Equipment	INT 5.4A Alkyd, Gloss Level G5 - Semi-gloss		
	1st Coat:	Vinyl Wash Primer	80
	2nd Coat:	Alkyd	47
	3rd Coat:	Alkyd	47

Substrate	Finish System And Description		MPI Product No.
Copper Piping	INT 5.5A Alkyd, Gloss Level G5 - Semi-gloss		
	1st Coat:	Vinyl Wash Primer	80
	2nd Coat:	Alkyd	47
	3rd Coat:	Alkyd	47
Plastic Piping	INT 6.8B Alkyd, Gloss Level G5 - Semi-gloss		
	1st Coat:	Bonding Primer	69
	2nd Coat:	Alkyd	47
	3rd Coat:	Alkyd	47

3.8 COLOURS

.1 Painting Schedule for Mechanical equipment, refer to and coordinate with Section 20 05 43.

.1 Mechanical system identification required.

.2 All mechanical equipment is to be painted the field colour ‘day break’, PT1 unless noted otherwise. (The gathering space mechanical ducts and piping is visible).

.3 The wall mounted radiant cabinets in the gymnasium are to be painted ‘lucky green’ PT2.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Submittal Forms	Section 01 33 00
.2	Sealants:	Section 07 92 00
.3	Painting:	Section 09 91 05

1.2 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.3 REFERENCE DOCUMENTS

.1 American Society for Testing and Materials (ASTM)

.1	ASTM D522-93a(2008)	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
.2	ASTM D1308-02(2007)	Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
.3	ASTM D1360-98(2004)	Standard Test Method for Fire Retardancy of Paints (Cabinet Method)
.4	ASTM D2486-06	Standard Test Methods for Scrub Resistance of Wall Paints
.5	ASTM E96/E96M-05	Standard Test Methods for Water Vapor Transmission of Materials

.2 Canadian General Standards Board (CGSB)

.1	CGSB 1-GP-71 Set of 3 Standards 2003	Methods of Testing Paints and Pigments - Set includes 1-GP-71 No. 5-96, 1-GP-71 No. 38-96 and 1-GP-71 No. 73-96

1.4 QUALIFICATIONS

.1 The work of this Section shall be applied only by experienced applicators of the specified products.

1.5 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with

Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.

.2 Samples:

.1 Submit 300 mm x 300 mm representative sample of coating in selected colour. Identify sample by project name including material and colour identification.

.2 Site apply sample installation to minimum 2 m^2 area, to surface as directed, for approval by the Province. Retain approved sample until work is completed and accepted.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installers / Applicators / Erectors:

.1 The work of this Section shall be applied only by experienced applicators of the specified products.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Deliver materials undamaged, in original containers, with manufacturer's labels and seals intact.

.2 Storage and Handling Requirements:

.1 Store materials in protected conditions with a minimum temperature of 12°C.

1.8 SITE CONDITIONS

.1 Ambient Conditions:

.1 For interior coatings: Minimum surface temperature 10°C 24 hours before, during and 24 hours after application or until cured; adequate controlled ventilation; bright, uniform lighting; broom clean; reasonably dust free.

1.9 PROTECTION

.1 Protect adjacent surfaces from damage and overspray resulting from work of this Section. Mask or cover adjacent surfaces. Make good any damage at own expense, to the Province's satisfaction.

.2 Post "Wet Coatings" and "No Smoking" signs while work is in progress and curing.

2. Products

2.1 MATERIAL

.1 Solvent based, two component thermo-setting, 100% epoxy coating meeting the following requirements:

Property	Test Method	Requirement
Water vapour transmission	ASTM E96	0.3 metric perms. max.
Colour fastness	CGSB 1-GP-71 Fade-ometer	No colour change, chalking or film defects, after 48 hours
Fire resistance	ASTM D1360 Cabinet method	Less than 17 g lost over masonry backing
Scrubbability	ASTM D2486 Gardner Scrubbability Machine	No effect on film after 5000 cycles
Radiation resistance	Exposure to Gamma rays of 35 roentgen intensity per hour at distance of 1625 mm from Cobalt 60 cell	Unaffected as measured by difference in reflectance
Toxicity	Evaluated by Canadian Department of Agriculture	Approved non-toxic

Continued next page

2.1 MATERIALS (Cont'd)

Property	Test Method	Requirement
Heat & cold cycling	50 cycles on masonry backing. Each cycle 8 hours at 70°C 16 hours at 23°C	No cracking, loss of adhesion, or other film defects
Flexibility	ASTM D522 Mandrel Test	Passing 3 mm bend without cracking or peeling
Impact resistance	CGSB 1-GP-71, Method 147.1 Gardner Impact Test	Passing 11 J without cracking
Stain resistance	ASTM D1308	Not affected by common acids, hydroxides, salts and household cleaning agents

2.2 COLOURS

.1 Colour: as selected by Consultant.

3. Execution

3.1 EXAMINATION

.1 Examine all surface conditions to which the work of this Section is to be applied. Report any deficient surfaces to the Province.

3.2 PREPARATION/APPLICATION

.1 Prepare surfaces and apply in accordance with manufacturer's instruction.

.2 Match finished work to approved samples, maintain uniform thickness, sheen, colour, texture and free from defects detrimental to appearance or performance.

.3 Minimum cured thickness of applied material shall be 200 to 250 micrometres.

.4 Cove flooring to heights indicated on Drawings.

3.3 CLEANUP

.1 Promptly, as the work proceeds and upon completion, clean up excess materials and rubbish.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Masonry wall backup	Section 04 20 00
.2	Gypsum wallboard backup	Section 09 29 00
.3	Staining and finishing	Section 09 91 05

1.2 REFERENCE DOCUMENTS

.1 Aluminum Association (AA):

.1	DAF 45-03	Designation System for Aluminum Finishes

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

.1	ANSI 208.1, 2009	Particleboard, Mat formed Wood
.2	ANSI A208.2, 2009	Medium Density Fiberboard for Interior Use

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

.1	ASTM A653/ A653M-09	Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
.2	ASTM A924/ A924M-09	Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process

.4 Canadian General Standards Board (CGSB):

.1	CAN/CGSB 11.3 M87	Hardboard

.5 Canadian Standards Association (CSA):

.1	CSA O121-08	Douglas Fir Plywood
.2	CSA O151-04	Canadian Softwood Plywood

.6 Porcelain Enamel Institute (PEI):

.1	PEI 501 Porcelain Enamel	

.7 Underwriters Laboratories of Canada (ULC):

.1	CAN/ULC S706-02	Wood Fibre Thermal Insulation for Buildings

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing for adhesives used in manufacturing.

.2 Submit Shop Drawings:

.1 Submit shop drawings in accordance with Division 01.

.2 Clearly indicate component size and configuration, attachment details, accessories, colour and finish.

.3 Samples:

.1 Comply with requirements of Division 01.

.2 Submit duplicate 300 mm x 300 mm samples of faced board.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Take delivery, uncrate and store until placement.

.2 Storage and Handling Requirements:

.1 Store in warm, dry and protected area.

2. Products

2.1 MATERIALS

.1 Tackboard (TB1): tack surface of 6 mm thick natural cork laminated to backing board of 8 mm thick wood chip particle board, colour of vinyl fabric will be selected by the Minister. Panel products must be manufactured with no added urea-formaldehyde and adhesives used to fabricate laminated assemblies must contain no urea formaldehyde.

.2 Magnetic Marker Boards:

.1 Face sheet, minimum 0.62 mm enamelling grade steel specifically processed for temperatures used in coating porcelain on steel to manufacturers standard process.

.1 Coat exposed face and edges with a 3-coat process consisting of primer, ground coat, and colour cover coat.

.2 Coat concealed face with a 2-coat process consisting of primer and ground coat.

.3 Cover Coats: Provide manufacturer's standard, light coloured, special writing surface with gloss finish intended for use with erasable dry markers.

.2 Core: Use any one of the following core materials to the manufacturer’s standard:

.1 10 mm thick, particleboard core material complying with requirements of ANSI A208.1, Grade 1 M 1.

.2 6 mm thick, tempered hardboard.

.3 13 mm gypsum board.

.3 Backing Sheet: Use any one of the following backing materials to the manufacturer’s standard:

.1 0.38 mm thick, aluminum sheet backing.

.2 0.127 mm thick, aluminum foil sheet backing.

.3 0.45 mm thick, galvanized steel sheet backing.

.4 Magnetic Backing: Provide manufacturers standard magnetic backing, compatible with marker board facer.

.5 Laminating Adhesive: Manufacturer's standard, moisture resistant, thermoplastic type adhesive.

.3 Frames: 38 mm x 38 mm clear fir as detailed on drawings.

.4 Frames: extruded aluminum profiles, mill finish, snap-on fastening methods. Chalkrail of single thickness profile, cast aluminum and closures.

.5 Accessories: lockable brackets for 'pull down' maps, flag holders, map hooks.

3. Execution

3.1 INSTALLATION

.1 Securely fasten tackboards and markerboards to walls, where indicated, with stainless steel screws.

.2 Provide two (2) accessory brackets per 2400 mm length of chalkboard.

.3 Coordinate installation with other work.

.4 Install to heights indicated on drawings.

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 This Section includes requirements for the following:

.1 Toilet compartments.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Environmental Procedures	Section 01 35 20
.2	Waste Management and Disposal	Section 01 74 19
.3	Gypsum wallboard backup:	Section 09 29 00
.4	Washroom accessories and grab bars:	Section 10 28 13

1.3 REFERENCE DOCUMENTS

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

.1	ASTM A167-99 (2009)	Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip
.2	ASTM A653/ A653M-09	Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
.3	ASTM A924/ A924M-09	Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process

.2 Canadian General Standards Board (CGSB):

.1	CAN/CGSB 1.81-M90	Air Drying and Baking Alkyd Primer for Vehicles and Equipment
.2	CAN/CGSB 1.88-92	Gloss Alkyd Enamel Air Drying and Baking
.3	CAN/CGSB 1.104-M91	Semigloss Alkyd Air Drying and Baking Enamel

.3 Safety Codes Council of Alberta:

.1 Barrier Free Design Guide, Fourth Edition, July 2008

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit descriptive literature for hardware items, including, but not limited to, hinges, latch sets, coat hooks, brackets, fastenings and trim.

.2 Shop Drawings:

.1 Comply with requirements of Division 01.

.2 Submit shop drawings, clearly indicating fabrication details, plans, elevations, edge details, hardware, and installation details.

.3 Submit large scale details of all anchorages, clearly indicating components, materials, and finishes, and related work.

.3 Samples:

.1 Submit duplicate 200 mm x 200 mm samples of partition types showing finish on both sides, two finished edges, corners, and core construction.

1.5 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data:

.1 Provide data describing maintenance of finishes recommended by finish manufacturers for incorporation into Maintenance and Operation Manual.

2. Products

2.1 MATERIALS

.1 Sheet steel: commercial grade, stretcher leveled, sheet steel to ASTM A653M, with Z275 zinc coating. Powder coat finish.

.2 Minimum steel thickness:

.1 Panels and doors: ..... 0.80 mm.
.2 Pilasters: ..... 1.2 mm.
.3 Reinforcement: ..... 3.00 mm.
.4 Headrails: ..... 1.00 mm.

.3 Basis-of-Design: Hadrian floor mounted powder coated Elite Series.

.4 Doors, Panels and Pilasters shall be constructed of two sheets of panel flatness zinc-coated galvanneal steel, ASTM A653 GR33, laminated under pressure to a honeycomb core for sound deadening and rigidity. Formed edges to be welded together and inter-locked under tension with a roll-formed oval crown locking bar, mitred, welded and ground smooth at the corners. Honeycomb to have a maximum 25mm (1”) cell size.

2.2 HARDWARE

.1 Hardware not specifically designed for partitions by a metal partition manufacturer shall be subject to approval by Minister.

.2 Material: one of the following:

.1 Chrome-plated non-ferrous, die-cast zinc alloy.

.2 Clear anodized aluminum castings and extrusions.

.3 Stainless steel, polished or brushed finish.

.3 Hardware shall operate smoothly, quietly and consistently.

.4 Latch Set, Door Bumper, Brackets: manufacturer's standard for type of partitions.

.5 Hinges shall be adjustable to automatically return inswinging doors from any position to nominal 30 degrees from closed position, and shall return outswinging doors to closed position.

.6 Hardware for compartments designed for barrier-free access shall be suitable for pilaster orientation indicated on drawings and shall conform to barrier-free design requirements of Alberta Building Code.

.7 Each type of hardware item shall be consistent as to type and finish.

2.3 BRACING, ANCHORAGE AND FASTENERS

.1 All panel-to-wall, panel-to-pilaster and pilaster-to-wall connections shall be made with full height continuous channels.

.2 Door hardware shall be chrome plated zinc die castings.

.3 Fasteners are zinc plated 12 x 1-3/4" and 12 x 5/8" TR-27 6-lobe security screws.

.4 Doors shall be equipped with gravity type hinges mounted on upper and lower pilaster hinge brackets.

.5 Door hinges shall be wrap-around style and adjustable to permit the door to come to rest at any position when not latched. Threaded upper hinge pin shall have a metal core and self lubricating nylon sleeve to ensure smooth, quiet operation.

.6 Each door to be fitted with a combined coat hook and bumper and a concealed latch, with face mortised flush with edge strip of door.

.7 A full length continuous stop and hinge side filler eliminate all sightline gaps between pilasters and doors.

2.4 FABRICATION

.1 Fabricate doors, panels and pilasters of sheet steel faces pressure bonded to sound deadening core, to manufacturer's standard heights and to plan dimensions as indicated on drawings.

.2 Standard compartment doors shall be 610 mm wide; doors to barrier-free compartments shall be minimum 800 wide.

.3 Door, Panel and Pilaster Thickness:

.1 Doors and Panels: 25 mm.
.2 Pilasters: 32 mm.

.4 Provide formed and closed edges for doors, panels, headrails, and pilasters. Miter and weld corners and grind smooth.

.5 Provide internal reinforcement at areas of attached hardware and fittings. Temporarily mark locations of reinforcement for tissue holders, grab bars, receptacles, coat hooks and other accessories.

2.5 SHOP FINISHING

.1 Clean, degrease and neutralize steel components with a phosphate.

.2 sheet metal to be thoroughly cleaned, phosphated and finished with a high performance powder coating, baked on to provide a uniform smooth protective finish.

.3 Finish (TP1): Refer to Interior Materials Legend on Drawing A005.

3. Execution

3.1 EXAMINATION

.1 Examine site conditions where the work is to be installed and ensure acceptability of existing room finishes for a complete and satisfactory installation.

3.2 INSTALLATION

.1 Install partitions secure, plumb and square.

.2 Leave 12 mm space between walls and panels, and walls and pilasters.

.3 Fasten anchoring brackets as follows:

.1 To masonry and concrete surfaces using screws and expansion anchors.

.2 To hollow walls using bolts and toggle type anchors.

.3 To steel supports with threaded rods in threaded holes.

.4 Attach panels and pilasters to brackets with through-type sleeved bolt and nut.

.5 Provide for concealed adjustment of floor variations with screw jack through steel saddles made integral with pilaster. Conceal floor anchorage with stainless steel covers secured in position.

.6 Equip each door with hinges, latch set, and coat hook. Adjust and align hardware for easy, proper function.

.7 Set inswinging doors to open position at 30° from closed. Set outswinging doors to return to closed position.

.8 Install door pulls on out-swinging doors in conformance with barrier-free design requirements of Alberta Building Code.

3.3 OVERHEAD BRACED COMPARTMENTS

.1 Attach pilasters to floor with pilaster supports and level. Plumb and tighten installation with levelling device.

.2 Secure headrail to pilaster face with not less than two fasteners per face.

.3 Set tops of doors parallel with overhead brace when doors are in closed position.

3.4 FLOOR ANCHORED COMPARTMENTS

.1 Secure pilasters to floor with pilaster supports anchored with minimum 50 mm penetration in structural concrete floor.

.2 Level, plumb and tighten installation with levelling devices.

.3 Set tops of doors level with tops of pilasters when doors are in closed position.

3.5 SCREENS

.1 Provide screens at urinal stalls as indicated on drawings.

.2 Provide screens at washroom entrances, consisting of panels and pilasters and headrails, as indicated on drawings.

.3 Anchor screens to wall and to posts consisting of tubular headrail stock and end sockets pilasters with minimum 2 panel brackets or continuous channel bracket per post or pilaster. Anchor posts and pilasters to floor.

3.6 CLEAN-UP

.1 Remove protective maskings and clean surfaces, leaving them free of oil and imperfections.

.2 Field touch-up of scratches or defaced enamel finish will be permitted only if approved by the Minister. Otherwise defective materials shall be rejected and replaced with new materials.

END OF SECTION

1. General

1.1 SUMMARY

.1 Provide cubicle curtains, tracks and accessories in accordance with requirements of the Contract Documents

1.2 SUBMITTALS

.1 Provide all information necessary to completely describe cubicle curtains, tracks and accessories, mounting details, colours, materials, and fabrication information.

.2 Provide duplicate 300 x 300 mm samples of curtain with grommets and hems, in colour as selected by the Consultant. Provide duplicate 300 mm long samples of track complete with attachments and curtain carriers.

1.3 DELIVERY AND STORAGE

.1 Deliver materials to site in labelled protective packaging.

.2 Time delivery of materials to coincide with work within which installation is scheduled.

.3 Protect materials from damage prior to installation.

1.4 GUARANTEE

.1 Provide manufacturer's five (5) year guarantee, commencing upon the date of Substantial Performance of the Work.

2. Products

2.1 MATERIALS

.1 Curtain Track as follows:

.1 Track Finish: anodized aluminum

.2 Bends: 300 mm radius, up to 90^{o}.

.3 End caps: aluminum end caps, part #1207.

.4 Connector: aluminum connector, part #1208.

.5 End Gate: removable plastic end gate, part #1210.

.6 Roller and hooks: nylon axle and wheels, tangle-free swivel, aluminum hook; Roller 12.

.7 Screws: stainless steel type, to suit installation.

.2 Curtain (PC1): anti-microbial hospital privacy curtain, sanitized, non-combustible, with top mesh, with reinforced grommets at 150 mm o/c.; as manufactured by AR Nelson, or preapproved product. 10% wider than actual curtain track length. Curtain to extend to 300 mm above floor. Colour as selected by Consultant.

.3 Fabrication: provide curtain with nylon mesh top. Mesh 530 mm high. Nylon mesh sewn to the body of the curtain with an over lapping operation performed by double needle interlocked stitch. Sides and top of the nylon mesh completely bound with the same fabric as the body of the curtain.

.4 Bottom and side hem 25 mm wide, triple thickness. Vertical seams overlapped and sewn with a double needle, interlocked stitch to ensure straightness and strength of seams. Bottom hem sewing turned vertically at each corner to prevent unravelling of sewing thread. All sewing performed with lock stitch machines in a quality workmanlike manner by experienced personnel.

.5 Grommets of nickel plated brass machined into the top hem at 150 mm intervals. Firmly anchor grommets into the hem.

.6 Fabricate cubicle curtains at least 10% wider than the track length upon which they run. Hang curtains to 300 mm above finished floor.

3. Execution

3.1 SURFACE CONDITIONS

.1 Prior to the Work of this Section, inspect and verify that surfaces are satisfactory.

.2 Do not proceed with installation until conditions are acceptable.

3.2 INSTALLATION

.1 Install cubicle track, hardware and accessories in accordance with manufacturer's specifications and recommendations to layout indicated on the reviewed shop drawings.

.2 Install all required stops, corners and splices. Install in single lengths.

.3 Install track in continuous length from wall to curve. Fabricate curve to uniform true curve.

.4 Install track switches to locations noted on the drawings.

.5 Install using screw clamps. Place fixing at close to ends as possible. In T-bar grid ceilings, fasten to each T-bar using self-tapping screws.

.6 Properly and securely place anchors, inserts and other fastening devices.

.7 When track is completely installed and ready for use, put required number of carriers into track at end gates. Install filler cap into end gate with #8 x 1" screws provided.

.8 Upon completion of installation, check all operable items and adjust where required to provide proper function.

3.3 CURTAIN INSTALLATION

.1 Install curtains to manufacturer's recommendations, to glide smoothly.

END OF SECTION

1. General

1.1 REFERENCE STANDARDS

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

.1 ASTM D751, Standard Test Methods for Coated Fabrics

.2 ASTM D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

.3 ASTM D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

.4 ASTM D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

.5 ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

.6 ASTM D2261, Standard Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)

.7 ASTM D3776, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric

.8 ASTM D5034, Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

.9 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials

.2 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.2 DELIVERY, HANDLING AND STORAGE

.1 Ship panels to site flat on skids; store panels indoors protected from weather and sunlight.

.2 Remove panels from skids and re-stack on solid, flat surface to eliminate waviness that may have developed during transportation; do not stand panels on edge; concrete floor is a satisfactory surface provided that a protective slip sheet is used between concrete and panels.

.3 Acclimate panels for a minimum of 24 hours before installation in temperature and humidity conditions similar to the operating environment of the finished room before starting installation.

1.3 MOCK UP

.1 Provide mock-up of glass fibre reinforced plastic panels, seams and edges including ceiling and floor.

.2 Construct mock up areas at location designated by the Consultant.

.3 Prepare mock-ups for Consultant's review with reasonable promptness and in an orderly sequence so as not to cause any delay in the Work.

.4 Sample installations must indicate materials, patterns, joints, colours, shades, installation methods and level of workmanship.

.5 Accepted sample installations will become the standard for the project and may be incorporated into the Work, if the mockup is in an undisturbed condition at time of Substantial Performance of the Work and may become part of the completed Work where they form a part of the completed Work. Any work which does not match the accepted mock-ups will be rejected and replaced to match accepted mock-ups.

2. Products

2.1 CRASH RAIL

.1 Crash Rails (indicated as Chair Rail): Extruded Rigid Plastic in accordance with ASTM D1784, Class 1, textured, chemical and stain resistant, high impact resistant PVC or acrylic modified vinyl plastic with integral colour throughout; and as follows:

.1 Crash Rail: 203.2 mm high surface mounted crash rail, mounted with 38.1 mm wide aluminum clips contain a continuous recycled PETG cushion for added shock absorption.

.2 Physical Properties:

.1 Impact Resistance: Minimum 1.36 kN of notch in accordance with ASTM D256, Test Method A.

.2 Chemical and Stain Resistance: In accordance with ASTM D543.

.3 Self-extinguishing in accordance with ASTM D635.

.4 Flame Spread Index: 25 or less.

.5 Smoke Developed Index: 450 or less.

.6 Colour: to match classic maple wood grain finish, submit samples for colour selection.

.3 Location: Chair rails in administration area and offices. Refer to Drawing A041 Main Floor Fitment Plan South Wing and A042 Main Floor Fitment Plan North Wing.

2.2 WALL PADDING

.1 Column Wall Padding: Column protection in gymnasium on the columns and in the mechanical room above catwalk. Refer to Drawing A041 Main Floor Fitment Plan South Wing and A042 Main Floor Fitment Plan North Wing.

.1 Covering: 14 oz vinyl coated fabric leather embossed finish.

.2 Performance:

- .1 Composition: In accordance with ASTM D751, 68.2 % Vinyl, 31.8% Polyester
- .2 Total Weight: 14 oz/yd2 in accordance with ASTM D3776
- .3 Tear (lbs): 92 (w) x 83 (f) in accordance with ASTM D2261
- .4 Tensile (lb/inch): 335 (w) x 348 (f) in accordance with ASTM D5034
- .5 Adhesion (lb/inch): 28 in accordance with ASTM D751
- .6 Flame Resistance: Pass in accordance with ASTM E84

.3 Colour: As selected by Consultant.

2.3 ACCESSORIES

.1 Sealant: Rigid two-part, high-solids, high-modulus epoxy security sealant for seams, edges including ceiling and floor.

.2 Aluminum: Extruded aluminum should be 6063-T6 alloy, nominal 2.29 mm thick clips. Minimum strength and durability properties as specified in ASTM B221.

.3 Fastenings: Nylon drive rivets or stainless steel screws as recommended by manufacturer.

3. Execution

3.1 EXAMINATION

.1 Verify that substrate conditions are in accordance with manufacturer’s installation requirements; installation will designate acceptance of existing conditions.

.2 Verify that wall surfaces are flat, even and true to line and solid, and that corners are plumb and straight, with all nails holes, screw depressions and cracks filled and smoothed flush to wall surface.

3.2 PREPARATION

.1 Remove minor imperfections such as high spots and fill low spots.

.2 Remove dirt, dust or grease that may be an impediment to proper installation of materials specified in this Section.

3.3 INSTALLATION

.1 Install panels in accordance with manufacturer's written instructions; maintain a reference copy of installation instructions on site for review by installers and the Consultant.

.2 Position panels leaving a minimum 6 mm gap at ceiling and floor junction; minimum 3 mm gap between each panel and division bar moulding to allow for normal expansion and contraction; minimum 3 mm gap around pipes, electrical fittings, other projections; and pre-drill oversize by 3 mm holes ready for fastenings.

.3 Cut and drill panels using a carbide tipped saw blade or drill bit; or cut with snips as recommended by manufacturer.

.4 Pre-fit each panel before securing in place; leave leading edger of first panel unfastened:

.1 Apply bead of silicone sealant on one side of division bar and install on leading edge of first panel.

.2 Push division bar all the way onto panel and pull back to form a minimum 3 mm gap; confirm plumb; tack division bar using fasteners recommended by manufacturer.

.3 Fasten leading edge of first panel.

.5 Install fasteners at nominal 400 mm O/C both horizontally and vertically. Maintain edge fasteners 25 mm from panel edge face.

.6 Stagger fasteners on opposing panel edges and corners next to a division bar to aid in maintaining tight, flat seam.

.7 Use combination of mechanical fasteners and adhesive to ensure flat surface, using compatible adhesives recommended by panel manufacturer prior:

.1 Fasten panel at top and work toward bottom or start at centre and work outward.

.2 After installation of first panel is completed remove excess sealant immediately.

.3 Apply bead of sealant in remaining channel of division bar.

.4 Install second panel into division bar.

.5 Pull panel back to leave a minimum 3 mm clearance.

.6 Check plumb.

.7 Remove excess sealant.

.8 Fasten second panel except for leading edge.

.9 Repeat previous steps until all panels are installed.

.8 Remove excess silicone sealant during installation.

.9 Seal corner seams, ceiling, and base junctions; install accessories as installation progresses, leaving a minimum 3 mm clearance for normal expansion and contraction of panels.

3.4 CLEAN-UP

.1 Remove temporary coverings and protection of adjacent work areas.

.2 Repair or replace products that have been installed and are damaged.

.3 Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

.4 Remove construction debris from project site and legally dispose of debris.

.5 Remove any adhesive or excessive sealant from panel face using solvent or cleaner recommended by panel manufacturer.

.6 Protect installed product and finish surfaces from damage arising from remainder of construction.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Environmental Procedures	Section 01 35 20
.2	Waste Management and Disposal	Section 01 74 19
.3	Mirror Glass:	Section 08 83 13
.4	Metal Washroom Partitions:	Section 10 21 13

1.2 REFERENCE DOCUMENTS

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

.1	ASTM A167 99 (2009)	Standard Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip
.2	ASTM B456-03 (2009)	Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
.3	ASTM A653/ A653M-09	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
.4	ASTM A666-03	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
.5	ASTM A924/ A924M-09	Standard Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process

.2 Canadian General Standards Board (CGSB):

.1	CAN/CGSB 1.36-97	General Purpose Interior Varnish
.2	CAN/CGSB 1.81-M90	Air Drying and Baking Alkyd Primer for Vehicles and Equipment
.3	CAN/CGSB 1.88-92	Gloss Alkyd Enamel, Air Drying and Baking
.4	CGSB 31 GP 107MA 1990	Non inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover

.3 Canadian Standards Association (CSA):

.1	CAN/CSA G164-R2003	Hot Dip Galvanizing of Irregularly Shaped Articles

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings or catalogue illustrations in accordance with Division 01.

.3 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Samples to be returned for inclusion into work.

1.4 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data:

.1 Provide maintenance data for toilet and bath accessories for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Tools:

.1 Provide special tools required for accessing, assembly/disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.

.2 Deliver special tools to Minister.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Management and Disposal.

2. Products

2.1 FIXTURES

.1 Napkin Dispenser: Provided by Owner, Contractor installed.

.2 Soap Dispenser: Provided by Owner, Contractor installed.

.3 Toilet Tissue Dispenser: Provided by Owner, Contractor installed.

.4 Paper Towel Dispenser: Provided by Owner, Contractor installed.

.5 Grab Bars: 32 mm dia. x 1.5 mm wall tubing of stainless steel, concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Length and configuration as indicated on Drawings. Knurl bar at area of hand grip.

.6 Mirror: Frameless stainless steel mirror 18-8 type 304, 0.9 mm stainless steel polished to a No. 8 mirror finish. Mirror to have 6 mm return concealing 6 mm tempered Masonite backing. Four corner countersunk holes provide flush fit of mounting screws with mirror surface.

3. Execution

3.1 INSTALLATION

.1 Install and secure all fixtures rigidly in place using the following techniques.

.1 For stud walls install steel back plate to stud prior to plaster or drywall finish. Plate to have threaded studs or plugs provided.

.2 For hollow masonry units or existing plaster/drywall surfaces use toggle bolts drilled into cell/wall cavity.

.3 In solid masonry, marble, stone or concrete use bolt with lead expansion sleeve set into drilled hole.

.4 In toilet and shower compartment partitions, use male/female through bolts.

.2 For installation of grab bars to metal toilet partitions, provide templates and detail to partition manufacturer for shop fabrication of steel reinforcing plates. Instruct whether shop or field, drill and tap technique will be used.

.3 Use tamper proof headed screws and bolts for fasteners.

3.2 LOCATION AND QUANTITY

.1 Locate accessories where indicated on drawings. Exact locations to be determined by Minister. Provide required quantity counts to School Board for School Board provided washroom accessories.

.2 Napkin Dispenser: one for each female washroom.

.3 Soap Dispenser: Refer to Drawings.

.4 Toilet Tissue Dispenser: Refer to Drawings.

.5 Grab Bars: Refer to Drawings.

.6 Feminine Napkin Disposal: one in each female toilet compartment.

.7 Mirror: Refer to Drawings.

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 This Section includes requirements for supply and installation of Signage.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Gypsum wallboard backup: Section 09 29 00

1.3 SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting work of this section:

.1 Submit shop drawings for each sign showing locations and extent including sections, details, power requirements and attachments to other work.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Store signage in original undamaged packages and containers inside well ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity:

1.5 PROJECT CONDITIONS

.1 Deliver and install signage after building is enclosed and weatherproof, when wet work is complete and dry, and HVAC system is operating and maintaining temperature at 21°C for not less than 72 hours before beginning installation and for the remainder of the construction period.

.2 Verify actual locations of walls, columns, and other construction contiguous with signage by field measurements before fabrication and indicate measurements on shop drawings.

1.6 WARRANTY

.1 Submit manufacturer's standard warranty agreeing to repair or replace components of signage units that fail in materials or workmanship within five (5) years from date of Substantial Performance for the Project.

2. Products

2.1 SIGNAGE

.1 Acrylic Plate: 2 mm thick plate with font, colour and images as indicated on Signage Plan on Drawing A042. Include permanent, non-removable lettering, clearly legible from a minimum distance of 3 m, utilizing all upper-case characters. Interior Signage requirements included on Signage Plan on Drawings. Mount and install with predrilled holes and tamper proof screws.

2.2 EXTERIOR SIGNAGE

.1 Exterior signage to be provided in the contract, cast aluminum, lettering, mounted on the front of the school near the main entrance. Exterior signage to read:

.1 "Name of School": 300 mm high, upper case, Helvetica Medium Font. Offset from wall surface minimum 19.05 mm (3/4").

.2 "Name of School Board": 150 mm high, upper and lower case, Times Roman Font.

.3 School Board logo may also be provided as determined the Project Manager.

.4 Powder coat, colour black.

.5 School name lettering to be located high enough (minimum 3000 mm) to be out of reach from the ground to reduce vandalism from hockey sticks, etc.

.2 Vinyl Lettering: Municipal address installed above entrance doors in vinyl lettering.

.3 Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of 5005-H15.

2.3 ACCESSORIES

.1 Mounting Methods: Use fasteners as indicated on Drawings, fabricated from materials that are not corrosive to sign material and mounting surface. School name signage offset from wall surface minimum 19.05 mm (3/4").

.2 Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.4 FABRICATION

.1 Fabricate signage units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

.2 Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

.3 Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

3. Execution

3.1 EXAMINATION

.1 Examine substrates and wall areas for compliance with manufacturer's requirements for installation tolerances and other conditions affecting performance of work. Provide vandal resistant mounting and hardware.

.2 Examine walls that will receive signage and verify that blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

.3 Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers for signage units attached with adhesive.

.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Complete finishing operations, including painting, before installing signage.

.2 Clean substrate to remove dust, debris, and loose particles before installation.

3.3 INSTALLATION

.1 Install signage level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

.2 Install signage units in locations and at mounting heights indicated on Drawings.

.3 Dimensional Characters: Mount characters using standard fastening methods recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

.1 Flush Mounting: Mount characters with backs in contact with wall surface.

.2 Projected Mounting: Mount characters at projection distance from wall surface indicated.

.3 Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Environmental Procedures	Section 01 35 20
.2	Waste Management and Disposal	Section 01 74 19
.3	Concrete Bases:	Section 03 30 00
.4	Wood grounds and nailing strips:	Section 06 10 00
.5	Ductwork and connections to exhaust system:	Division 23

1.2 REFERENCE DOCUMENTS

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

.1	ASTM A167-99(2009)	Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip
.2	ASTM A653/ A653M-09	Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
.3	ASTM A924 /A924M-09	Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process

.2 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-44.40-2001	Steel Clothing Locker

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer’s printed product literature, specifications and data sheets in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Division 01.

.2 Indicate thicknesses of metal, fabricating methods, assembled banks of lockers, bases, trim, numbering, filler panels, and end/back panels.

.3 Samples:

.1 Submit sample of colour and finish on actual base metal in accordance with Division 01.

2. Products

2.1 MATERIALS

.1 Lockers (LK1, LK2): to CAN/CGSB-44.40, Size; 381 mm x 381 mm x 1830 mm, Class 2.

.1 Double tier, free standing with double wall construction, flush with frame, bright recessed handle/lock pockets bright metal handles, number plates, shelves, coat hooks, base, wall trim, filler panels/false front, welded construction, sloping tops, finish end/back panels, in baked enamel finish. Refer to Interior Materials Legend on Drawing A005 for colour and finish.

.2 Locking system: padlocks.

.3 Numbering: Provide locker numbering.

3. Execution

3.1 INSTALLATION

.1 Assembly and install lockers.

.2 Secure locker to wall with expansion bolts or to wood grounds and nailing strips. Inter-bolt locker units together.

.3 Install wall trim around recessed locker banks.

.4 Install filler panels and false fronts where indicated and where obstruction occur.

.5 Install finished end panels to exposed ends of locker banks.

.6 Provide metal end panels and fillers to suit building openings.

END OF SECTION

1. General

1.1 SUMMARY

.1 Provide flagpoles in accordance with requirements of the Contract Documents.

1.2 REFERENCE STANDARDS

.1 Aluminum Association (AA):

.1 Aluminum Design Manual,

.2 American Architectural Manufacturer's Association (AAMA):

.1 AAMA 611, Voluntary Specification for Architectural Anodized Aluminum

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

.1 ASTM C33/C33M, Standard Specification for Concrete Aggregates

.2 ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

.4 Canadian Standards Association (CSA):

.1 CAN/CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles

.5 The National Association of Architectural Metal Manufacturers (NAAMM):

.1 Metal Finishes Manual for Architectural and Metal Products

.2 ANSI/AMP-FP 1001, Guide Specifications for Design of Metal Flagpoles Manual

1.3 SUBMITTALS

.1 Product Data: Submit for Consultant's action. Furnish each type of product and accessories to be used in the Work; before starting work of this section.

.2 Certification: Provide the following submittals before starting work of this section:

.1 Submit letter certifying that installed products are in accordance with design conditions for location of installation for flagged and unflagged installations.

.2 Samples: Submit for Consultant's action. Submit samples prior to starting work of this section as follows; accepted samples will form the standard of acceptance for the remainder of the work:

.3 Submit samples for each finished material used for flagpoles and accessories for verification of selections by the Consultant

1.4 QUALITY ASSURANCE

.1 Provide flagpole assemblies including; but not limited to, anchorages and supports capable of withstanding effects of wind loads determined in accordance with q30 wind load criteria listed in the Building Code specific for the municipality of installation.

.1 Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

.2 Obtain flagpole as a complete unit, including fittings, accessories, bases, and anchorage devices, through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Spiral wrap flagpoles with heavy paper and enclose in a hard fibre tube or other protective container.

.2 Ship flagpole to installation site in one piece; except provide precision joints with self aligning internal splicing sleeve arrangement where more than one piece is required.

2. Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 All-Canadian Flagpole Co.

.2 John Ewing and Co. Inc.

.3 Dominion Aluminum Fabricators (Indal) Ltd.

2.2 MATERIALS

.1 Aluminum: Seamless extruded aluminum tubing in accordance with AA 6063-T6 alloy with a minimum wall thickness of 5 mm; heat treated after fabrication, having clear anodized finish.

.2 Isolation Coating: Alkali resistant bituminous paint or epoxy resin solution.

2.3 FLAGPOLES

.1 Construct flagpoles in one piece where possible; fabricate as follows where one piece construction is not practical:

.1 Fabricate shop and field joints without using fasteners, screw collars, or lead calking.

.2 Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves for tapered flagpoles.

.3 Provide self aligning, snug fitting joints for stepped sectional flagpoles.

.2 Flagpole:

.1 Exposed Height: 9 m.

.2 Type: Aluminum, cone tapered flagpoles fabricated from seamless tubing.

.3 Mounting Type:

.1 Hinged Base Plate:

.1 Cast metal tilting base and anchored plate joined by permanently secured pivot pin.

.2 Provide stainless steel screws for securing tilting base to anchored plate when not tilted, anchor bolts and setting templates.

.3 Provide aluminum base or aluminum flashing collar, finished to match flagpole.

.4 Halyard: Internal stainless steel Cable Halyard System. Plastic links not acceptable.

2.4 ACCESSORIES

.1 Concrete: Normal weight, air entrained, ready mix concrete having minimum 28 day compressive strength of 25 MPa, in accordance with Structural Drawings.

.2 Non-Shrink, Non-Metallic Grout: Factory packaged, non-staining, non-corrosive, non-gaseous grout in accordance with ASTM C1107.

2.5 FINISHES

.1 Finish flagpoles in accordance with NAAMM recommendations for applying and designating finishes.

.2 Aluminum:

.1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

.2 Anodized Finishes:

.1 Class I, Clear Anodic Finish: AA-M12C22A41 mechanical finish, non-specular as fabricated; chemical finish, etched medium matte; anodic coating, Architectural Class I, clear coating 0.018 mm or thicker in accordance with AAMA 611.

3. Execution

3.1 EXAMINATION

.1 Examine site conditions where Work will be applied and ensure acceptability for complete and satisfactory installation; beginning of installation will denote acceptance of site conditions

3.2 PREPARATION

.1 Excavate foundations to neat clean lines in undisturbed soil; remove loose soil and foreign matter from excavation and moisten earth before placing concrete.

.2 Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade; secure and brace forms and foundation tube, sleeve, or anchor bolts in position, to prevent displacement during concreting.

.3 Place concrete immediately after mixing; compact concrete in place by using vibrators; moist cure exposed concrete for not less than seven days or use non-staining curing compound.

.4 Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance; provide positive slope for water runoff to perimeter of concrete base.

3.3 FLAGPOLE INSTALLATION

.1 Install flagpoles where shown and in accordance with manufacturer's written instructions.

.2 Base Plate Installation:

.1 Install base plate on washers placed over levelling nuts on anchor bolts and adjust until flagpole is plumb.

.2 After flagpole is plumb, tighten retaining nuts and fill space under base plate solidly with non-shrink, non-metallic grout.

.3 Finish exposed grout surfaces smooth and slope 45° away from edges of base plate.

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 Provide gymnasium equipment in accordance with requirements of the Contract Documents.

1.2 REFERENCE DOCUMENTS

.1 American National Standards Institute (ANSI):

.1	NPA A208.2-2009	Medium Density Fibreboard (MDF) for Interior Application

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

.1	ASTM A36/A36M-12	Standard Specification for Carbon Structural Steel
.2	ASTM A47/A47M-99 (2014)	Standard Specification for Ferritic Malleable Iron Castings
.3	ASTM A391/A391M-07 (2012)	Standard Specification for Grade 80 Alloy Steel Chain
.4	ASTM A1011/A1011M-14	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
.5	ASTM A1023/A1023M-09e1	Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
.6	ASTM B179-11e1	Standard Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Casting Processes
.7	ASTM B209-10	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
.8	ASTM B221-13	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

.3 Canadian Standards Association (CSA):

.1	CSA O151-09	Canadian Softwood Plywood.

.4 International Basketball Federation/Federation Internationale de Basketball Amateur) (FIBA):
Official Basketball Rules: Basketball Equipment

1.3 SUBMITTALS

.1 Submit product data for each type of product specified including, but not limited to, assembly, disassembly, and storage instructions for removable equipment and motor nameplate data, ratings, characteristics, and mounting arrangements.

.2 Submit shop drawings for gymnasium equipment including, but not limited to, the following:

.1 Plans, elevations, sections, details, and attachments to other work.

.2 Method of field assembly for removable equipment, connections, installation details, mountings, floor inserts, attachments to other work, and operational clearances.

.3 Transport and storage accessories for removable equipment.

.4 Submit structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, point reactions, and locations for attachment of gymnasium equipment to structure.

.5 Submit product certificates signed by product manufacturer for each type of gymnasium equipment indicating compliance with referenced standards, requirements of the Authorities Having Jurisdiction, and requirements of the Owner.

1.4 QUALITY ASSURANCE

.1 Obtain each type of gymnasium equipment through one source from a single manufacturer having experience with the type of installation and complexity indicated in this Section.

.2 List and label electrical components, devices, and accessories in accordance Canadian Electrical Code and Canadian Standards Association using an accepted testing agency, and marked for intended use.

1.5 PROJECT CONDITIONS

.1 Install gymnasium equipment when spaces are fully enclosed and weatherproof, after wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels required for project when occupied for its intended use.

1.6 COORDINATION

.1 Coordinate layout and installation of overhead supported gymnasium equipment and suspension system components with other construction including, but not limited to, light fixtures, HVAC equipment, fire suppression system components, and partition assemblies.

.2 Coordinate wiring requirements and electrical characteristics with building electrical system for electrically powered equipment.

1.7 WARRANTY

.1 Submit manufacturer's standard form of warranty indicating that manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship for a period of ten (10) years from date of Substantial Performance for the Project.

.2 Failures will be considered to include, but are not limited to, the following:

.1 Basketball backboard failures including glass breakage.
.2 Faulty operation of operable components.

2. Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar products or systems may be incorporated into the work provided they meet the performance requirements established by the named products.

.2 Subject to compliance with requirements, suppliers providing products that may be incorporated into the Work include, but are not limited to, the following:

.1 Centaur Products Inc.
.2 Draper Inc.
.3 Laurentian Gymnasium Industries
.4 Quality Stage Drapery Inc.

2.2 MATERIALS

.1 Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, and as follows:

.1 Extruded Bars, Profiles, and Tubes: ASTM B221 (ASTM B221M).
.2 Cast Aluminum: ASTM B179.
.3 Flat Sheet: ASTM B209 (ASTM B209M).

.2 Steel: Type and shape recommended by manufacturer for use indicated and as follows:

.1 Steel Plates, Shapes, and Bars: ASTM A36/A36M.
.2 Steel Tubing: ASTM A500 or ASTM A513, cold formed.
.3 Steel Sheet: ASTM A1011/A 1011M.

.4 Castings and Hangers: Malleable iron, ASTM A47/A47M, grade required for structural loading.

.5 Softwood Plywood: CSA O151, exterior grade.

.6 Equipment Wall Mounting Board: Wood, neutral colour painted finish, size, and quantity as required to mount gymnasium equipment in accordance with manufacturer's written instructions.

.7 Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion resistant or non-corrodible materials; concealed.

.8 Grout: Non-shrink, non-metallic, premixed, factory packaged, non-staining, non-corrosive, non-gaseous grout in accordance with ASTM C1107 having minimum compressive strength recommended in writing by gymnasium equipment manufacturer.

2.3 BASKETBALL BACKSTOPS – WALL MOUNTED SIDEFOLD

.1 Provide wall mounted backstops, with sidefolding mechanism, with operating pole, quantity as indicated on Drawings.

.2 Steel tubing frame, 50 mm square, including adjustable stabilizing bars. No cable braces permitted, height adjustment of minimum 610 mm required.

.3 Steel parts primed and finished with spray coat of industrial enamel paint.

2.4 BACKBOARDS AND GOALS

.1 Backboards and Goals: Glass, rectangular, complete with spring release regulation goal, removable nylon net, safety edge cushion. Backboard to have baked enamel border and target area.

2.5 VOLLEYBALL/BADMINTON END AND INTERMEDIATE POSTS

.1 Volleyball/Badminton end and intermediate posts: 76 mm dia. O.D. x 3.5 mm thick round tubing, with 350 mm reinforcing insert. External bracing of 25 mm x 2.7 mm gauge round tubing. Complete with nets fabricated from high quality nylon chord square mesh. Bottom brace with rubber padding for floor protection.

.2 End post accessories:
.1 Adjustable nickel plated fittings for net height adjustment.
.2 Manual crank winch and polypropylene leaders to receive nets.
.3 Finish: primed and finished in industrial enamel.
.4 Transporter: provide minimum (2) transporters, each supplied with two castors for the movement of the poles to and from storage.

2.6 FLOOR SOCKETS (VOLLEYBALL AND BADMINTON)

.1 Floor Sockets:
.1 Floor post sockets: steel tube with base plate.
.2 Flush socket floor covers. Bronze post socket covers to sit over post sockets flush with floor. Provide 13 mm diameter finger insert for removal.
.3 Storage Room Sockets: steel tube with base plate.
.4 Refer to Drawings for layout, location and numbers required.

.2 Grout: non shrink premixed type with a minimum compressive strength of 16 MPa at 24 hours.

3. Execution

3.1 EXAMINATION

.1 Examine substrates, areas, and conditions for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.

.2 Verify critical dimensions.

.3 Examine supporting structure and subgrade, subfloors and footings below finished floor.

.4 Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked. Locate reinforcements and mark locations.

.5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install and assemble products in accordance with manufacturer's written instructions and competition rules indicated for each type of gymnasium equipment.

.2 Install gymnasium equipment after other finishing operations, including painting, have been completed.

.3 Permanently Placed Gymnasium Equipment and Components:

.1 Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.
.2 Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

.4 Floor Insert Setting:

.1 Position sleeve in oversized, recessed voids in concrete slabs and footings.
.2 Clean voids of debris.
.3 Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions.
.4 Protect portion of sleeve above subfloor and footing from splatter.
.5 Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured.
.6 Set insert so top surface of completed unit is flush with finished flooring surface.
.7 Verify relationship of mounting height, height of pad, and presence or absence of fire suppression sprinklers.
.8 Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.
.9 Connect automatic operators to building electrical system.
.10 Removable Gymnasium Equipment and Components:
.11 Assemble in place to verify that equipment and components are complete and in proper working order.
.12 Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units.
.13 Disassemble removable gymnasium equipment after assembled configuration has been approved by Owner, and store units in location indicated on Drawings.

3.3 ERECTION TOLERANCES

.1 Backboard: Maximum Variation from Plumb: 3 mm.

.2 Hoop Ring: Maximum Variation from Level: 3 mm.

3.4 ADJUSTING

.1 Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range; lubricate hardware and moving parts.

3.5 CLEANING

.1 Inspect components after completing gymnasium equipment installation.

.2 Remove spots, dirt, and debris and touch up damaged shop applied finishes in accordance with manufacturer's written instructions.

.3 Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner acceptable to the Consultant, before time of Substantial Performance.

END OF SECTION

1. General

1.1 SUBMITTALS

.1 Submit fully detailed drawings indicating all components, finishes and perimeter construction conditions for review by the Consultant.

.2 Provide duplicate samples of solar shade fabric of each colour and texture, minimum size 300 mm x 300 mm for review by the Consultant.

.3 Provide duplicate sample section(s) of track and shade assemblies, 600 mm long, for review.

1.2 QUALITY ASSURANCE

.1 All work specified under this Section shall be supplied and installed entirely by one sub-contractor using his own forces.

.2 Shades to be installed by a firm specializing in the fabrication and installation of shading systems which has been in operation for a minimum of five (5) years.

.3 Installation shall conform to the Alberta Building Code and local authority having jurisdiction.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials in original wrappings or containers with manufacturer's labels and seals intact.

.2 Handle and store materials in accordance with manufacturer's recommendations protecting materials and finishes from damages, marring of finishes or soiling.

.3 Do not deliver to site until areas to receive shades are completely finished:

.1 All mechanical and electrical work completed, tested and approved.

.2 All walls and ceilings completed and painted.

1.4 WARRANTY

.1 Provide manufacturer's two (2) year warranty from date of Substantial Performance.

2. Products

2.1 MATERIALS

.1 Shade side channels: continuous extruded aluminum U-shaped, 50 mm x 19 mm x 1.5 mm thick. Finished to match window framing.

.2 Shade roller assembly: top roller axle shall be an extruded aluminum one piece tube with a diameter of 50 mm, wall thickness of 1.0 mm designed to suit window span, with two fabric mounting channels. For spans 3657 mm and over, one piece tube 85 mm diameter, wall thickness 1.5 mm. An integral slotted spline retains the fabric edge, reinforces the tube along its entire length and serves as a locking device for the sprocket clutch assembly.

.3 Operator:

.1 Motorized Operator:

.1 Mounting Brackets: Angle shaped brackets size and thickness to manufacturer's standard; unitized pre-moulded assembly in lengths to suit system supplied; attached to high density polyethylene brackets, using manufacturer's standard adjustable motor coupling and end support assemblies.

.2 Motor Drive System: Manufacturer's standard in-tube motor drive having the following characteristics:

.1 Coupled shade panels being driven by a single motor may be coupled at a maximum angle of up to 90°.

.2 Mounting assembly: Allow for continuous front or back roll fascia across multiple shades without exposed fasteners.

.3 Shade roller tube: Removable from mounting bracket without hardware removal; non-metal components shall be self-lubricating.

.4 Shade hardware system: Allow for site adjustments or component replacement without removing brackets, regardless of mounting location.

.5 Shade hardware: Allow for bottom-up or sideways roller tube installation and removal without removing brackets.

.6 Motor Characteristics: Asynchronous motor unit, start and run, 120 Volt - single phase - 1.5 Amp, 60 Hz, thermally protected, brushless motor, permanently lubricated bearings and gearbox, containing all components for a properly functioning unit, and as follows:

.1 Gears manufactured from non-corrosive metal containing a 3 phase planetary gear reducer; non-metallic planetary gearboxes will not be acceptable.

.2 Shade motor located inside the extruded aluminum roller tube using appropriate adapters to allow for a smooth operation.

.3 Lifting Capacity: 30% safety factor.

.4 Sound Generated: not exceeding 30DB.

.5 Equip shade motor using disconnect plug at motor lead.

.6 Shade motor shall contain a conical steel disk brake allowing no slippage and adjusting to high torque.

.7 Fit shade motor with solid steel adjustable drive extensions, rectangular bar shaped for drive and torque transfer to single or multiple coupled extruded roller tubes, to suit installation.

.8 Motor Speed: Adjustable from 12 to 30 RPM to suit Owners requirements and correct operation.

.9 Motor Lead: Plenum rated quality.

.10 Equip shade motor with externally located control wheels that allow exact control of shade position at the upper and lower shade location, preventing over winding of the fabric shade cloth.

2.2 CONTROLS

.1 Controls: Key operated switches with momentary stopping, raising and lowering capabilities.

2.3 ACCESSORIES

.1 Hem bar: to be extruded aluminum or galvanized steel tube to maintain a straight bottom and flat surface.

.2 Bottom Bar: Rectangular 6 mm x 37 mm with internal grooves to accommodate fabric guide carrier to each end and hardware to attach to cable guide system where applicable.

.3 Cable guide, full length for all shades.

.4 Bearings: all bearings for ends shall be self-lubricating nylon (Delrin).

.5 Sealant: General construction sealant, refer to Section 07 92 00, colour black.

.6 Roller end caps: friction fit PVC idler cap with shift axis extension and side slot to lock into roller tube reinforcing spline.

.7 Drive shafts: solid brass drive extensions, square bar shape, for drive transfer for multiple groupings of shade rollers and manual gear box attachment.

2.4 FABRIC

.1 Black out fabric (SC1): 1 ply fiberglass, 3-ply PVC, 406 g/m^2 weight for blackout properties. Submit samples to Consultant for selection. Fabric to match SunProject BO-100 Blackout, Colour as selected by Consultant. Flame retardance: passess NFPA 701.

2.5 FABRICATION

.1 Shading system components to be manufactured and assembled allowing for custom installation techniques to suit project requirements.

.2 Individual items shall be designed and fabricated, assembled and erected in accordance with manufacturer's recommendations.

.3 Finished assemblies shall be complete in every respect, square, true to size and free from distortion, twist or any other defects which could affect their strength, operation or appearance. Factory applied finish shall be uniform, smooth and without blemish.

.4 The fabric shall retain its shape and not be affected by moisture or heat and be non-flammable.

.5 Materials shall be colourfast, cut glare and reverberation from shining surfaces at the exterior. The top of the fabric shall be held in place in the retention spline of the shade roller.

2.6 MOTORIZED ROLLER SHADE OPERATORS

.1 General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-prewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.

.2 Comply with NFPA 70.

.3 Electric Motors: UL-approved or -recognized, asynchronous, totally enclosed, insulated, capacitor-start motors, complying with NEMA MG 1, with thermal overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.

.1 Service Factor: According to NEMA MG 1, unless otherwise indicated.
.2 Motor Characteristics: Single phase, 120V, 60 Hz.
.3 Motor Mounting: Within manufacturer's standard roller enclosure.

2.6 FINISHES

.1 All exposed aluminum to be clear anodized finish.

.2 Unexposed aluminum: mill finish.

.3 All steel components to be galvanized finish to G275 designation.

3. Execution

3.1 INSPECTION/PREPARATION

.1 Verify that all blocking and framing necessary to carry shade assembly hardware is properly and securely installed.

.2 Notify the Consultant of any deficiencies in the work of other trades which would affect the work of this Section.

.3 Make accurate measurements at the site before fabrication. Check glazing framing section layout and spans and loading capabilities. Additional supports and track may be required and are to be included in the contract price.

3.2 INSTALLATION

.1 Work shall be installed only by manufacturer's skilled tradesmen and installed in strict accordance with the reviewed shop drawings.

.2 All items shall be installed plumb, square, rigidly coupled and adequately anchored, maintaining uniform clearances and accurate alignment levels and parallel with window plane.

.3 The shade fabric shall be pre-measured and manufactured off-site.

.4 Use only non-corrosive metal fasteners for installation.

.5 Apply side channels.

3.3 ADJUSTING AND CLEANING

.1 Adjust shades to provide for operation without binding.

.2 Perform operation check with Consultant's inspection.

.3 Adjust and replace shades and operating components as required to ensure smooth and trouble free operation.

.4 Clean shades and exposed components.

END OF SECTION

1. General

1.1 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Environmental Procedures	Section 01 35 20.
.2	Waste Management and Disposal	Section 01 74 19.
.3	Cast-In-Place Concrete	Section 03 30 00.
.4	Resilient flooring:	Section 09 65 00.

1.2 REFERENCE DOCUMENTS

.1 American Architectural Manufacturers Association(AAMA):

.1	AAMA 607.1	Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum

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

.1	ASTM A276-08a	Standard Specification for Stainless Steel Bars and Shapes
.2	ASTM A653/A653M-09	Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
.3	ASTM A924/A924M-09	Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process
.4	ASTM B 221-08	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
.5	ASTM D2047-04	Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

1.3 SEQUENCING AND SCHEDULING

.1 If product is to be recessed, coordinate with concrete work so that products are available for placing integrally with floor slabs.

1.4 SUBMITTALS

.1 Shop Drawings

.1 Comply with requirements of Division 01.

.2 Shop Drawings: Show layout and types of grates and frames not less than half-scale sections of typical installations, details of patterns or designs, anchors, and accessories, and field measurements of slab recess to receive frames grates (if applicable).

.2 Product Data:

.1 Comply with requirements of Division 01.

.2 Manufacturer's product specifications, installation and maintenance instructions.

.3 Samples:

.1 For Selection purposes: submit actual sections of grate and frame material in a convenient but representative size showing full range of colors, textures, finishes and patterns available for each type of floor grate and frame specified.

.2 For Verification purposes: Submit not less than 150 x 150 mm square sections of grate material and 150 mm length of frame material in selected colors and finishes for each type of grate and frame specified.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 19 Waste Management and Disposal and with the Waste Reduction Workplan.

1.6 WARRANTY

.1 Floor mats and frames shall be fabricated free of defects in materials and workmanship in accordance with the General Conditions, and the manufacturer shall offer a 5 year warranty against defects in materials and workmanship.

2. Products

2.1 MATERIALS

.1 Entrance Mat (WM): Recessed Level base with drain pan system forming a part of a foot traffic cleaning system and as follows:

.1 Aluminum: In accordance with ASTM B221, alloy 6105-T5 for rail extrusions and 6061-T6 for key lock bars.

.2 Rail: Powder coat, black

.3 Tread: Recycled rubber for first 600 mm of entrance mat system, remaining heavy-duty carpet finish.

.4 Frame: 6063-T5 aluminum alloy with 12.7 mm exposed surface and 46.0 mm depth level base frame with drain pan. PVC drain 50.8 mm diameter, stainless steel strainer, and 1.295 mm aluminum pan.

.5 Finish: As selected by Consultant

.6 Height: 46 mm

.7 Length: as Indicated on Drawings.

.8 Width: as indicated on Drawings.

2.2 FABRICATION

.1 Shop fabricate mats and frames to greatest extent possible in sizes indicated, not exceeding manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning.

.2 Space symmetrically and away from normal traffic lanes where joints in mats are necessary.

.3 Mitre corner joints in framing elements with hairline joints or provide prefabricated corner units without joints to manufacturers standard.

.4 Fabricate edge frame members in single lengths or provide minimum number of pieces possible where frame dimensions exceed maximum available lengths, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

.5 Coat surfaces of aluminum frames that will contact cementitious material with manufacturer's standard protective coating.

3. Execution

3.1 EXAMINATION

.1 Substrate must be flat and level to tolerance of no more than 3mm in 3 m.

.2 Examine the substrates and conditions under which the work is to be performed, and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Aluminum Foot Grilles

.1 Install products in accordance with manufacturers instructions, at locations shown and with top of products level with adjoining finished flooring where applicable.

.2 Coordinate top of product surfaces with swinging doors to provide under-door clearance.

3.3 PROTECTION

.1 Upon completion of frame installations, provide temporary filler of plywood or fiberboard in grate recesses, and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near time of Substantial Completion.

.2 Install product when no further wheeled construction traffic will occur and wet type operations including painting and decorating are complete.

END OF SECTION

1. INTENT

.1 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract documents of this Division and 300 series Drawings are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are **not** detailed installation instructions.

.3 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.

.4 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Minister at no extra cost.

.5 Connect to equipment specified in other Sections and to equipment supplied and installed by other Contractors or by the Minister. Uncrate equipment, move in place and install complete; start-up and test.

2. RELATED REQUIREMENTS

.1	Submittals:	Division 01.
.2	Temporary Facilities:	Division 01.
.3	Temporary Heat:	Division 01.
.4	Contract Acceptance Procedures:	Division 01.

3. RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Services connections:	Division 01.
.2	Painting, colour coding and identification of mechanical work:	Section 09 91 30.
.3	Electric motor power characteristics:	Division 26.
.4	Earthwork General Requirements:	Section 31 20 10.
.5	Trench Excavating and Backfilling:	Section 31 23 38.

4. UTILITY SERVICE CONNECTIONS

.1 Refer to Division 01 for requirements pertaining to utility service connections.

5. MATERIALS

.1 Materials and equipment installed shall be new, full weight and of quality specified. Use same brand or manufacturer for each specific application.

.2 Statically and dynamically balance rotating equipment for minimum vibration and low operating noise level.

.3 Each major component of equipment shall bear manufacturer's name, address, catalog and serial number in a conspicuous place.

6. METRIC CONVERSION

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

.2 Submit all shop drawings and maintenance manuals in SI units.

.3 On all submittals (shop drawings etc.) use the **same** SI units as stated in the specification.

7. CUTTING AND PATCHING

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

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

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

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

.5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

8. SHOP DRAWINGS

.1 Comply with requirements of Division 01.

.2 Provide shop drawings as indicated.

.3 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalog material. Do not assume applicable catalogues are available in the Minister's office. Maintenance and operating manuals are not suitable submittal material.

.4 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.

.5 Include dimensional and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes.

.6 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by Minister.

.7 Shop drawings not requested will not be reviewed and processed by the Minister.

.8 Do not order equipment or material until Minister has reviewed and returned shop drawing.

9. PRODUCTS OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

10. PERFORMANCE VERIFICATION OF INSTALLED EQUIPMENT

.1 Installed mechanical equipment whose performance is questioned by Minister, may be subject to performance verification as specified herein.

.2 When performance verification is requested, equipment shall be tested to determine compliance with specified performance requirements.

.3 Minister will determine by whom testing shall be carried out. When requested, arrange for services of an independent testing agency.

.4 Testing procedures shall be approved by Minister.

.5 Maintain building comfort conditions when equipment is removed from service for testing purposes.

.6 Promptly provide Minister with all test reports.

.7 Should test results reveal that originally installed equipment meets specified performance requirements, Minister will pay all costs resulting from performance verification procedure.

.8 Should test results reveal that equipment does **not** meet specified performance requirements, equipment will be rejected and the following shall apply:

.1 Remove rejected equipment. Replace with equipment which meets requirements of Contract Documents including specified performance requirements.

.2 Replacement equipment will be subject to performance verification as well, using same testing procedures on originally installed equipment.

.3 Contractor shall pay all costs resulting from performance verification procedure.

11. PROJECT RECORD DRAWINGS

.1 Submit record drawings identifying location of fire dampers, major control lines, EMCS sensors, access doors, tagged valves and actual room names or numbers.

12. TEMPORARY HEAT

.1 Do not use the permanent system for temporary heating purposes without written permission from the Minister.

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

.3 Use of permanent systems for temporary heat shall not modify terms of warranty.

.4 Operate heating systems under conditions which ensure no temporary or permanent damage. Operate fans at proper resistance with filters installed. Change filters at regular intervals. Operate with proper safety devices and controls installed and fully operational. Operate systems only with treated water as specified.

.5 Where air systems are used during temporary heating, provide filter media on return and exhaust air outlets. Clean duct systems which have become dirty.

.6 When permanent systems are used for temporary heat, provide alarm indicating system failure.

.7 Where pumps are used for temporary heating, replace mechanical seals, regardless of condition, with **new** mechanical seals.

13. EQUIPMENT PROTECTION AND CLEAN-UP

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

.2 Protect equipment with polyethylene covers and crates.

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

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

.5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.6 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

14. TEMPORARY OR TRIAL USAGE

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

.2 Repair or replace permanent equipment used temporarily.

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

15. SITE UTILITY SERVICES

.1 Maintain liaison with the Minister to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

.2 Avoid thermal shock to heating system by co-ordination with the Minister during planning, construction and operation of temporary heating system.

.3 Obtain approval from the Minister for thermal insulation work and automatic control equipment associated with temporary heating system. Have temporary heating system approved by authority having jurisdiction.

16. ELECTRICAL MOTORS

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide motors to CEMA and CSA standards for hard, continuous service, designed to limit temperature rise to 40°C for open housing and 50°C for drip proof housing, and operate at 1200 or 1800 r/min unless otherwise specified.

.3 Motors shall have ball or roller type bearings.

.4 Provide grease lubrication fittings on motors with frame sizes 254T and larger.

.5 Refer to electrical specification for voltage, phase and cycle.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Spare Parts and Maintenance Materials: Division 01.

1.2 REFERENCE DOCUMENTS

.1 National Fire Protection Association (NFPA):

.1 NFPA13-2010 Installation of Sprinkler Systems

2. Products

2.1 SPARE PARTS AND MAINTENANCE MATERIALS SCHEDULE

Item	Quantity
Chemical Treatment Supplies:	
Bypass filter - string wound filter media for hydronic and glycol systems:	30 for each size per system
Chemical treatment for: - Hydronic systems.	Amount equal to 50% of initial fill charge for each system. Amount equal to 100% of initial fill charge for each system
Glycol for glycol systems:	Amount equal to 10% of initial fill charge
Sprinklers:	
Sprinkler heads:	As Per NFPA 13, of each type

Continued next page

2.1 SPARE PARTS AND MAINTENANCE MATERIALS SCHEDULE (Cont'd)

Item	Quantity
Pump Seals:	one for each pump type and size
Air Filters:	
Air system - complete replacement set of air filters	One for each system
Valves:	
Washers:	Six for each valve size and type
Seats:	Six for each valve size and type
Belt Driven Equipment:	
Belts:	[One] [ ] set of belts for each drive type and size

2.2 EQUIPMENT AND TOOLS

.1 Unless specified otherwise, provide one of each of the following equipment and tools to facilitate proper operation and maintenance of mechanical equipment and systems:

.1 Portable Circuit Balancing Valve Meter: one meter as specified in Section 20 05 23 to suit circuit balancing valves installed.

.2 Portable Pitot-Tube Meter: one meter as specified in Section 20 05 19.

.3 Five hand wheels for balancing valves.

.4 Keys for non-freeze hose bibbs. Provide one key for each hose bibb.

.6 Five keys for air vents and drain cocks.

.7 Five keys for each different controls cabinet lock.

.8 Gas cock wrenches. Provide one wrench for every four gas cocks of each size.

.9 Sprinkler cabinet to store sprinkler heads.

.10 Sprinkler head wrench. Provide one wrench for each head type.

.11 One thermostat adjustment kit.

.13 One of each type of thermometer and pressure gauge for use with Pete's Plugs.

3. Execution

3.1 DELIVERY

.1 Deliver spare parts and maintenance materials to project site or other location designated by Minister.

END OF SECTION

1. INTENT

.1 Contractor shall obtain all specified operation and maintenance data. Using this data, Contractor shall prepare and submit operation and maintenance manuals as specified.

2. RELATED REQUIREMENTS

.1 Comply with requirements of Operation and Maintenance Data and Manual requirements specified in Division 01.

3. FORMS

.1 Following forms are appended hereto and form part of this Section:

.1 20 01 06.01 Operation and Maintenance Manual - Controls Section Outline.
.2 20 01 06.02 Point Mnemonic Descriptions

4. MANUAL DIVISIONS

.1 Organize manual into following divisions:

.1 Operations Division
.2 Maintenance Division
.3 Contract Documentation Division
.4 Standards Division

.2 Provide master divider tab and index for each division.

5. OPERATIONS DIVISION - MECHANICAL SYSTEMS

.1 Organize all data into sections according to system category, with divider tabs, as follows:

.1 AIR - Air Systems
.2 CTL - Control Systems
.3 CLG - Cooling Systems
.4 FPN - Fire Protection Systems
.5 HTG - Heating Systems
.6 MIS - Miscellaneous Systems
.7 PLG - Plumbing Systems

.2 Organize data for each system category (section) into individual systems (subsections). Provide an index for each system category and a divider tab for each individual system.

.3 For each individual system, except Controls System, include following data.

.1 System Description: provide details of system type, composition, areas served, location in building, design criteria and function of major components. All equipment arranged to operate together as one system shall be considered part of that system description. Design criteria shall, at minimum, include following:

.1 Occupied space conditions.
.2 Outdoor ambient conditions.
.3 Air circulation rate.
.4 Exhaust air rate.
.5 Minimum outside air.
.6 Building pressurization.
.7 Future load allowances.
.8 Standby capabilities.
.9 Calculated load and design capacity of domestic water supply mains.
.10 Calculated load and design capacity of drainage mains.

.2 System Schematic: provide a system schematic showing all components comprising central system. Identify each component using its EMCS mnemonic and generic name designation. Use this mnemonic in all references to equipment throughout manual.

.3 Operating Instructions: provide, in "operator" layman language, specific instructions for start-up, shutdown and seasonal change over of each system component. Include following:

.1 Exact type and specific location of each switch and device to be used in system operation.

.2 Identify safety devices and interlocks that must be satisfied in order for equipment to start.

.3 List conditions to be fulfilled before attempting equipment start up, i.e. valves position correct, glycol mixture concentration proper, piping filled with fluid, filters/strainers in place, etc.

6. OPERATIONS DIVISION - CONTROLS SYSTEM HARDWARE

.1 Organize Controls System section of Operations Division according to Detail 20 01 06.01 - "Operation and Maintenance Manual - Controls Section Outline".

.2 EMCS Hardware:

.1 System Description
.2 System Schematic
.3 Operating Instructions

.3 Complete EMCS Hardware subsections according to general format and contents outlined in “Operations Division - Mechanical Systems”.

7. OPERATIONS DIVISION - CONTROLS SYSTEM SOFTWARE

.1 System Introduction:

.1 Provide a brief description of overall control philosophy.

.2 Describe hardware interlocks with other equipment that may affect or override action of software control modules.

.3 Describe procedure for operating staff to interface with software control modules to override system or component operation, to adjust system or building control set points, etc. Name virtual points provided in software for this purpose and recommend adjustment increments and limits where applicable.

.2 System Schematic: provide a labeled schematic indicating locations, point mnemonics, and proper names of physical control points in system. Include RCU panel wiring diagrams with field point termination addresses. Good quality shop drawings may be used for this purpose.

.3 Software Modules:

.1 For each module provide a description of purpose and logic of module.

.2 Provide a description of each software Input and Output Variable on "Form 20 01 06.02-Point Mnemonic Descriptions".

.3 Provide a hard copy listing of software module.

8. MAINTENANCE DIVISION

.1 Summarize data for this section from Supplier and Sub-trade maintenance submissions, supplemented by appropriate additional data.

.2 Organize data into sections, with divider tabs as follows:

.1 Maintenance Tasks and Schedules
.2 Spare Parts
.3 Suppliers and Contractors
.4 Tags and Directories

.3 Maintenance Tasks and Schedules: organize data according to system category, with further breakdown into individual systems as used in operations division of the manual. Provide section index and divider tabs for each system category. Summarize maintenance tasks from manufacturers maintenance brochures, for each component of each system in following format:

.1 Daily
.2 Weekly
.3 Monthly
.4 Semi-annually
.5 Annually
.6 When required

.4 Spare Parts List: organize data according to system category, with further breakdown into individual systems as used in operations division of manual. Provide section index and divider tabs for each system category. Summarize from manufacturers maintenance brochures recommended spare parts for each component of each system.

.5 Suppliers and Contractors List: provide summary of Suppliers and Contractors for each component of each system. List Company name, address and telephone number of each.

.6 Tags and Directories: provide a copy of tag and other directories.

9. CONTRACT DOCUMENTATION DIVISION

.1 Organize operation and maintenance data into sections, with divider tabs, as follows:

.1 Drawings List
.2 Shop Drawings and Product Data
.3 Certifications
.4 Warranties and Bonds
.5 Maintenance Brochures
.6 Reports

.2 Drawings List: provide a list of all drawings used in performance of the construction contract.

.3 Shop Drawings and Product Data: provide final copies of all shop drawings and product data. Include section index and divider tabs. Maximum of twenty-five sheets or one shop drawing per tab.

.4 Certifications by Contractor: provide copies of Contractor certifications for performance of products and systems, and test reports verifying performance of products and systems. Include section index and divider tabs with maximum of twenty-five sheets or one report per tab.

.5 Certifications by Inspection Agency: collect and include copies of following inspection certification reports:

.1 Plumbing and Gas Standards
.2 Building Standards and Fire Prevention
.3 Boilers and Pressure Vessel Standards
.4 Utility Company
.5 Other Reports Required by Authorities

.6 Warranties and Bonds: include one copy each of the Contractor's warranty, Manufacturers' warranties longer than one year, the bond, and any service contract provided by the Contractor. Provide section index.

.7 Maintenance Brochures: include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment or system. Provide section index and divider tabs. Maximum of twenty-five sheets or one brochure per tab.

.8 Field Reports: collect and include field reports. Include section index and divider tab for each report:

.1 Valve tag directory specified in Section 22 05 53.

.2 Hydronic systems pipe pressure test certificates specified in Section 23 08 43.

.3 Chemical treatment and cleaning reports specified in Sections 23 25 02, 23 25 13 and 23 25 26.

.4 Start-up and testing reports specified in Sections 23 08 13, 23 08 23, 23 08 33 and 23 08 95.

.5 Manufacturer's start-up reports specified in Section 23 08 23.

.6 Acoustic reports specified in Section 23 08 83.

.7 Testing, Balancing and Adjusting reports specified in Section 23 08 83.

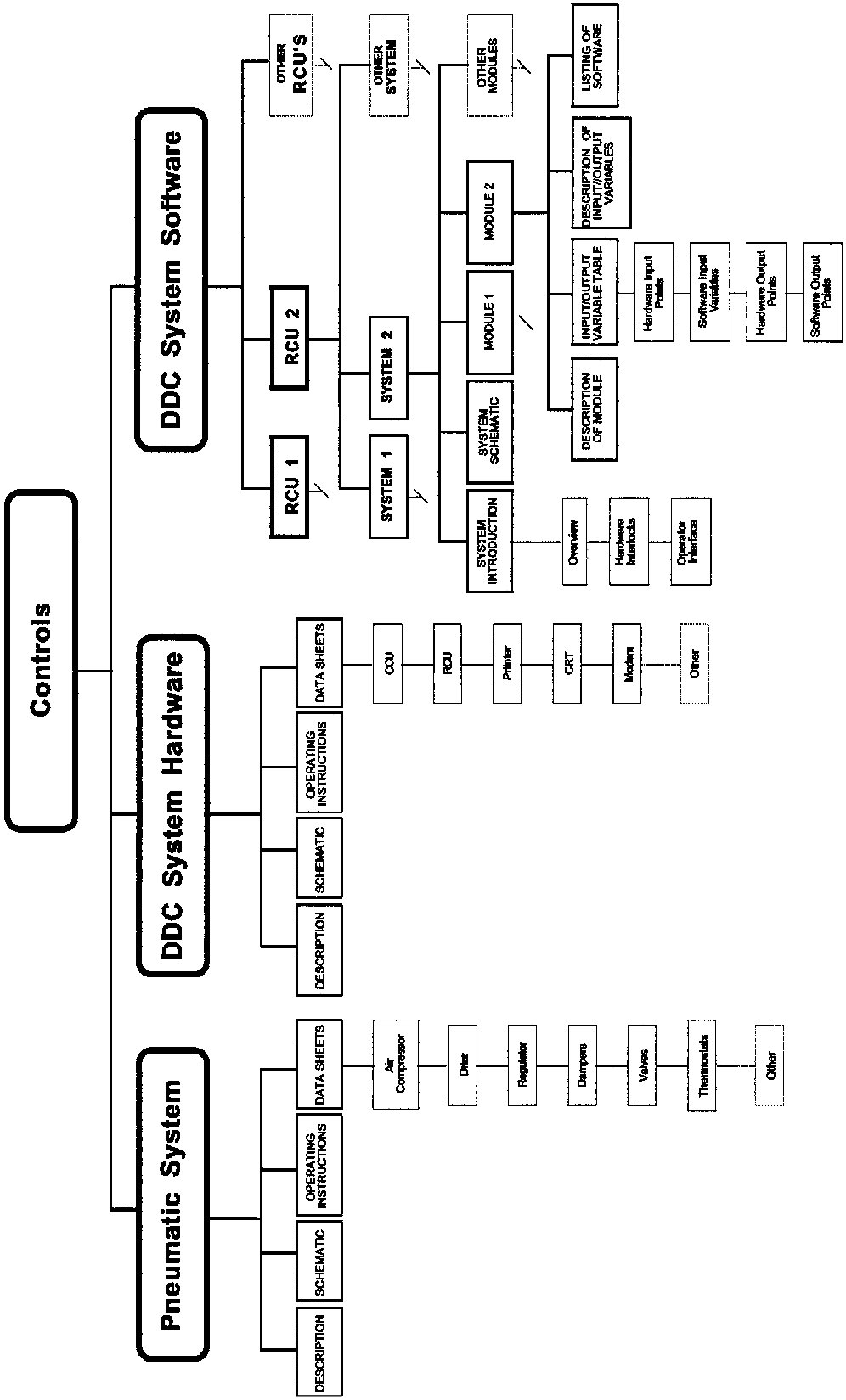
.8 EMCS physical point confirmation and calibration reports specified in Section 23 08 95.

.9 EMCS software verification report specified in Section 23 09 93.

10. STANDARDS DIVISION

.1 Allow 25mm binder space for standards. The Minister will supply and insert these standards in operation and maintenance manual.

END OF SECTION


Controls
DDC System Software
RCU 1
RCU 2
OTHER RCU'S
SYSTEM 1
SYSTEM 2
OTHER SYSTEM
SYSTEM INTRODUCTION
SYSTEM SCHEMATIC
MODULE 1
MODULE 2
OTHER MODULES
Overview
Hardware Interlocks
Operator Interface
DESCRIPTION OF MODULE
INPUT/OUTPUT VARIABLE TABLE
DESCRIPTION OF INPUT/OUTPUT VARIABLES
LISTING OF SOFTWARE
Hardware Input Points
Software Input Variables
Hardware Output Points
Software Output Points
DDC System Hardware
DESCRIPTION
SCHEMATIC
OPERATING INSTRUCTIONS
DATA SHEETS
CCU
RCU
Printer
CRT
Modem
Other
Pneumatic System
DESCRIPTION
SCHEMATIC
OPERATING INSTRUCTIONS
DATA SHEETS
Air Compressor
Drier
Regulator
Dampers
Valves
Thermostats
Other

RCU Number: _____ **System:** _____ **Mnemonic:** _____

Software Module: _____

Point Name (MNEMONIC)	**Description of Point**

Building Name and Location	Date	Sheet No

1. General

1.1 RELATED SECTIONS

.1 Mechanical General Requirements: Section 20 00 13.
.2 Spare Parts and Maintenance Materials: Section 20 00 23.

1.2 REFERENCE DOCUMENTS

.1 American Society of Mechanical Engineers (ASME):

.1 ASME Fluid Meter's Handbook: Their Theory and Application, Sixth Edition 1971.

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

.3 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 00 13 – Mechanical General Requirements

.1 Submit copies of manufacturer's product literature, specifications and datasheets.
.2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Provide a schedule, listing service, size, location, meter, tag no., and design flow rate.
.2 Submit shop drawings stamped and signed by a professional engineer registered or licensed in the Province of Alberta, Canada.

.3 Submit the following quality assurance submittals in accordance with Section 20 00 13 – Mechanical General Requirements:

.1 Certificates signed by manufacturer certifying that materials comply with specified characteristics and physical properties.

.2 Instructions:
.1 Manufacturer's installation instructions.
.2 Systems supplier's installation instructions.

.4 Closeout Submittals:

.1 Submit maintenance data including monitoring requirements for incorporation into manuals specified in Section 20 01 06 – Mechanical Operation and Maintenance Manual.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 POSITIVE DISPLACEMENT FLUID METERS

.1 Positive displacement fluid meters:

.1 Type: designed to be used with the fluid being metered.

.2 Case: bronze construction with cast iron [frostproof, breakaway] bottom cap.

.3 Register: hermetically sealed.

2.2 USER UTILITY METER

.1 Meter of same type and manufacture as utility company's meter.

3. Execution

3.1 INSTALLATION

.1 Install positive displacement fluid meters with isolating valves and unions.

3.2 METER SCHEDULE

.1 Positive Displacement Fluid Meter:

.1 Provide positive displacement meters in the following systems at locations indicated on the drawings:

.1 Domestic cold water.
.2 Expansion tank make-up.
.3 Natural gas.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Mechanical General Requirements: Section 20 00 13.

1.2 REFERNCE DOCUMENTS

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

.1	ASTM A126-04	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
.2	ASTM B21/B21M-06	Standard Specification for Naval Brass Rod, Bar, and Shapes
.3	ASTM B61-08	Standard Specification for Steam ir Valve Bronze Castings
.4	ASTM B62-09	Standard Specification for Composition Bronze or Ounce Metal Castings
.5	ASTM B98/B98M-08	Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes
.6	ASTM B139/B139M-07	Standard Specification for Phosphor Bronze Rod, Bar, and Shapes

.2 Canadian Standards Association (CSA):

.1	CSA B149.1-05	Natural Gas and Propane Installation Code
.2	CSA B139-09	Installation Code for Oil Burning Equipment
.3	CSA Z305.1-1992 (R2001)	Non-Flammable Medical Gas Piping Systems
.4		National Plumbing Code 2005

.3 National Fire Protection Association (NFPA):

.1	NFPA 13-2010	Standard for the Installation of Sprinkler Systems
.2	NFPA 14-2007	Standard for the Installation of Standpipe Systems

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 VALVE SIZES

.1 Valves sizes are specified in preferred metric sizes.

1.5 ABBREVIATIONS

.1 OS&Y: Outside Screw and Yoke.

1.6 SOURCE OF SUPPLY

.1 Valves of same type shall be by a single manufacturer.

1.7 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Submit valve schedule before ordering.

.2 Submit shop drawings stamped and signed by a professional engineer registered or licensed in the Province of Alberta, Canada.

1.8 IDENTIFICATION

.1 Valves shall bear the following information permanently marked on valve body:

.1 Manufacturer's name or trademark.
.2 Pressure rating.
.3 Flow direction.

2. Products

2.1 GATE VALVES

.1 Isolating Services 50 mm or smaller:

.1 Body and Trim: bronze with wedge guide.
.2 Stem: rising, bronze.
.3 Connection: soldered or screwed ends.
.4 Wedge: solid wedge.

.2 Isolating Service 65 mm and larger:

.1 Body: cast iron with wedge guide.
.2 Trim: bronze.
.3 Stem: rising OS&Y.
.4 Connection: flanged ends.
.5 Wedge: solid wedge, bronze.

2.2 GLOBE AND ANGLE GLOBE VALVES

.1 Throttling Service and Steam Services 50 mm and smaller:

.1 Body: bronze with union bonnet.
.2 Stem: rising.
.3 Disc and Seat Ring: stainless steel.
.4 Connections: soldered or screwed ends.

.2 Isolating Service 50 mm and smaller:

.1 Body: bronze with union bonnet.
.2 Stem: rising.
.3 Disc: renewable composition.
.4 Connection: soldered or screwed ends.

.3 Isolating Service 65 mm and larger:

.1 Body: cast iron body.
.2 Trim: bronze.
.3 Stem: rising OS&Y.
.4 Disc: bronze or cast iron bevelled.
.5 Connection: flanged ends.

2.3 BALL VALVES

.1 Isolating Service or Throttling Service, 50 mm or smaller:

.1 Body and Trim: bronze.
.2 Stem: brass.
.3 Connection: screwed ends.
.4 Seats: buna up to 90°C, Viton up to 150°C.
.5 Ball: brass chrome plated.

2.4 CHECK VALVES

.1 Swing Check Valve 50 mm and smaller:

.1 Body: bronze Y pattern.
.2 Trim: bronze.
.3 Disc: swing.
.4 Connection: screwed or soldered.

.2 Swing Check Valve 65 mm and larger:

.1 Body: iron Y pattern.
.2 Trim: bronze.
.3 Disc and Seat: renewable.
.4 Connection: flanged ends.

.3 Wafer Check Valve 65 mm and larger:

.1 Body: cast iron.
.2 Trim: bronze.
.3 Connection: threaded lugs.

.4 Lift Check Valve 65 mm and larger:

.1 Body: cast iron.
.2 Trim: bronze.
.3 Connection: flanged ends.
.4 Use: vertical piping.

2.5 SPRING LOADED CHECK VALVES

.1 50 mm and smaller:

.1 Body: bronze.
.2 Stem: brass.
.3 Spring: beryllium copper.
.4 Disc and Seat: teflon.
.5 Connection: screwed.

.2 65 mm and larger:

.1 Body: cast iron.
.2 Seat: bronze.
.3 Plug: bronze.
.4 Spring: stainless steel.
.5 Connection: flanged.

2.6 RADIATION VALVES

.1 Isolation or throttling service, 30 mm and smaller:

.1 Body: bronze, globe type.
.2 Stem: inside screw.
.3 Disc: renewable composition.
.4 Connection: threaded or union ends.

2.7 CIRCUIT BALANCING VALVES

.1 Body Design: suitable for throttling.

.2 Construction: all metal parts non-ferrous, pressure die cast, non-porous copper alloy.

.3 Installation: designed to be installed in any direction without affecting flow measurement.

.4 Functions:

.1 Precise flow measurement ±2%.
.2 Precision flow balancing.
.3 Positive shut-off with no drip seat and teflon disc.
.4 Drain connections with protective cap.

.5 Balancing Connection: "hidden memory" feature to program valve with precision tamper-proof balancing setting.

.6 Meter Connection: fittings for connecting a portable differential pressure meter and positive shut-off cocks for each meter connection.

.7 Portable Circuit Balancing Valve Meter:

.1 Direct differential pressure diaphragm type.
.2 Service temperature rating of 108° C.
.3 Service pressure rating of 2758 kPa.
.4 Hoses with quick connect fittings.
.5 Calibration chart and instructions.
.6 Carrying case.
.7 Quantity specified in Section 20 00 23.

2.8 HOSE BIBBS

.1 Standard Type Hose Bibbs:

.1 Body: bronze or red brass.
.2 Disc: replaceable hexagonal.
.3 Spout: with hose thread.
.4 Finish: chrome plated on exposed surfaces.

.2 Non-Freeze Type Hose Bibbs:

.1 Body: bronze.
.2 Disc: replaceable.
.3 Spout: with hose thread.
.4 Finish: polished bronze.
.5 Style: recessed box and removable key.

2.9 PLUG COCKS

.1 50 mm and smaller:

.1 Body: cast iron.
.2 Plugs and Washers: brass.
.3 Connection: screwed ends.

.2 65 mm and larger:

.1 Body: cast iron.
.2 Plug: cast iron.
.3 Lubrication: pressure lubricated.
.4 Connection: flanged ends.

2.10 DRAIN VALVES

.1 Globe Type Drain Valves:

.1 Body: bronze.
.2 Disc: compression stop.
.3 Ends: nipple and cap or hose.

.2 Ball Type Drain Valves:

.1 Body: bronze.
.2 Ends: cap and chain.

3. Execution

3.1 INSTALLATION

.1 Install valves with stems in upright or horizontal position. Do not install stems in inverted position.

3.2 VALVE OPERATORS

.1 Provide suitable die-cast handwheels for gate, globe, radiation, drain valves and inside hose bibbs.

.2 Supply one plug cock wrench for every ten plug cocks 50 mm and smaller, supply wrench and set screws with each plug cock 65 mm and larger.

3.3 VALVE SCHEDULE

.1 Provide valves as indicated on drawings and following schedule:

.1 Gate Valves:

.1 Shut-off.
.2 Isolating Service - Isolate equipment and vertical risers.
.3 Branch take-offs.

.2 Globe and Angle Globe Valves:

.1 Throttling service.
.2 Control device.
.3 Meter bypass.

.3 Ball and Quick Opening Valves:

.1 Interchangeable with gate and globe valves.
.2 Low water cut-offs.
.3 Boiler drains.
.4 Chemical pot feeders.

.4 Swing Check Valves:

.1 Discharge or pumps.
.2 Backflow prevention.

.6 Spring Loaded Check Valves:

.1 Discharge of condenser water pumps.
.2 Water booster pumps.
.3 Condensate pumps.

.7 Radiation Valves and Ball Valves:

.1 Heating/cooling coils.
.2 Isolation of unit heaters and force flows.

.8 Circuit Balancing Valves:

.1 Boiler discharge.
.2 Heat exchangers.
.3 Pumps discharge.
.4 Heating/cooling coils.
.5 Branch pipe take-offs from main and sub-mains.

.9 Hose Bibbs:

.1 Shut off valve for water service.

.10 Non-Lubricated Plug Cocks:

.1 Gas service.
.2 Balancing service where shut-off or isolating valve is also provided.

.11 Lubricated Plug Cocks:

.1 Water system for throttling service.

.12 Drain Valves:

.1 Near main shut-off valves.
.2 Low points in piping systems.
.3 Bases or vertical risers.
.4 At equipment.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Mechanical General Requirements: Section 20 00 13.

1.2 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.3 REFERNCE DOCUMENTS

.2 Canadian Standards Association (CSA):

.1	CGSB 14-GP-2a	Thermometers: Liquid-in-Glass, Self-indicating, 5-inch Nominal Scale Length
.2	CAN/CGSB 14.5-M88	Thermometers, Bimetallic, Self-indicating, Commercial Type

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Comply with requirements of Section 20 00 13.

.2 Submit product data for each type of pressure gauge or thermometer indicating operating range, total range, accuracy, repeatability, size and style.

.3 Submit schedule of gauges and thermometers listing service, size, location, tag no., design operating parameters.

2. Products

2.1 PRESSURE GAUGES

.1 Positive Pressure Gauge:

.1 Type: pressure type.

.2 Accuracy: accurate within ±1%.

.3 Gauge Size: 110 mm diameter.

.4 Case Material: steel, protected against corrosion and painted black.

.5 Crystal: shatterproof glass.

.6 Mounting: stem mounting at bottom of case.

.7 Bourdon Tube Material: phosphor bronze.

.8 Dial Graduations: kPa.

.9 Scale Range:

.1 Hydronic Systems: 0-100 kPa
.2 Domestic Water Systems: 0-100 kPa
.3 Sprinkler Systems: 0-1000 kPa.

.10 Stop: bourdon tube and stop.

.11 Movement: stainless steel or non-ferrous metal.

.12 Calibrator: set screw.

.2 Compound Pressure Gauge:

.1 Type: compound pressure.

.2 Accuracy: accurate within ±1%.

.3 Gauge Size: 100 mm diameter.

.4 Case Material: steel, protected against corrosion and painted black.

.5 Crystal: shatterproof glass.

.6 Mounting: stem mounting at bottom of case.

.7 Bourdon Tube Material: phosphor bronze.

.8 Dial Graduations:

.1 Vacuum: Pa.
.2 Pressure: kPa.

.9 Scale Range:

.1 Hydronic Systems:

.1 Vacuum: 0-100 kPa.
.2 Pressure: 0-1000 kPa.

.2 Domestic Water Systems:

.1 Vacuum: 0-100 kPa.
.2 Pressure: 0-700 kPa.

.3 Sprinkler Systems:

.1 Vacuum: 0-100 kPa.
.2 Pressure: 0-1000 kPa.

.10 Stop: bourdon tube and stop.

.11 Movement: stainless steel or non-ferrous metal.

.12 Calibrator: set screw.

.3 Air System Static Pressure Gauge:

.1 Type: pressure type.

.2 Accuracy: within ±1%.

.3 Gauge Size: 110 mm diameter.

.4 Case Material: aluminum alloy.

.5 Crystal: shatterproof glass.

.6 Mounting: stem mounting at back of case.

.7 Actuator: diaphragm actuated.

.8 Dial Graduations: Pa.

.9 Scale Range: 0-2000 Pa.

.10 Stop: movement stop.

.4 Filter Differential Pressure Gauges: incline tube manometer with tubing, static pressure tips and mounting assembly for differential pressure measure mounts.

2.2 THERMOMETERS

.1 Stem Type Thermometer: to CGSB 14-GP-2a and as follows:

.1 Type: Type C - any angle, adjustable.

.2 Class: Class 2 - fixed calibration.

.3 Case Material: steel, protected against corrosion and painted black.

.4 Crystal: shatterproof glass.

.5 Case Length: 225 mm.

.6 Capillary Tube: filled with red mercury.

.7 Graduations: °C.

.8 Scale Range:

.1 Hot Water Heating: 0 - 110°C.
.2 Domestic Hot Water: 0-110°C.
.3 Domestic Cold Water: 0-50°C.

.2 Dial Type Thermometer: to CAN/CGSB-14.5-M88 and as follows:

.1 Type: Type B - back connected.

.2 Class: Class 1 - adjustable calibration.

.3 Stem Length: 300 mm.

.4 Dial Graduations: °C.

.5 Dial Size: 75 mm diameter.

.6 Scale Range:

.1 Mixed Air Plenum: -40°C to 40°C.
.2 Outside Air Plenum: -40°C to 40°C.
.3 Other: 0°C to 100°C.

.3 Thermometer Wells: to CAN/CGSB 14.5-M88 and as follows:

.1 Construction: one piece brass construction.

.2 Diameter: 6 mm.

.3 Depth: to suit thermometer stem.

2.3 PRESSURE/TEMPERATURE TAPS

.1 Fitting to allow a 3 mm O.D. plug-in gauge to measure temperature or pressure.

.1 Maximum pressure: 3450 kPa.

.2 Maximum temperature: 135°C.

.2 Fitting constructed of:

.1 13 mm NPT brass body with hex head screw cap.

.2 Two self-closing valves constructed of nordel.

.3 Test kit including the following:

.1 One 65 mm diameter compound pressure gauge with 3 mm O.D. plug-in stem.

.2 One 125 mm diameter temperature gauge with 3 mm O.D. plug-in stem, range 0-110°C.

.3 One 125 mm diameter temperature gauge with 3 mm O.D. plug-in stem, range 0-50°C.

3. Execution

3.1 INSTALLATION

.1 Provide one compound pressure gauge per pump. Install taps on pump suction, pump discharge and before strainer. Pipe to gauge with needle valve on each tap.

.2 For gauges on liquid service, provide tee in piping with bronze pulsation damper and needle valve.

.3 For steam service, provide a pigtail siphon and needle valve.

3.2 PRESSURE/TEMPERATURE TAPS

.1 Install pressure/temperature taps into threaded pipe nipples welded to wall of pipe. Locate fittings in accessible spaces.

.2 Provide one pressure/temperature taps test kit.

.3 Install pressure/temperature taps in the following locations:

.1 Both sides of two-way control valves.
.2 All lines to three-way control valves.

.3 Major heating and cooling coils: at common inlet and at outlet of each coil.
.4 Heat exchanger: at inlet and outlet.
.5 Reheat coils: at inlet and outlet.

3.3 GAUGE SCHEDULE

.1 Provide pressure gauges, thermometers, pressure gauge taps and thermometer taps as indicated on the drawings and as specified in the following Schedule:

.1 Positive Pressure Gauges:

.1 Expansion tanks.
.2 Pressure tanks.
.3 Standpipe highest point.
.4 Standpipe and sprinkler water supply connection.
.5 Sprinkler system.
.6 Pressure reducing valves.
.7 Domestic water supply to building.

.2 Compound Pressure Gauges:

.1 Pumps.

.3 Air System Static Pressure Gauges:

.1 Medium and high pressure system.
.2 Supply fan discharge.

.4 Filter Differential Pressure Gauges:

.1 Built-up filter banks.

.5 Stem Type Thermometers:

.1 Headers to central equipment.
.2 Coil banks at inlet and outlet.
.3 Heat exchangers at inlet and outlet.
.4 Boilers at inlet and outlet.

.6 Dial Type Thermometers:

.1 After coils in air system.
.2 Each supply air zone.
.3 Outside air intake.
.4 Return air plenum.
.5 Mixed air plenum.

.7 Air System Static Pressure Taps:

.1 Inlet and discharge of supply and return fans.
.2 Inlet and discharge of coils.
.3 Inlet and discharge of silencers.
.4 Inlet and discharge of mixing chambers.
.5 Inlet and discharge of humidifier section.
.6 Inlet and discharge of heat recovery sections.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Mechanical General Requirements: Section 20 00 13.
.2 Vibration Isolation: Section 20 05 48.

1.2 REFERENCE DOCUMENTS

.1 American National Standards Institute (ANSI):

.1	ANSI/ASME B31.1-2004	Power Piping

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

.1	ASTM A653/A653M-09	Standard Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

.3 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-1.40-M89	Primer, Structural Steel, Oil Alkyd Type

.4 National Fire Protection Association (NFPA):

.1	NFPA 13-2010	Standard for the Installation of Sprinkler Systems
.2	NFPA 14-2007	Standard for the Installation of Standpipe Systems

.5 Duct hangers shall follow the recommendations of the SMACNA Duct Manuals.

1.3 GENERAL REQUIREMENTS

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

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

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

.4 Fasten hangers and supports to building steel or inserts in concrete construction.

.5 Provide and set sleeves required for equipment, including openings required for placing equipment.

.6 Dielectrically isolate dissimilar metals.

1.4 APPROVALS

.1 Obtain approval from the Minister prior to drilling for inserts and supports for piping systems.

.2 Obtain approval from the Minister prior to using percussion type fastenings.

.3 Use of existing piping or equipment for hanger supports is not permitted.

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

2. Products

2.1 INSERTS

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

.2 Size inserts to suit threaded hanger rods.

2.2 PIPE HANGERS AND SUPPORTS

.1 Hangers: Pipe sizes 15 mm to 40 mm: Adjustable wrought steel ring.

.2 Hangers: Pipe sizes 50 mm to 100 mm and Cold Pipe Sizes 150 mm Over: Adjustable wrought steel clevis.

.3 Hangers: Hot Pipe Sizes 150 mm and Over: Adjustable steel yoke and cast iron roll.

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

.5 Wall Support: Pipe Sizes to 80 mm: Cast iron hook.

.6 Wall Support: Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp, adjustable steel yoke and cast iron roll for hot pipe sizes 150 mm and over.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Pipe Sizes to 100 mm and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.

.9 Floor Support: Hot Pipe Sizes 150 mm and over: Adjustable cast iron roll and stand, steel screws and concrete pier or steel support.

.10 Design hangers so they cannot become disengaged by movements of supported pipe.

.11 Provide copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping.

.12 Insulate aluminum piping from dissimilar metal supports.

2.3 HANGER RODS

.1 Provide steel hanger rods, threaded both ends, threaded one end, or continuous threaded.

2.4 DUCT HANGERS AND SUPPORTS

.1 Hangers: Galvanized steel band iron or rolled angle and 10 mm rods.

.2 Wall Supports: Galvanized steel band iron or fabricated angle bracket.

.3 Vertical Support at Floor: Rolled angle.

2.5 FLASHING

.1 Steel Flashing: 0.55 mm galvanized steel.

.2 Lead Flashing: sheet lead, as follows:

.1 For Waterproofing: 25 kg/m^2.

.2 For Soundproofing: 5 kg/m^2.

.3 Lead Sheet Size:

.1 Roof Plumbing Vents: as required to provide base flashing overlap to ARCA detail.

.2 Floor Drains: minimum 920 x 920 mm and as specified.

.3 Other Locations: as specified.

.3 Safes: 25 kg/m^2 sheet lead or 200 micrometre neoprene.

.4 Caps: Steel, 0.70 mm thickness minimum, 1.6 mm thickness at fire resistance structures.

2.6 SLEEVES

.1 Pipes through Floors: Form with 1.2 mm galvanized steel.

.2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form with steel pipe or 1.2 mm thickness galvanized steel.

.3 Round Ducts: Form sleeves with galvanized steel.

.4 Rectangular Ducts: Form sleeves with galvanized steel or wood.

.5 Size large enough to allow for expansion with continuous insulation.

2.7 FINISHES ON HANGER RODS, HANGERS AND SUPPORTS

.1 All steel hanger rods, hangers and supports shall be galvanized or factory primed with alkyd red oxide primer to CAN/CGSB-1.40-M89.

3. Execution

3.1 INSERTS

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

.2 Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying piping over 100 mm or ducts over 1500 mm wide.

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

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

3.2 PIPE HANGERS AND SUPPORTS

.1 Support horizontal steel and copper piping as follows:

Nominal Pipe Size	Distance Between Supports	Hanger Rod Diameter
15 mm	1.8 m	10 mm
20 mm to 40 mm	1.8 m	10 mm
50 mm & 65 mm	3 m	10 mm
80 mm & 100 mm	3.6 m	16 mm
150 mm to 300 mm	4.3 m	22 mm
350 mm to 450 mm	6.1 m	25 mm

.2 Install hangers to provide minimum 12 mm clear space between finished covering and adjacent work.

.3 Place a hanger within 300 mm of each horizontal elbow.

.4 Use hangers which are vertically adjustable 40 mm minimum after piping is erected.

.5 Support horizontal soil pipe near each hub with 1.5 m maximum spacing between hangers.

.6 Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

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

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

3.3 LOW VELOCITY DUCT HANGERS AND SUPPORTS

.1 Hanger Minimum Sizes:

.1 Up to 750 mm wide: 25 x 1.6 mm at 3 m spacing.

.2 790 to 1200 mm wide: 40 x 1.6 mm at 3 m spacing.

.3 Over 1200 mm wide: 40 x 1.6 mm at 2.4 m spacing.

.2 Horizontal Duct on Wall Supports Minimum Sizes:

.1 Up to 450 mm wide: 40 x 1.6 mm or 25 x 25 x 3 mm at 2.4 m spacing.

.2 480 x 1000 mm wide: 40 x 40 x 3 mm at 1.2 m spacing.

.3 Vertical Duct on Wall Supports Minimum Sizes at 3.65 m spacing:

.1 Up to 610 mm wide: 40 x 1.6 mm.

.2 640 to 900 mm wide: 25 x 25 x 3 mm.

.3 Over 1520 mm wide: 50 x 3 mm.

.4 940 to 1200 mm wide: 30 x 30 x 3 mm.

.4 Vertical Duct Floor Supports Minimum Sizes, riveted or screwed to ducts:

.1 Up to 1520 mm wide: 40 x 40 x 3 mm.

.2 Over 1520 mm wide: 50 x 3 mm.

3.4 MEDIUM AND HIGH VELOCITY DUCT HANGERS AND SUPPORTS

.1 Hanger Minimum Sizes:

.1 Up to 900 mm wide: 2 at 25 x 1.6 mm at 3 m spacing.

.2 940 x 1520 mm wide: 2 at 25 x 1.6 mm at 2.4 m spacing and 50 x 50 x 6 mm trapeze.

.3 1550 x 3050 mm wide: 2 at 38 x 2.6 mm at 2.4 m spacing and 50 x 50 x 7 mm trapeze.

.4 3070 x 6700 mm wide: 3 at 10 mm diameter at 1.2 m spacing and 65 x 65 x 5 mm trapeze.

.2 Round Duct Hangers Minimum Sizes at 3 m spacings:

.1 Up to 460 mm diameter: 25 x 1.6 mm.

.2 480 to 900 mm diameter: 25 x 2.6 mm.

.3 940 to 1270 mm diameter: 40 x 2.6 mm.

.4 1300 to 2130 mm diameter: 2 at 40 x 2.6 mm from girth reinforcing angle.

.3 Vertical Duct Floor Supports Minimum Sizes:

.1 Up to 1220 mm wide: 40 x 40 x 3 mm.

.2 Over 1220 mm wide: 50 x 50 x 30 mm.

.3 Rivet to duct and tie angles together with rod, angles or band Iron.

.4 Angle reinforcing may be used for support omitting trapeze.

3.5 EQUIPMENT BASES AND SUPPORTS

.1 Provide for major equipment, reinforced concrete housekeeping bases poured directly on structural floor slab 100 mm thick minimum, extended 100 mm minimum beyond machinery bedplates. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.

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

.3 Rigidly anchor ducts and pipes immediately after vibration connections to equipment.

3.6 FLASHING

.1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.

.2 Flash vent and soil pipes projecting 75 mm minimum above roof membrane with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides. For pipes through outside walls turn flange back into wall and caulk.

.3 Flash floor drains over finished areas with lead minimum 250 mm clear on sides. Fasten flashing to drain clamp device.

.4 Provide curbs for mechanical roof installations, minimum 200 mm high.

.5 Attach counterflashings to mechanical equipment and lap base flashings on roof curbs.

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

.7 Screw vertical flange section of roof jacks to face of curb.

.8 Provide lead flashing around ducts and pipes passing from equipment rooms, installed according to manufacturer's data for sound control.

3.7 SLEEVES

.1 Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

.2 Extend sleeves through potentially wet floors 25 mm above finished floor level. Caulk sleeves full depth and provide floor plate.

.3 Where piping or ductwork passes through floor, ceiling or wall, close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

.4 Install chrome plated escutcheons where piping passes through finished surfaces.

END OF SECTION

1. General

1.1 SCOPE

.1 Identification for mechanical equipment, piping systems and related components.

1.2 RELATED REQUIREMENTS

.1 Submittals — Division 01

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	General Mechanical Provisions	Section 20 01 13
.2	Painting of Mechanical and Electrical Work	Section 09 91 30
.3	Pipe and Pipe Fittings	Section 20 20 10
.4	Piping and Equipment Insulation	Section 20 20 30
.5	Medical Gas Systems for Healthcare Facilities	Section 22 60 00
.6	Fire Suppression	Division 21
.7	Plumbing	Division 22
.8	Heating, Ventilation and Air Conditioning	Division 23

1.4 QUALITY CONTROL

.1 Coordinate painting of piping and equipment with work of Section 09 91 30.

.2 Colour Code mechanical equipment, piping and exposed ductwork. Refer to label identification schedules.

.3 Submit a schedule of pipe and equipment identification methods, materials and colours to the Minister's representative for review.

1.5 REFERENCE STANDARDS

.1 ASME A13.1 – Scheme for the Identification of Piping Systems.
.2 CAN/CGSB-24.3 – Identification of Piping Systems.
.3 CAN/CSA-B149.1 – Natural Gas Installation Code.
.4 Federal Standard 595C Colours.
.5 WHMIS Pictograms – Workplace Hazardous Materials Information System – GHS (Globally Harmonized System of Classification and Labelling Chemicals) – Pictograms.

2. Products

2.1 IDENTIFICATION LABELS

.1 Identification Labels for all mechanical piping and ductwork systems, to include:

.1 WHMIS Pictogram (as applicable), same colour as legend letters.
.2 A lettered legend on a coloured background, defining the contents in the pipe, its pressure and temperature and the information necessary to define the hazard.
.3 Arrows to define the direction of flow, same colour as legend letters.
.4 50 mm wide black tape at each end of the label, wrapped around the entire circumference of pipe/insulation to secure the Identification Labels.

.2 Identification Labels may be accomplished by paint, stenciling and/or factory fabricated labels. Labels shall cover full circumference of pipe or insulation.

2.2 LEGEND LETTERS AND NUMBERS

.1 Height of Legend Letters and Numbers;

Outside Diameter of Pipe or Covering (mm)	Height of Letters and Numbers (mm)	Length of Colour Field (mm)
19 to 32	13	200
38 to 51	19	200
64 to 150	32	300
200 to 250	64	600
Over 250	89	800

.2 Lettering and Direction of Flow Arrow:

.1 Lettering: Capital, Bold, Sans Serif, Century Gothic or Helvetica.

.2 For hazardous piping system: black letters and arrows.

.3 Fire protection, other piping systems and ductwork: white letters and arrows, unless otherwise specified.

2.3 VALVE TAGS, DIRECTORIES AND NAMEPLATES

.1 Valve tags: 40 mm diameter with 20 mm lettering: brass, lamicoid or metal photo black numbers, secured to valve stem with key chain.

.2 Valve Directories: laminated sheets and electronic copy. Include the following information for each tagged valve:

.1 Valve identified (valve number or logical point mnemonic).
.2 Location.
.3 Service.
.4 Make/model/size and CV for control valves.

.3 Engraved Plastic Nameplates: self-adhesive composite laminated plastic nameplates with one smooth white surface and core of black plastic designed to leave black lettering on a white background. Engraved lettering height as follows:

.1 All major equipment: 20 mm
.2 Air terminal boxes: 20 mm
.3 Magnetic contactors and VFDs: 20 mm
.4 All other: 8 mm

3. Execution

3.1 GENERAL

.1 Identify piping systems and ductwork systems with Identification Labels. Refer to Article 3.2 Identification Schedules.

.2 Identify the location of the following items of equipment which are concealed above a ceiling with Avery “Data Dots”. The colours shall conform to the following schedule:

HVAC Equipment and duct cleaning access	Yellow
HVAC valves and dampers	Blue
Plumbing equipment and valves	Green
Control dampers and sensors	Black
Fire, smoke, and sprinkler equipment	Red

When T-bar ceilings are installed, adhere “Data Dots” on T-bar framing adjacent to panel to be removed.

3.2 IDENTIFICATION SCHEDULES

.1 Colour numbers for Identification Labels on piping systems, valves and equipment are defined in Federal Standard 595C Colours for colour code identification.

- Black : 17038
- Yellow : 13591
- Green : 14193
- Orange : 12473
- Brown : 10115
- Red : 11350
- White : 17860
- Aluminum : 16515
- Blue : 15180
- Grey : 16293
- Light Blue : 15450
- Purple : 17155

.2 Pipe Identification Label Schedule:

Service	Background	Lettering	WHMIS Symbol	Legend
Sprinkler	Red	White	N/A	WET SPRINKLER
Natural Gas	Yellow	Black	Yes	*kPa NATURAL GAS
Domestic Cold Water	Light Blue	White	N/A	DOMESTIC COLD WATER
Domestic Hot Water	Light Blue	White	N/A	DOMESTIC HOT WATER
Domestic Hot Water Recirc.	Light Blue	White	N/A	DOMESTIC HOT WATER RECIRC.
Heating Hot Water Supply	Yellow	Black	N/A	*°C HOT WATER HEATING SUPPLY
Heating Hot Water Return	Yellow	Black	N/A	*°C HOT WATER HEATING RETURN
Heating Glycol Supply	Yellow	Black	Yes	*°C HEATING GLYCOL SUPPLY

Service	Background	Lettering	WHMIS Symbol	Legend
Heating Glycol Return	Yellow	Black	Yes	*°C HEATING GLYCOL RETURN
Drains	Aluminum	Green	N/A	DRAIN
Vent	Aluminum	Green	N/A	VENT
Blow Down	Aluminum	Green	N/A	HOT BLOW DOWN
Refrigerant -Liquid	Grey	White	Yes	REFRIGERANT -LIQUID
Refrigerant -Gas	Grey	White	Yes	REFRIGERANT - GAS

* Operating conditions as suitable.

.3 Mechanical Equipment Painting:

Heat Exchangers (hot) Yellow

.4 Ductwork:

Identify all ductwork with Identification Labels as follows, complete with directional arrows:

Service	Background	Legend	Lettering
Return Air	Blue	RETURN AIR	White
Supply Air	Blue	SUPPLY AIR	White
Mixed Air	Blue	MIXED AIR	White
Combustion Air	Blue	COMBUSTION AIR	White
Relief Air	Blue	RELIEF AIR	White
General Exhaust Air	Blue	GENERAL EXHAUST AIR	White
Toilet Exhaust	Blue	TOILET EXHAUST AIR	White

.5 Identify duct access panels with Identification Labels, conforming to the following schedule:

	Background	Lettering
Cleaning and service access	Yellow	Black
Controls, including heat sensors	Black	White
Dampers (backdraft, balance and control)	Blue	White
Fire dampers	Red	White
Smoke dampers and detectors	Red	White

.6 Equipment Bases/Housekeeping Pads:

Grey, with 100 mm yellow and black angled bands around edges.

.7 Buried Piping:

Utilize a detectable metallized ribbon laid 150 mm below ground level and above the buried pipe. Ribbon to display the same information as Identification Labels in intervals not exceeding 800 mm.

3.3 LOCATION OF LABELS

.1 Orient labels on piping systems in visual sight lines while standing at floor levels.

.2 Locate labels as follows:

.1 Upstream of valves.
.2 Adjacent to changes in direction.
.3 Branches.
.4 Where pipes pass through walls or floors.
.5 On straight pipe runs at 6 m intervals.
.6 For natural gas and propane piping systems, at 6 m intervals on straight pipe runs.
.7 Where system is installed in pipe chases, ceiling spaces, shafts, or similar confined spaces, at entry and exit points and at access openings
.8 At beginning and end points of each run and at each piece of equipment.

.3 Adhere labels to piping/insulation. Labels to cover entire pipe circumference. Secure both ends of labels with 50 m wide black tape around the entire pipe circumferences.

3.4 VISIBLE (EXPOSED) DUCTWORK

.1 Pain visible ductwork as directed by Architect. Refer to Section 09 91 30.

.2 Paint ductwork/flexible connectors that are visible behind grilles/diffusers, matt black. Refer to Section 09 91 30.

3.5 MECHANICAL CONTROL IDENTIFICATION

.1 Refer to Section 23 09 28, EMCS Fieldwork.

3.6 RECORD PROVISIONS

.1 Mark valve numbers on Red Line system schematic drawings for transfer onto record drawings. Include copies of Operation and Maintenance Manuals.

3.7 VALVE TAGS

.1 Tag pneumatic/electric controls, instruments and relays. Key to control schematics on which instruments are numbered in sequence.

.2 Tag all valves in mechanical rooms.

.3 Tag all control valves external to mechanical rooms. This includes control valves on radiant panels, perimeter radiation and air terminal boxes.

.4 Tag all circuit balancing and isolating valves external to mechanical rooms except valves at terminal heating and cooling equipment.

.5 Identify and tag pneumatic/electric thermostats relating to terminal unit and valve numbers.

3.8 VALVE DIRECTORIES

.1 Include laminated directories in operation and maintenance manuals. Also provide electronic copy in PDF, as well as spreadsheet user editable format.

3.9 NAMEPLATES

.1 Identify the following with engraved plastic nameplates:

.1 All mechanical equipment.
.2 Air terminal boxes, VFDs.
.3 Pneumatic/electric thermostats.
.4 Electric starting switches, electric disconnects, remote push buttons and control panels.

.2 All nameplates to be mechanically fastened, easily visible without need to use ladder or extraordinary body position. Affix additional nameplates if necessary.

.3 Provide the Minister with an example of the contents of each type of nameplate. Obtain approval prior to engraving.

END OF SECTION

1. General

1.1 REFERENCE STANDARD

.1 Provide and install mechanical equipment so that Average Noise Criteria Curves, as outlined in ASHRAE Guide, are not exceeded.

1.2 SUBMITTALS

.1 Provide vibration isolation shop drawings showing isolator locations, load on each isolator, inertia slab dimensions.

1.3 GENERAL REQUIREMENTS

.1 Supply vibration isolation equipment and materials by one supplier. Consider side loading of equipment and inertia bases when calculating maximum loads on isolators.

.2 Ensure equipment is sufficiently rigid for isolator point loading.

1.4 INSPECTION

.1 Provide inspection services by vibration isolation equipment and materials manufacturer's representative for final installation and provide written report that installation is in accordance with specifications and manufacturer's recommendations.

2. Products

2.1 INERTIA BASES

.1 Type A: Integral structural steel fan and motor base with motor slide rails.

.2 Type B: Slung structural steel base with gussetted brackets.

.3 Type C: Reinforced 20 MPa concrete base with full depth perimeter structural channel frame, with gussetted brackets and anchor bolts.

.4 Type D: Reinforced 20 MPa concrete base with chamfered edges without channel frame.

2.2 VIBRATION ISOLATORS

.1 Type 1: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

.2 Type 2: Open spring mount with iso-stiff springs (horizontal stiffness equal to vertical stiffness).

.3 Type 3: Open spring mount with iso-stiff springs, heavy mounting frame and limit stop.

.4 Type 4: Closed spring mount with iso-stiff springs and limit stop.

.5 Type 5: Closed spring hanger with acoustic washer.

.6 Type 6: Closed spring hanger with 25 mm thick acoustic isolator.

.7 Type 7: Elastomer mount with threaded insert and hold down holes.

.8 Type 8: Neoprene jacketed pre-compressed moulded fiberglass.

.9 Type 9: Rubber waffle pads, 30 durometer, minimum 12 mm thick, maximum loading 280 kPa. Use neoprene in oily locations or outdoors.

.10 Type 10: Rubber-steel-rubber pads, 12 mm thick rubber waffle pads bonded to 6 mm thick steel plate.

.11 Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.

.12 Colour code spring mounts, springs selected to operate at no greater than 2/3 solid deflection and have 6 mm ribbed neoprene pads.

3. Execution

3.1 APPLICATION

.1 Provide vibration isolators for mechanical motor driven equipment throughout, unless specifically noted otherwise.

3.2 INSTALLATION

.1 Set steel bases for 15 mm clearance between housekeeping pad and base. Set concrete inertia bases for 50 mm clearance. Adjust equipment level.

.2 Provide spring isolators on piping connected to isolated equipment as follows: up to 100 mm diameter, first 3 points of support; 125 mm to 200 mm diameter, first 4 points of support; 250 mm diameter and over, first 6 points of support. Static deflection of first point shall be twice deflection of isolated equipment.

3.3 PERFORMANCE

.1 Install inertia bases of type and thickness, and isolators of type and static deflection as indicated on Isolation Schedule.

3.4 ISOLATION SCHEDULE

Isolated Equipment	Base		Isolation	
	Type	Thickness	Type	Deflection
Vertical In-line pumps			9	2.5
Boilers			10	2.5
Base Mounted Centrifugal Fans			2	25

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1 Mechanical General Requirements: Section 20 00 13.
.2 Chemical Treatment and Cleaning - General Requirements: Section 23 25 01.

1.2 REFERENCE DOCUMENTS

.1 Underwriters Laboratories Canada (ULC):

.1	CAN/ULC-S602-07	Aboveground Tanks for Fuel Oil and Lubricating Oil
.2	CAN/ULC-S603-00	Steel Underground Tanks for Flammable and Combustible Liquids
.3	CAN/ULCS603.1-03	External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combutatible Liquids
.4	ULC-S615-98	Reinforced Plastic Underground Tanks for Flammable and Combustible Liquids

1.3 SHOP DRAWINGS

.1 Comply with requirements of Section 20 00 13.

1.4 CERTIFICATES

.1 Submit inspection certificate for tanks that require inspection under the Alberta Safety Codes Act, Design, Construction and Installation of Boilers and Pressure Vessels Regulations.

2. Products

2.1 PRESSURE VESSELS

.1 Fabricate pressure vessels to ASME Code for Unfired Pressure Vessels.

2.2 EXPANSION TANKS - BLADDER TYPE

.1 Body Construction: steel pressure vessel outer tank.

.2 Support: steel skirt for vertical floor support.

.3 Air Chamber: heavy duty butyl diaphragm bonded with polypropylene liner to steel shell, separating air chamber from water. Chamber precharged to insure that a positive pressure of at least 35 kPa gauge is maintained at top of the system.

.4 Fittings: air side charge connection; water side inlet connection.

2.3 GLYCOL FILL TANKS - ATMOSPHERIC VESSEL TYPE

.1 Body Construction: welded steel, atmospheric vessel.

.2 Coating: red zinc rich primer, outside only.

.3 Accessories: portable type manual gear pump.

2.4 DOMESTIC HOT WATER STORAGE TANKS

.1 Body Construction: closed type pressure vessel, welded steel.

.2 Coating: red zinc rich primer, inside and out.

.3 Support: steel support saddles.

.4 Lining: minimum 20 mm thick internal corrosive resistant concrete lining. Line tank and connections.

.5 Accessories:

.1 Thermometer: as specified in Section 20 20 25.

.2 Access manhole.

.3 Chlorine resistant stainless steel screwed fittings.

.6 Tappings: inlet, outlet, drain pressure relief valve, water make-up, spare.

3. Execution

3.1 DOMESTIC HOT WATER STORAGE TANKS

.1 Refer to Detail 20 15 00.03.

.2 Provide pressure relief valve; pipe discharge to drain. Set relief valve for tank rated pressure specified in schedule.

.3 Provide thermometer on inlet and discharge pipes.

.4 Provide valved tank drain; pipe to floor drain.

.5 Support tank on steel saddle directly to floor.

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 This Section includes requirements for pipe and pipe fittings for all mechanical services and systems, inside and outside building perimeter, except:

.1 Services and connections provided by a utility.
.2 Domestic water and sanitary sewer services from 1.5 m outside building perimeter to utility connection point.
.3 Sprinkler system.

1.2 RELATED REQUIREMENTS

.1 Mechanical General Requirements: Section 20 00 13.

1.3 RELATED SECTIONS

.1 Mechanical and Electrical Service Connections: Division 01.
.2 Sprinkler Pipe: Section 21 13 10.
.3 Piped Utilities: Division 33.

1.4 ALTERNATIVES

.1 Pipe and pipe fitting products are specified by system in Piping Schedule at end of this Section. Unless otherwise specified, where schedule specifies more than one type of material for a single system, select any one of the specified alternative materials.

1.5 REFERENCE DOCUMENTS

.1 American Society of Mechanical Engineers (ASME):

.1	ASME B16.18-2001	Cast Copper Alloy Solder Joint Pressure Fittings
.2	ANSI/ASME B16.22-2001	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
.3	ASME B16.3-2006	Malleable - Iron Threaded Fittings: Classes 150 and 300
.4	ASME B16.5-2009	Pipe Flanges and Flanged Fittings, NPS 1/2 Through NPS 24 – Metric/Inch Standard
.5	ASME B16.25-2007	Buttwelding Ends
.6	ASME B16.39-2009	Malleable Iron Threaded Pipe Unions Classes 150, 250 and 300
.7	ASME B31.1-2007	Power Piping
.8	ASME B31.3-2008	Process Piping
.9	ASME B31.5-2010	Refrigeration Piping and Heat Transfer Components

.10	ANSI/ASME B16.9-2007	Factory-Made Wrought Steel Buttwelding Fittings
.11	ASME Section IX	Welding and Brazing Qualifications

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

.1	ASTM A53/A53M-10	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
.2	ASTM A106/A106M-10	Seamless Carbon Steel Pipe for High-Temperature Service
.3	ASTM 214/A214M - 96(2005)	Electric Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
.4	ASTM B32-08	Solder Metal
.5	ASTM B88-09	Seamless Copper Water Tube
.6	ASTM B280-08	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
.7	ASTM B306-09	Copper Drainage Tube (DWV)
.8	ASTM B664-90(2006)	80% Silver - 20% Graphite Sliding Contact Material
.9	ASTM C564-09a	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
.10	ASTM D1002-10	Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
.11	ASTM D2235-04	Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
.12	ASTM D2464-06	Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
.13	ASTM D2564-04(2009)e1	Solvent Cements for Poly (Vinyl Chloride) PVC Plastic Piping Systems
.14	ASTM D3138-04	Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Non-Pressure Piping Components
.15	ASTM G17-07	Test Method for Penetration Resistance of Pipeline Coatings (Blunt Rod)

.3 Canadian Gas Association (CGA):

.1	CAN/CGA B149.1-05	Natural Gas and Propane Installation Code

.4 Canadian Standards Association (CSA):

.1	CSA B52-05	Mechanical Refrigeration Code

.2	CAN/CSA-B70-06	Cast Iron Soil Pipe, Fittings and Means of Joining
.3	CSA B139-09	Installation Code for Oil Burning Equipment
.4	CAN/CSA-B181.1-06	ABS Drain, Waste and Vent Pipe and Pipe Fittings (Published in CAN/CSA-B1800-06)
.5	CAN/CSA-B181.2-06	PVC Drain, Waste and Vent Pipe and Pipe Fittings (Published in CAN/CSA-B1800-06)

1.6 REFERENCES

.1 Fabricate systems in accordance with the following fabrication standards:

.1 Flanged, welded steel piping systems:

.1 Butt welded ends: to ASME B16.25.

.2 Steel pipe flanges: to ASME B16.5.

.2 Natural Gas and Propane:

.1 Natural gas and propane vapour phase, up to 70 kPa: to ASME B31.3

.2 Propane, liquid phase: to ASME B31.3.

1.7 WELDING QUALIFICATIONS

.1 Conform to ASME Section IX and Alberta Labour Regulations.

1.8 WELDING PROCEDURES

.1 Conform to ASME B31.1, ASME B16.25 and ASME Section IX.

1.9 CONTRACTOR'S QUALITY CONTROL

.1 Provide specified quality control for the following joint systems:

.1 Mechanically formed connections in copper pipe.

.2 Pressfitting system.

.3 Mechanical grooved coupling and fitting system.

.2 Arrange and pay for site services of joint system supplier or proponent to:

.1 Instruct on the correct use of the system.

.2 Inspect twelve random samples of installed joints.

.3 Submit a report describing findings of the inspection to the Minister.

1.10 COORDINATION

.1 Coordinate piping installation routes and elevations with installation of sprinkler, sheet metal and electrical work.

2. Products

2.1 STEEL PIPE SYSTEM COMPONENTS

.1 Pipe:

.1 Black Steel, Schedule 40: electric resistance welded, ASTM A53, Grade B.

.2 Black Steel, Schedule 80: electric resistance welded, ASTM A53, Grade B.

.3 Galvanized Steel, Schedule 40: electric resistance welded, ASTM A53, Grade B.

.2 Joint and Fitting Components:

.1 Threaded Fittings: malleable iron to ASME B16.3.

.2 Welded Fittings: wrought steel, butt welding type to ANSI/ASME B16.9.

.3 Mechanical Grooved Couplings: ductile or malleable iron housing, synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

.4 Mechanical Grooved Fittings: to ASTM A106M, steel fittings with grooves or shoulders designed to accept grooved end couplings.

2.2 PRESSFITTING PIPE SYSTEM COMPONENTS

.1 Pressfitting Pipe: mild steel, electric resistance welded precision thin walled tubing to ASTM A214M, suitable for working pressure of 1600 kPa at 100°C.

.2 Pressfitting Connection: mild steel fitting, rubber "O" ring seal, designed to provide a permanent fluid tight connection.

2.3 CAST IRON SOIL PIPE COMPONENTS

.1 Pipe: cast iron soil pipe to CAN/CSA-B70.

.2 Mechanical Joint Components: hubless fittings, elastomeric gaskets and stainless steel mechanical joint couplings to CAN/CSA-B70.

2.4 COPPER PIPE COMPONENTS

.1 Pipe:

.1 Copper Water Tube: to ASTM B88.
.2 ACR Copper Tube: to ASTM B280.
.3 DWV Copper Tube: to ASTM B306.

.2 Joint and Fitting Components:

.1 Wrought Copper Fittings: to ANSI/ASME B16.22.
.2 Cast Copper, Brass & Bronze Fittings: to ASME B16.18.
.3 Solder Joints: to ASTM B32.
.4 Brazed Joints: to ASTM B664.

2.5 ABS PIPE COMPONENTS

.1 Pipe: ABS Plastic Pipe: to CAN/CSA-B181.1.

.2 Joint and Fitting Components:

.1 Fittings: ABS fittings to CAN/CSA-B181.1.
.2 ABS Solvent Cement: to ASTM D2235.
.3 ABS - PVC Solvent Cement: to ASTM D3138.

2.6 PVC PIPE COMPONENTS

.1 Pipe: PVC plastic pipe to CAN/CSA-B181.2.

.2 Joint and Fitting Components:

.1 Fittings: PVC fittings to CAN/CSA-B181.2.
.2 PVC Solvent Cement: to ASTM D2564.
.3 ABS-PVC Solvent Cement: to ASTM D3138.

2.7 UNIONS AND FLANGES

.1 Pipe size 50 mm and smaller: 1035 kPa and as follows:

.1 Ferrous piping: malleable iron unions with bronze to iron ground joint to ASME B16.39.

.2 Copper piping: bronze unions.

.2 Pipe size 65 mm and larger: 1035 kPa and as follows:

.1 Ferrous piping: forged steel slip-on flanges to ASME B16.5 with 1.6 mm thick preformed neoprene bonded to asbestos for general applications, neoprene gasket for gas service.

.2 Copper piping: bronze flanges.

3. Execution

3.1 INSTALLATION REQUIREMENTS

.1 Install piping systems in accordance with the following:

.1 Natural gas and Propane distribution system: to CAN/CGA B149.1 and Alberta amendments.

.3 Plumbing and drainage system: to National Building Code of Canada 2005 and Alberta Regulation 119/2007 – Plumbing Code Regulation.

.4 Heating and cooling system: to comply with recommendations of ASHRAE Guide.

.5 Refrigeration system: to CSA B52.

.2 Install piping to allow for expansion and contraction without exceeding maximum allowable stresses for pipe and equipment flanges.

.3 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.

.4 Provide all offsets necessary to install piping systems within the physical limitations of the building.

.5 All openings around piping passing through walls are to be sealed with non-hardening acoustic caulking.

3.2 ROUTES AND GRADES

.1 Route piping in an orderly manner and maintain proper grades.

.2 Install piping to conserve headroom and space.

.3 Route above grade piping parallel to walls.

.4 Where practicable, group piping at common elevations.

.5 Install concealed pipes close to building structure to keep furring to a minimum.

.6 Slope hydronic and domestic water system piping at 0.2% and drain at low points.

.7 On closed loop water systems, equip low points with 20 mm drain valves and hose nipples. At high points, provide collecting chambers and high capacity float operated automatic air vents.

.8 Make reductions in water, steam and condensate piping with eccentric reducing fittings to provide complete drainage and venting.

.9 Grade horizontal sanitary and storm drainage vent piping at 2% minimum, unless noted otherwise.

3.3 STEEL PIPING SYSTEM - GENERAL

.1 Use mechanical grooved couplings and fittings in accessible locations only.

.2 Use only long radius elbows.

.3 Ream piping and tubing. Clean off scale and dirt inside and outside before assembly. Remove welding slag or other foreign material from piping.

.4 Protect galvanized pipe threads with pipe paste.

3.4 STEEL PIPING SYSTEM - TEEING OFF MAIN LINE

.1 Mains 150 mm and smaller:

.1 Use saddle type connections where main is at least one size larger than branch.

.2 Use direct connection where branch is at least three sizes smaller than main.

.2 Mains 200 mm and larger:

.1 Use saddle type connections where main is at least two sizes larger than branch.

.2 Use direct connection for branches 65 mm and smaller.

.3 Do not project branch pipe inside main line.

3.5 PRESSFITTING SYSTEM

.1 Install pressfitting system in accordance with system manufacturers instructions.

3.6 NON-FERROUS PIPING CONNECTIONS

.1 Use non-toxic joint compound on potable water lines.

.2 Provide non-conducting type connections wherever joining dissimilar metals. Brass adaptors and valves are acceptable.

.3 Sleeve copper piping buried under building so that pipe can move freely; joints are not allowed in piping buried under building.

3.7 COPPER PIPING - MECHANICALLY FORMED CONNECTIONS

.1 Mechanically formed tee connections with brazed joints may be used in lieu of tee fittings in copper tubing provided they meet the following:

.1 Size and wall thickness of main tube and branch tube are listed by manufacture of forming equipment as an acceptable application.

.2 Height of drawn collar is not less than three times wall thickness of main tubing.

.3 End of branch tube is notched to conform to inner curve of tube and dimpled to set exact penetration depth into collar.

.4 Resulting joint is brazed and is minimum of three times as long as thickness of thinner joint member.

3.8 UNIONS AND FLANGES

.1 Make connections to equipment and branch mains with unions or flanges.

.2 Use 1.5 mm thick preformed synthetic rubber asbestos gaskets for flanged connections for all services except gas.

.3 Gas Service:

.1 Air test unions used for gas service.
.2 Use synthetic rubber gaskets for flanged connections.

3.9 GAS PIPING

.1 Use isolating gas cocks on primary gas line installed with isolating union at outlet.

.2 Band interior gas piping to electrical system ground conductor to maintain gas piping at electrical system ground.

.3 For buried piping, use piping with factory or site applied 250 µm thick polyethylene jacketing.

.4 Apply heat shrink plastic jacketing to joints on buried piping.

.5 Install gas piping in open or ventilated spaces. Pitch lines and provide drip legs for condensation and dirt at appliance connection. Where gas piping is run in a concealed space, provide ventilation grilles to CAN/CGA B149.1.

3.10 PIPING SCHEDULE

System	Pipe	Fitting	Joint
Hydronic heating and cooling up to 120°C and 1035 kPa	Black steel Schedule 40, 50 mm or less	Threaded	Screwed
		Welding	Welded
		Mechanical grooved	Clamped
	Black steel, Schedule 40, greater than 50 mm	Welding	Welded
		Mechanical grooved	Clamped
	Pressfitting 50 mm or less	Pressfitting	Compression
	Copper water tube type L, Drawn temper	Wrought copper	Soldered, 95-5 tin-antimony
		Cast copper	Soldered, 95-5 tin-antimony
Equipment drains and overflows	Galvanized steel, Schedule 40, ASTM A53-96 only	Galvanized threaded	Screwed
	Copper water tube, Type L, drawn temper	Wrought copper	Soldered, 95-5 tin-antimony

Continued next page

3.10 PIPING SCHEDULE (Cont'd)

System	Pipe	Fitting	Joint
Refrigerant freon	ACR copper	Wrought copper	Brazed
		Cast copper	Brazed
Domestic water above grade	Copper water tube type L, drawn temper	Wrought copper	Soldered, 95-5 tin-antimony
		Cast copper	Soldered, 95-5 tin-antimony
DWV above grade and buried	Cast iron	Hubless cast iron	Clamped
	DWV copper (above grade only)	Cast bronze	Soldered, 50-50 tin-lead
		Wrought copper	Soldered, 50-50 tin-leaded
	ABS	ABS	Solvent welded
	PVC	PVC	Solvent welded

Continued next page

3.10 PIPING SCHEDULE (Cont'd)

System	Pipe	Fitting	Joint
Storm sewer, above grade	Cast iron	Hubless cast iron	Clamped
	DWV copper	Cast bronze	Solder, 50-50 tin-lead
		Wrought copper	Solder, 50-50 tin-lead
	ABS	ABS	Solvent welded
	PVC	PVC	Solvent welded
Natural gas low pressure less than 1400 kPa, inside building	Black steel, Schedule 40 50 mm or less	Threaded	Screwed
		Welding	Welded
	Black steel, Schedule 40 greater than 50 mm	Welding	Welded

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Mechanical General Requirements: Section 20 00 13.

1.2 REFERENCE DOCUMENTS

.1 American Society for Testing and Materials (ASTM)

.1	ASTM B209	Aluminum and Aluminum Alloy Sheet and Plate
.2	ASTM C335	Steady State Heat Transfer Properties of Pipe Insulation
.3	ASTM C411	Hot-Surface Performance of High Temperature Thermal Insulation
.4	ASTM C449	Mineral Fiber Hydraulic Setting Thermal Insulating and Finishing Cement
.5	ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
.6	ASTM C534	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
.7	ASTM C547	Mineral Fiber Pipe Insulation
.8	ASTM C553	Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
.9	ASTM C612	Mineral Fiber Block and Board Thermal Insulation
.10	ASTM E96	Water Vapor Transmission of Materials

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

.1	ASHRAE 90.1-2010	Energy Standard for Buildings except Low Rise Residential Buildings

.3 National Research Council of Canada

.1	NECB-2011	National Energy Code of Canada for Buildings

.4 Thermal Insulation Association of Canada (TIAC)

.1	TIAC	Mechanical Insulation Best Practices Guide

.5 Underwriters Laboratories Canada (ULC)

.1	CAN/ULC-S102	Surface Burning Characteristics of Building Materials and Assemblies
.2	CAN/ULC-S102.2	Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies
.3	CAN/ULC-S701	Thermal Insulation, Polystyrene, Boards and Pipe

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01, Section 01 62 00, for requirements pertaining to product options and substitutions.

1.4 SUBMITTALS

.1 Product Data

.1 Submit manufacturer's product data in accordance with Section 01 33 00 – Submittal Procedures, and Section 20 00 13 – Mechanical General Requirements.

.1 When requested, submit product data and test reports indicating that insulation and recovery assemblies meet flame/smoke development ratings and performance requirements.

.2 Shop Drawings

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures, and Section 20 00 13 – Mechanical General Requirements.

.1 For each application submit an insulation schedule to include the following information:

.1 Materials
.2 "k" value
.3 Thickness
.4 Density
.5 Finish
.6 Jacketing

.3 Submit information showing installed insulation thicknesses meet the minimum performance requirements of the National Energy Code of Canada for Buildings 2011 (NECB-2011).

1.5 DEFINITIONS

.1 For the purposes of this Section, the following definitions apply:

.1 Concealed: piping systems and equipment in trenches, shafts, furring, and suspended ceilings.
.2 Exposed: piping systems and equipment in mechanical rooms or otherwise not "concealed".
.3 "k" Value: thermal conductivity of insulating material per unit of thickness (W/m.°C).

1.6 FLAME/SMOKE DEVELOPMENT RATINGS

.1 Pipe insulations, recovery materials, tapes, vapor barrier facings and adhesives shall have maximum flame spread rating of 25 and maximum smoke developed rating of 50, when tested in accordance with CAN/ULC-S102 and/or CAN/ULC-S102.2.

.2 Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking or flaming when tested in accordance with ASTM C411.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver and store materials in original packaging with manufacturer's labels.

.2 Protect materials against damage from weather and construction activities.

.3 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

1.8 QUALITY ASSURANCE

.1 Insulation materials shall be new, undamaged and of the respective types specified for each specific application.

.2 Installer to be specialist in performing work of this section and have at least 3 years successful experience with work of similar complexity and size as required for this project.

.3 Contractor and tradespeople hold a recognized credential to work as insulator in Alberta, and is a member of TIAC.

.4 Installation conforms to TIAC Mechanical Insulation Best Practices Guide.

2. Products

2.1 HOT PIPE INSULATION

.1 Hot Pipe Insulation - Mineral Fiber:

.1 Material: preformed rigid mineral fiber insulation to ASTM C547.
.2 "k" Value: maximum 0.033 W/m.°C at 24°C mean temperature.
.3 Operating Temperature Range: -18 °C to 454 °C to ASTM C411.
.4 Jacket: factory applied all service jacket.

2.2 HOT EQUIPMENT INSULATION

.1 Hot Equipment Insulation - Flat Surfaces:

.1 Material: rigid mineral fiber board insulation to ASTM C612.
.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.
.3 Operating Temperature Range: -18 °C to 232 °C .

.2 Hot Equipment Insulation - Curved Surfaces:

.1 Material: mineral fiber blanket insulation to ASTM C553.
.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.
.3 Operating Temperature Limit: up to 343°C.

2.3 COLD PIPE INSULATION

.1 Cold Pipe Insulation: Mineral Fibre:

.1 Material: preformed rigid mineral fiber insulation to ASTM C547.
.2 "k" Value: maximum 0.033 W/m.°C at 24°C mean temperature.
.3 Operating Temperature Range: -18 °C to 454 °C to ASTM C411.
.4 Jacket: factory applied vapor barrier jacket to ASTM E96, with longitudinal lap seal.

.2 Cold Pipe Insulation - Black Rubber:

.1 Material: flexible elastomeric closed-cell preformed pipe insulation to ASTM C534 with antimicrobial protection.
.2 "k" Value: 0.04 W/m. °C at 24°C mean temperature.
.3 Service Temperature: -4°C to 100°C.
.4 Maximum Allowable Thickness: 25 mm.

2.4 COLD EQUIPMENT INSULATION

.1 Cold Equipment Insulation - Flat Surfaces:

.1 Materials: rigid mineral fiber to ASTM C612.
.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.
.3 Service Temperature: -14°C to 100°C.
.4 Jacket: factory applied vapor barrier jacket to ASTM E96.

.2 Cold Equipment Insulation - Curved Surfaces:

.1 Material: mineral fiber blanket to ASTM C553.
.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.
.3 Service Temperature: -14°C to 100°C.
.4 Jacket: factory applied vapor barrier jacket to ASTM E96.

2.5 ACCESSORIES

.1 For mineral fiber insulation materials:

.1 FSK Tape: vapor barrier tape consisting of laminated aluminum foil, glass fiber scrim and paper, with pressure sensitive self adhesive.
.2 ASJ Tape: vapor resistant tape consisting of all service jacket material with pressure sensitive self adhesive.
.3 Adhesive: quick setting adhesive for joints and lap sealing.

.2 Black Rubber Insulation Adhesive: manufacturers recommended contact cement.

.3 Thermal Insulating and Finishing Cement: to ASTM C449 mineral fibre hydraulic setting thermal insulating and finishing cement for use up to 650°C.

2.6 RECOVERY MATERIALS

.1 Canvas: ULC listed, 220 g/m^2 plain weave cotton fabric.

.2 Aluminum: to 0.4 mm thick embossed with longitudinal slip joints and 50 mm end laps, 0.4 mm thick die shaped fitting covers with factory attached protective liner on interior surface.

.3 PVC: 0.4 mm thick for interior use and UV resistant 0.8 mm thick for exterior use, white in color with pre-moulded fitting covers.

3. Execution

3.1 INSTALLATION, GENERAL

.1 Apply insulation after required piping system tests have been completed, witnessed and certified.

.2 Ensure piping surface is clean and dry before insulating.

.3 Install in accordance with TIAC Mechanical Insulation Best Practices Guide.

.4 Install in accordance with manufacturers recommendations.

.5 Ensure insulation is continuous through walls and floor penetrations. Terminate insulation on either side where fire stop is installed at penetration.

.6 Locate cover seams in least visible locations.

.7 Stagger butt joints where multi-layered insulation is used.

.8 On vertical piping with diameters 25 mm and larger, use insulation supports welded or bolted to pipe directly above lowest pipe fitting. Repeat supports on 4.5 m centers and at each valve and flange.

.9 Tightly fit insulation sections to pipe to make smooth and even surfaces. Cut insulation for proper fit where weld beads protrude. Bevel away from studs and nuts to allow their removal without damage to insulation. Trim closely and neatly around extending parts of pipe saddles, supports, hangers, clamp guides and seal with insulating/finishing cement.

.10 Install 25mm thick aluminum foil-backed fibrous glass or mineral fiber insulation on top of all radiant panels with foil side facing up.

3.2 HOT PIPE INSULATION APPLICATION

.1 Apply mineral fibre insulation when pipe surface temperatures are 50°C to 60°C.

.2 Apply mineral fibre insulation and recovery over full length of pipe without penetration of hangers, interruption at sleeves and fittings. Seal butt joints with 100 mm wide ASJ tape.

.3 Terminate mineral fibre insulation at each end of unions and flanges. Trowel finishing cement into bevel.

.4 Cover fittings, strainers and valves with equivalent thickness and insulation value of finishing cement or preformed insulation inserts and apply PVC fitting covers.

.5 Cut mineral fibre insulation layers straight on 10 m centers with 25 mm gap to allow for expansion between terminations. Pack void tightly with insulation and protect joints with aluminum sleeves.

.6 Seal black rubber insulation butt joints and seams with black rubber insulation adhesive.

.7 Recover all exposed insulated piping:

.1 Mechanical rooms: canvas or PVC.
.2 Occupied spaces: PVC.
.3 Indoor equipment: canvas or aluminum.
.4 Outdoor equipment: aluminum.
.5 Outdoor piping: Sealed weather tight aluminum.

.8 Cover all exposed black rubber insulation:

.1 Indoor piping: manufacturer’s recommended polymeric covering.
.2 Outdoor piping: Sealed weather tight aluminum.

.9 Insulate flanges and unions next to equipment with removable insulation and recovery system for easy disassembly and reassembly.

.10 Do not insulate the following piping system components:

.1 Hot water heating piping in radiation cabinets.
.2 Expansion joints, flexible piping connectors.
.3 Chrome plated piping and fittings.

.4 Valve bonnets on domestic water systems.
.5 Drains, plugs and caps.

3.3 HOT EQUIPMENT INSULATION APPLICATION

.1 Use rigid fibreboard for flat surfaces and segmented rigid pipe and tank insulation for curved surfaces.

.2 Tightly butt edges and stagger joints. Weld mechanical fastener pins to equipment where necessary.

.3 Cover insulation with 25 mm galvanized hexagonal mesh and 12 mm coat of insulating cement. Finish with a final 12 mm coat of finishing cement and recover with canvas.

3.4 COLD PIPE INSULATION APPLICATION

.1 Insulate 5 m portion of plumbing vents measured from roof outlet back. Do not insulate remaining vent piping.

.2 Insulate storm sewer piping final 5 m portion from outlet drain back with 25 mm insulation.

.3 Apply vapor retardant mineral fibre insulation and recovery over full length of pipe without penetration of hangers, interruption at sleeves and fittings. Apply adhesive to ends of butt joints and seal joint seams with 100 mm wide strips of joint tape.

.4 Insulate complete system including valves, unions, flanges, strainers, drains, caps and fittings. Cover fittings and valves with equivalent thickness of finishing cement. Cover finishing cement with open mesh glass cloth and vapor retardant adhesive. Seal lap joints with 100% coverage of joint tape and seal the assembly with vapor retardant adhesive. Alternatively, insulate with tightly placed flexible insulation and apply reinforcing membrane embedded in vapor retardant coating and apply PVC fitting covers.

.5 Seal black rubber insulation butt joints and seams with black rubber insulation adhesive.

.6 Recover all exposed insulated piping:

.1 Mechanical rooms: canvas or PVC.
.2 Occupied spaces: PVC.
.3 Indoor equipment: canvas or aluminum.
.4 Outdoor equipment: aluminum.
.5 Outdoor piping: Sealed weather tight aluminum.

.7 Coat exposed black rubber insulation with two coats of black rubber finish material.

3.5 COLD EQUIPMENT INSULATION APPLICATION

.1 Tightly butt edges and stagger joints. Seal joints with 100 mm wide FSK tape.

.2 Cover insulation with 25 mm galvanized hexagonal mesh and 12 mm coat of finishing cement. Finish with a final 12 mm coat of finishing cement and recover with canvas.

3.6 INSULATION TYPE AND THICKNESS SCHEDULE

Insulation Type and Thickness Schedule		
Service Type and Nominal Pipe Diameter (mm)	**Application**	**Insulation Thickness (mm)**
Hot Water Heating (up to 93°C): 32 and smaller 38 and larger	Hot Pipe	 38 50
Glycol Heating (up to 93°C): 32 and smaller 38 and larger	Hot Pipe	 38 50
Domestic Hot Water and Recirculation: 50 and smaller 65 and larger	Hot Pipe	 25 38
Refrigerant and Chilled Glycol (5°C to 13°C): All Sizes	Cold Pipe	 25
Domestic Cold water: 38 and smaller 50 and larger	Cold Pipe	 12 25
Plumbing Vents: All sizes	Cold Pipe	 25
Heat Exchangers	Hot Equipment	50
Hot Water Storage Tanks	Hot Equipment	50
Radiant Panels	Hot Equipment	25
Heat Exchangers	Cold Equipment	50

END OF SECTION

1. General

1.1 REFERENCE STANDARD

.1 Conform to Standards of "Expansion Joint Manufacturers Association" and manufacturer's recommendations.

1.2 SHOP DRAWINGS

.1 Flexible pipe connector shop drawing data shall include maximum allowable temperature and pressure rating, overall face-to-face length, live length, hose wall thickness, hose convolutions per 300 mm and per assembly, fundamental frequency of assembly, braid structure and total number of wires in braid.

.2 Expansion joint shop drawings shall include maximum allowable temperature and pressure rating, and maximum expansion compensation.

1.3 GENERAL REQUIREMENTS

.1 Examine piping layout and notify the Minister of additional anchors or expansion joints required to adequately protect system.

.2 Base expansion calculation on 10°C installation temperature to 100°C for hot water heating and 60°C for domestic hot water, plus 30% safety factory.

1.4 INSPECTION

.1 Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

2. Products

2.1 FLEXIBLE PIPE CONNECTIONS

.1 For steel piping construct with stainless steel inner hose and braided exterior sleeve.

.2 For copper piping construct with bronze inner hose and braided exterior sleeve.

.3 Use connectors suitable for minimum 860 kPa WSP and 230°C and 1380 kPa WOG and 120°C.

.4 Construct spool pieces to exact size for insertion of flexible connection.

2.2 EXPANSION JOINTS

.1 Steel piping 75 mm and under: stainless steel bellows type with antitorque device, limit stops and internal guide.

.2 Steel piping over 75 mm: external ring controlled type with hydraulically formed stainless steel bellows.

.3 Steel piping 50 mm and over: spool type expansion, flexible compensator with tapped steel flanges, Teflon or neoprene and nylon body suitable for minimum 1030 kPa working pressure and 120°C.

.4 Copper piping: all bronze type with two-ply bronze bellows, anti-torque device limit stops, internal guides and solder joint end.

.5 Use joints suitable for minimum 860 kPa WSP and 200°C, and 1380 kPa WOG and 120°C.

.6 Copper or steel piping 50 mm and under: low pressure compensators with two-ply bronze bellows suitable for minimum 520 kPa pressure and 120°C, and maximum 12 mm expansion.

.7 Copper or steel piping 50 mm and under: copper type with packed sliding sleeve suitable for minimum 860 kPa working pressure and 120°C.

2.3 CONNECTIONS

.1 Provide flexible pipe connectors or expansion joints suitable to connect to adjoining piping as specified for pipe joints. Use pipe sized units.

3. Execution

3.1 APPLICATION

.1 Provide flexible pipe connectors on pipes connected to equipment supported by vibration isolation where indicated on the drawing.

.2 Provide structural work and equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints and provide corrugated bellows type expansion joints where indicated or required.

3.2 INSTALLATION

.1 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

.2 Rigidly anchor pipe to building structure at points shown, and where necessary provide pipe guides so that movement takes place along axis of pipe only.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Mechanical General Requirements: Section 20 00 13.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Standpipe and Hose System: Section 21 12 00.

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 ABBREVIATIONS

.1 NPSHR: Net Positive Suction Head Required.

.2 EEMAC: Electrical Equipment Manufacturers Association of Canada.

1.5 REFERENCE DOCUMENTS

.1 National Fire Association (NFPA)

.1	NFPA 20-2010	Standard for the Installation of Stationary Pumps for Fire Protection
.2	NFPA 37-2010	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines

1.6 SHOP DRAWINGS AND PRODUCT DATA

.1 Comply with requirements of Section 20 00 13.

.2 Submit following information:

.1 Certified pump performance curves showing performance characteristics with system operating point plotted and NPSHR curve.

.2 Details of pump drive motor.

.3 Details of drive assembly, including the rated capacity of the drive at the specified r/min.

.4 Details of bearings including manufacturers ratings of full load operating hours.

.5 Details of pump seals, listing maximum operating temperatures and material limitations.

.6 Complete data showing pump materials, dimensional data and ratings.

2. Products

2.1 PUMPS - GENERAL

.1 Balance all rotating parts.

.2 Pump construction shall permit complete servicing without disassembly of piping or motor connections.

.3 Pump operating speed: 1750 r/min, unless otherwise specified.

.4 Pump Connections: flanged pump connections.

2.2 BASE MOUNTED CENTRIFUGAL PUMPS

.1 Type: centrifugal, single stage, direct connected.

.2 Casing: single or split suction cast iron volute rated for greater of 1035 kPa or 1.5 times actual discharge working pressure, seal flushing connections, air vent, wear rings, drain plug, suction and discharge gauge ports.

.3 Impeller: bronze or cast iron, fully enclosed, keyed to shaft, dynamically balanced.

.4 Shaft: stainless steel.

.5 Bearings: oil lubricated ball or roller bearings with oil reservoir, oil seals with integral dirt and water seals at each end of reservoir; rated for minimum life of 10,000 h.

.6 Drive: flexible coupling with safety guard.

.7 Seals: spring loaded carbon rotating washer complete with rubber bellow held against a stationary floating stellite or ceramic seat and seat ring. Condenser water pump seals with packing glands, minimum four rings teflon impregnated packing and lantern ring.

.8 Baseplate: high grade heat treated cast iron or reinforced heavy rolled steel which will restrict deflections to not more than 1.5 mm/m. Units with packing glands shall include an integral drain rim.

2.3 VERTICAL PUMPS

.1 Type: centrifugal, single stage, close coupled in-line, back pullout design suitable for vertical operation.

.2 Casing: cast iron, rated for greater of 1035 kPa or 1.5 times actual discharge working pressure, suction and discharge gauge ports, air vent, wear rings, seal flushing connection, drain plug.

.3 Impeller: bronze or cast iron, fully enclosed, keyed to shaft, dynamically balanced.

.4 Shaft: stainless steel.

.5 Bearings: oil lubricated ball or roller and thrust bearings with oil reservoir, oil seals with integral dirt and water seals at each end of reservoir; rated for minimum lift of 10,000 hours.

.6 Seals: spring loaded carbon rotating washer complete with rubber bellow held against a stationary floating stellite seat and seat ring.

2.4 IN-LINE CIRCULATOR PUMPS

.1 Type: horizontal mount, centrifugal, close coupled, mounted in-line.

.2 Casing: cast iron, volute, rated for 860 kPa working pressure. Bronze casing for domestic hot and cold water services.

.3 Impeller: bronze or cadmium plated steel.

.4 Shaft: carbon steel alloy with integral thrust collar.

.5 Bearings: bronze with spiral grooves to convey lubricant the entire length of the bushing.

.6 Seals: spring loaded carbon rotating washer complete with rubber bellow held against a stationary floating stellite seat and seat ring.

3. Execution

3.1 INSTALLATION

.1 Provide drains for bases and stuffing boxes, piped to and discharging into floor drains.

.2 Provide air cocks and drain connection on horizontal pump casings.

.3 Provide pipe size shut-off valve and strainer on suction, pipe size spring loaded check valve and valve for throttling on discharge. Factory designed combination valve inlet and discharge fittings may be used if certified by pump manufacturer.

.4 Decrease from pipe size with long radius reducing elbows or reducers. Install to Hydraulic Institute recommended practices.

.5 Support pipe adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge lines 100 mm and over.

.6 Where pipe rises more than 1000 mm before being supported, use spring type supports on systems operating at more that 50°C differential from ambient temperature for lines 75 mm and over.

.7 Prior to start-up, align and certify pumps with a flexible coupled drive using a qualified millwright.

.8 Provide bilge and sewage pumps with shaft length long enough to locate pump in sump pit a minimum of 600 mm below lowest invert, and with a minimum of 150 mm clearance from bottom of sump pit.

.9 Support "in-line" circulators directly from inlet and discharge pipe. Do not use flexible connections.

.10 Install pumps to allow maintenance and removal of component parts.

3.2 IMPELLER MATERIALS

.1 Provide cast iron impellers on pumps for closed loop systems, such as hot water heating, chilled water, hot or cold glycol, unless otherwise indicated.

.2 Provide bronze impellers on pumps for open loop systems such as domestic hot water, domestic cold water, well water, condensing water, condensate, unless otherwise indicated.

3.3 PERFORMANCE

.1 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation and operate within 75% of the maximum published efficiency, unless otherwise indicated.

.2 Provide pumps labelled on the drawings to the performance and quality standards scheduled.

END OF SECTION

1. General

1.1 QUALITY ASSURANCE

.1 Comply with Provincial Regulations and have CSA approval.

1.2 SUBMITTALS

.1 Provide shop drawings and schedules for review where requested.

2. Products

2.1 MANUAL AIR VENTS

.1 Construct manual air vents from short vertical section of 50 mm dia. pipe to form air chamber. Provide 3 mm brass needle valve at top of chamber.

2.2 AUTOMATIC AIR VENTS

.1 Provide automatic float type with isolating valve, brass or semi-steel body, copper float, stainless steel valve and valve seat, suitable for system operating temperature and pressure.

.2 Provide automatic washer type, all brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off and integral spring loaded ball check valve to prevent water leakage.

2.3 AIR SEPARATORS

.1 Provide centrifugal type with 860 kPa WSP steel tank, galvanized steel 5 mm perforated strainer, perforated stainless steel air collector tube and drain connection.

2.4 RELIEF VALVES

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

2.5 COMBINATION CHECK AND SHUT-OFF VALVE

.1 Provide angle or straight type with screwed or flanged cast iron body, and bronze disc and seat.

2.6 COMBINATION PUMP INLET AND STRAINER FITTING

.1 Provide angle type suction guide fitting with flanged cast iron body, steel or cast iron guide vanes and removable stainless steel strainer.

2.7 HANDWHEEL RADIATOR VALVES

.1 Provide angle or straight rising stem globe valve, with bronze body and renewable composition disc.

2.8 RADIATOR BALANCING VALVES

.1 Provide angle or straight, rising stem, combination, balancing, indicating and shut-off valve.

.2 Construct body, bonnet, stem and packing nut of bronze or brass.

.3 Provide stainless steel indicating dial plate and lockable balancing yoke.

3. Execution

3.1 AIR VENTS

.1 Provide manual type at system high points.

.2 Use automatic float type at heating units and system high points not readily accessible for servicing.

.3 Use automatic washer type for convection type heating units.

.4 Where large air quantities can accumulate, provide enlarged air collection standpipes.

.5 For float type air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

3.2 AIR SEPARATOR

.1 Provide on suction side of system circulation pump and connect to expansion tank.

3.3 RELIEF VALVES

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

.2 Drain relief valve to nearest floor drain.

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

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

3.4 COMBINATION CHECK AND SHUT-OFF VALVE

.1 Provide on discharge side of base mounted centrifugal pumps where indicated.

3.5 COMBINATION PUMP INLET AND STRAINER FITTINGS

.1 Provide on suction side of base mounted centrifugal pumps where indicated.

.2 Support fitting with floor mounted pipe and flange support to eliminate undue stress on pump suction connection.

3.6 HANDWHEEL RADIATOR VALVES

.1 Provide on water inlet to terminal heating units such as radiation, unit heaters and fan coil units.

3.7 RADIATOR BALANCING VALVES

.1 Provide on water outlet from terminal heating units.

END OF SECTION

1. General

1.1 QUALITY ASSURANCE

.1 Comply with Provincial Regulations and Mechanical Refrigeration Codes.

1.2 SUBMITTALS

.1 Provide shop drawings and schedules for review where requested by the Minister.

2. Products

2.1 LIQUID INDICATORS

.1 Liquid indicators shall be double port type with copper brass body, and flared or solder ends.

.2 Provide removable seal caps on each port to inspect refrigerant condition.

2.2 STRAINERS

.1 Refrigerant strainers shall be angle replaceable cartridge type with brass shell.

.2 Cartridge material and screen size shall be suitable for refrigerant and piping material utilized in the system.

2.3 REFRIGERANT DRIERS

.1 Driers shall be in-line or angle type with copper or brass shell.

.2 Desiccant drier material shall be replaceable.

2.4 FILTER-DRIERS

.1 Combination filter-driers shall be angle type, with brass shell and incorporate a combined straining and drying material.

.2 Desiccant material shall be replaceable.

2.5 SOLENOID VALVES

.1 Solenoid valves shall have copper or brass body with flared or screwed ends.

.2 Coil assembly shall be replaceable.

.3 Valves shall incorporate a manually operated stem to serve as a bypass in case of coil failure.

2.6 EXPANSION VALVES

.1 Provide angle type or straight through expansion valves suitable for the refrigerant utilized in the system.

.2 Valves shall have brass body, internal or external equalizer, adjustable superheat setting and be complete with capillary tube and remote sensing bulb.

2.7 CHARGING VALVES

.1 Provide general purpose type refrigerant charging valves with brass body, flared or solder ends and with removable valve core.

.2 Provide valve inlet with quick coupling connection for ease of charging.

2.8 FLEXIBLE CONNECTORS

.1 Flexible connectors shall consist of close pitch corrugated bronze hose with single layer of exterior braiding to provide additional strength and prevent elongation of corrugated section.

.2 Connectors shall be minimum 230 mm long and provided with bronze fittings to facilitate connection to equipment.

3. Execution

3.1 LIQUID INDICATORS

.1 Provide full size liquid indicators in main liquid line leaving condenser. If a receiver is used, install in liquid line leaving receiver.

3.2 STRAINERS

.1 Provide full size strainer ahead of each automatic valve. Where multiple expansion valves with integral strainers are used, install single main liquid line strainer.

.2 On steel piping systems provide adequate strainer in suction line to remove scale and rust inherent in steel pipe.

.3 Provide shut-off valve on each side of strainer to facilitate maintenance.

3.3 REFRIGERANT DRIERS

.1 Provide full flow permanent refrigerant drier in low temperature systems and systems utilizing hermetic compressors.

.2 Mount drier vertically in liquid line adjacent to receiver with three valve bypass assembly to permit isolation of drier for servicing.

3.4 FILTER-DRIERS

.1 Filter-driers may be used in systems instead of separate strainers and driers.

.2 Install with three valve bypass assembly to permit isolation for servicing.

3.5 SOLENOID VALVES

.1 Provide solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

.2 Provide solenoid valves with manually operated stems.

3.6 EXPANSION VALVES

.1 Size expansion valves properly to avoid penalty of being undersized at full load and of being excessively oversized at partial load.

.2 Properly evaluate refrigerant pressure drop through system to determine the available pressure drop across the valve.

.3 Select valves for maximum load at design operating pressure and minimum 42°C of superheat.

.4 Locate remote expansion valve sensing bulb immediately after evaporator outlet and suction line.

3.7 CHARGING VALVES

.1 Provide refrigerant charging connections in liquid line between receiver shut-off valve and expansion valve.

3.8 FLEXIBLE CONNECTORS

.1 In general install suction and hot gas piping connections to compressors with three directional changes for distance of minimum six pipe diameters before reaching point of support.

.2 Flexible connectors shall only be utilized at or near compressors where it is not physically possible to absorb vibration within piping configuration.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Spare Parts and Maintenance Materials: Section 20 00 23.

1.2 REFERENCE DOCUMENTS

.1 National Fire Protection Association (NFPA):

.1	NFPA 13	Standard for the Installation of Sprinkler Systems
.2	NFPA 25	Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems

1.3 GENERAL REQUIREMENTS

.1 Provide labour, design and materials for a complete sprinkler system as required by the *Alberta Building Code* and as indicated on drawings.

1.4 RESPONSIBILITY

.1 The sprinkler contracting firm shall provide all sprinkler system work meeting the requirements of the *Alberta Building Code*, authorities having jurisdiction and all applicable codes and standards.

.2 The sprinkler contracting firm shall employ or engage a Professional Engineer registered in the Province of Alberta who shall be the Responsible Engineer of Record for the design, supervision of installation, verification and certification of the sprinkler system. The Engineer shall be responsible for the work of all fire protection systems.

.3 The Responsible Engineer shall complete and submit schedule “B” and “C” of professional involvement for the fire sprinkler work as per the *Alberta Building Code*.

1.5 SUBMITTALS

.1 Preliminary Layout Drawings: Submit preliminary layout showing only head locations for review. Refer to architectural drawings for ceiling coordinated head locations.

.2 Samples: Submit two (2) samples of each style of sprinkler specified.

.3 Water Supply Verification Report utilized for design purposes.

.4 Product Data:

.1 Submit manufacturer’s product data in accordance with *Section 20 00 13 – Mechanical General Requirements*.

.2 Submit copies of manufacturer's product literature, specifications and datasheets including sprinklers, valves and specialties.

.5 Shop Drawings:

.1 Submit shop drawings in accordance with *Section 20 00 13 – Mechanical General Requirements*.

.2 Submit design shop drawings, including pipe layout, product data and hydraulic calculations. Design shop drawings to be stamped by a professional engineer registered or licensed in the Province of Alberta.

.3 Submit design shop drawings, product data and hydraulic calculations to the authority having jurisdiction for approval. Submit copies of authority having jurisdiction's approval to the coordinating professional, mechanical consultant and Owner.

.6 Closeout Submittals:

.1 Submit maintenance and engineering data for incorporation into manuals specified in *Section 20 01 06 – Mechanical Operation and Maintenance Manual*.

.2 Submit record drawings in electronic PDF and on AutoCAD CD disks.

.3 Submit test reports and certificates.

.4 Submit certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.

.5 Submit Schedule B and C of professional involvement as per the *Alberta Building Code*.

.6 Submit warranty certificates.

.7 Submit sprinklers and spare parts list, valve directory.

1.6 QUALITY ASSURANCE

.1 Comply with the *Alberta Building Code*.

.2 Sprinkler design, equipment and installation shall be reviewed and approved by the authority having jurisdiction.

.3 Sprinkler equipment shall be installed by qualified Contractors licensed and regularly engaged in installation of automatic fire sprinkler equipment.

.4 Equipment, design and installation shall meet the requirements of NFPA 13 – Standard for the Installation of Sprinkler Systems.

1.7 DESIGN CRITERIA

.1 The Responsible Engineer shall design systems in accordance with NFPA 13 using following parameters:

.1 Hazard: To suit occupancy classification, based on the quantity and/or combustibility of the building contents and as indicated, whichever is greater.

.2 Pipe Size and Layout: Hydraulic design in accordance with NFPA 13. Lay out piping as indicated on drawings for areas with specific architectural requirements. Avoid piping run in electrical, IT and communication rooms, except piping solely serving sprinklers of these spaces.

.3 Sprinkler Head Layout: Comply with NFPA 13 and as directed by authorities having jurisdiction. Lay out sprinkler heads in locations as indicated on drawings for areas with specific architectural requirements. Coordinate sprinkler head layout with reflected ceiling plan and ceiling mounted equipment and devices.

.4 Water Supply: Sprinkler contractor shall perform hydraulic flow and pressure tests of water supply from the nearest fire hydrants in the vicinity of the project to obtain parameters for final system design. Preliminary flow test results from December 1, 2016: Static pressure 66.0 psi, Flow test 583 gpm residual pressure 62.0 psi, Flow test 993 gpm residual pressure 56.0 psi.

.5 Zoning: System zoning as indicated and in accordance with NFPA 13.

1.8 CONSTRUCTION REVIEW

.1 The Responsible Engineer shall conduct field reviews during construction.

1.9 TESTS AND CERTIFICATION

.1 Perform tests of sprinkler system as per NFPA 13.

.2 At the completion of the installation, testing and verification of the systems, provide certification of verification bearing the seal of the Responsible Professional Engineer, that the systems have been designed, installed and tested in full conformance with the *Alberta Building Code*, the authorities having jurisdiction and all applicable codes and standards.

2. Products

2.1 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous: To NFPA 13.

.2 Copper Tube: To NFPA 13.

.2 Fittings and Joints:

.1 Ferrous: Screwed, welded, flanged or rolled grooved to NFPA 13.

.2 Copper Tube: Soldered or brazed to NFPA 13.

.3 Valves:

.1 ULC listed for fire protection services.

.2 Gate and Ball Valves: Up to 50 mm: brass body, screw ends.

.3 Gate Valves: 65 mm and over, cast iron body, rolled grooved ends, OS&Y, positive shut off, indicating type.

.4 Butterfly Valves: 65 mm and over, cast iron body, rolled grooved ends.

.5 Check Valves: 65 mm and over, cast iron body, rolled grooved ends.

.6 System Control Valve and Isolation Valves: Listed indicating type with supervisory switch that is compatible with the fire alarm system.

.4 Pipe hangers:

.1 Comply with NFPA 13.

2.2 SPRINKLER HEADS

.1 General:

.1 Quick response, glass bulb type to NFPA 13 and ULC listed for fire services.

.2 Temperature rating of sprinklers to suit specific hazard area.

.3 Sprinkler heads located close to heat producing equipment or other sources of heat shall be intermediate or high temperature type in accordance with NFPA 13.

.4 Sprinklers subject to mechanical or physical damage shall be protected by ULC listed guards.

.5 Sprinklers exposed to freezing temperatures shall be dry type.

.2 Suspended Ceilings: Provide concealed pendant type with white cover plates and escutcheon.

.3 Drywall Ceilings: Provide concealed pendant type with white cover plate and escutcheon.

.4 Exposed Areas: Provide standard upright type with brass finish.

2.3 ALARM CHECK VALVE

.1 Alarm check valve assembly to NFPA 13 and ULC listed for fire services with clapper, retard chamber, alarm pressure switch, alarm bypass test connection, alarm devices, pressure gauges and system main drain.

.2 All internal components replaceable without removal of valve from installed position.

2.4 SIAMESE FIRE DEPARTMENT CONNECTION

.1 Two way standard 65 mm siamese fire department connection to NFPA-13 with brass chrome plated finish, dust caps and chains, female hose thread comply with the *Alberta Fire Code*, 20 mm automatic drip, identification plate marked "AUTO SPKR - Fire Department Connection."

2.5 SPARE SPRINKLER HEAD CABINET

.1 Provide enameled steel, wall mounted cabinet with hinged front panels for storing spare sprinkler heads, sprinkler wrenches, sprinkler list and valve directory. Type and quantity of spare sprinkler heads as per NFPA 13.

3. Execution

3.1 INSTALLATION

.1 Install equipment to manufacturer instructions.

.2 Install, flush, inspect and test to acceptance in accordance with NFPA 13 and authority having jurisdiction.

.3 Provide ULC approved double check valve assembly on sprinkler system take-off from water supply.

.4 Locate sprinkler heads as shown on architectural reflected ceiling plans and at center lines of ceiling panels as required to produce orderly and symmetrical patterns with other ceiling mounted equipment and devices, and to meet or exceed the requirements of

authority having jurisdiction.

.5 Coordinate and install pipe runs to avoid interference with structure, piping, lights, cable trays, ductwork and other equipment.

.6 In areas with ceiling, run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only sprinkler heads.

.7 Provide sufficient sprinkler coverage above and below ductwork and other obstructions.

.8 In electrical, IT and communication rooms, avoid running piping above electrical equipment.

.9 In emergency generator room or other similar spaces, avoid running piping near outdoor air intake louvers.

.10 At each sprinkler zone station, provide supervised indicating control valve, pressure gauge, water flow switch, sight glass, test valve and drain connection as per NFPA 13. Locate zone control valve assemblies visible from the floor.

.11 Provide system test connection at hydraulically most remote branch line as per NFPA 13.

.12 Make provision so that all parts of system can be properly drained.

.13 Identify valves and drains located above ceilings or where their location is not evident.

.14 Supply and install drain piping as required. Pipe drain discharge line as shown on drawings or to floor drains or service sinks. Do not discharge to the building exterior.

.15 Provide sprinkler head protective guards in mechanical service rooms, shafts, loading dock, storage rooms, elevator machine room and where sprinkler heads are subjective to mechanical or physical damage.

.16 Mount spare sprinkler head cabinet on wall adjacent to the sprinkler tree.

.17 Locate fire department connection with sufficient clearance from walls, obstructions or adjacent Siamese connectors to allow full swing of fire department wrench handle. Fire department connection shall be within 45 m of a fire hydrant.

.18 Locate outside alarms on wall of building adjacent to Siamese fire department connection.

.19 Coordinate with electrical contractor to insure all flow, pressure and tamper switches and devices are compatible with the building fire alarm systems.

.20 Flush and hydraulically tests the piping system as per NFPA 13.

.21 Test and verify system flow, tamper switches and alarm devices with the fire alarm system.

.22 Tests to be witnessed by the Responsible Engineer, local authority having jurisdiction and Owner.

.23 Provide valve tags, valve directory, labels, identification and flow markings in accordance with *Section 20 05 43 - Identification for Mechanical Systems*.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Installation of roof drains: Section [07].

1.2 REFERENCE DOCUMENTS

.1 Canadian Standards Association (CSA):

.1	CSA B140.12-03 (R2008)	Oil-Buring Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools

1.3 GENERAL REQUIREMENTS

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

.2 Provide water and drainage connections to equipment furnished in other sections of this specification and by the Minister.

.3 Provide an approved water meter and bypass installation conforming to Local Codes and Standards.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Submit copies of manufacturer's product literature, specifications and datasheets.

.2 Closeout Submittals:

.1 Submit maintenance data for incorporation into manuals specified in Section 20 01 06 – Mechanical Operation and Maintenance Manual.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 CLEAN-OUTS AND CLEAN-OUT ACCESS COVERS

.1 Provide caulked or threaded type extended to finished floor or wall surface. Provide bolted coverplate clean-outs on vertical rainwater leaders only. Ensure ample clearance at clean-out for rodding of drainage system.

.2 Floor cleanout access covers in unfinished areas shall be round with nickel bronze scoriated frames and plates. Provide square access covers in finished areas with depressed centre section to accommodate floor finish. Wall cleanouts to have chrome plated caps.

2.2 WATER HAMMER ARRESTERS

.1 Fit water supply to each fixture or group of fixtures with an air chamber. Provide air chambers same size as supply line or 20 mm minimum, and minimum 450 mm long.

.2 Install stainless steel bellows type water hammer arresters on water lines connected to solenoid valves, flush valves and to fixture or group of fixtures complete with accessible isolation valve.

2.3 FLOOR DRAINS

.1 Floor drains shall have lacquered cast iron body with double drainage flange, weep holes combined two piece body reversible clamping device and adjustable nickel/bronze strainer. Shower and washroom floor drains shall have a removable perforated sediment bucket.

.2 Floor drains in equipment rooms shall have polished bronze funnel type strainer.

3. Execution

3.1 INSTALLATION

.1 Bury outside water and drainage pipe minimum 2400 mm.

.2 Lubricate clean-out plugs with mixture of graphite and linseed oil. Prior to building turnover remove clean-out plugs, re-lubricate and reinstall using only enough force to ensure permanent leakproof joint.

.3 Install vacuum breakers on plumbing lines where contamination of domestic water may occur. Generally necessary on boiler make-up lines, hose bibs and flush valves.

.4 Install gas piping in open or ventilated spaces. Pitch lines and provide drip legs for condensation collection points. Where gas piping is run in a concealed space, provide ventilation grilles as required.

.5 Where floor drains are located over occupied areas, provide waterproof installation.

.7 Install trap primer where required by Codes and/or where indicated on drawings.

.8 Drainage lines shall grade 2 mm per 100 mm unless otherwise indicated on drawings.

.9 Install pressure reducing valves to limit maximum static pressure at plumbing fixtures to 550 kPa.

3.2 SERVICES

.1 Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with sufficient slope for drainage and adequate cover to avoid freezing.

.2 Provide new water service complete with water meter with by-pass valves. Provide necessary thrust blocks on underground water piping as required and detailed. Provide 1.2 mm galvanized sheet metal sleeve around service main to 150 mm above floor and 1800 mm minimum below grade. Size for minimum of 50 mm of loose fill insulation.

.3 Provide new gas service complete with gas meter and regulators. Provide regulators on each line servicing appliances, sized in accordance with equipment. These regulators are in addition to normal controls.

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies services and material required for onsite, cleaning of a hot and cold domestic water system.

1.2 SUBMITTALS

.1 Submit a written report of actual cleaning activities including:

.1 Times.
.2 System status.
.3 Problems encountered.
.4 Actions taken.
.5 Inspection results.

2. Products

NOT USED

3. Execution

3.1 CLEANING - GENERAL

.1 Maintain following conditions during cleaning process:

.1 Manual and automatic valves are in full open position.

.2 By-pass valves are operated to ensure full flow through entire system.

.3 Safety devices, including pressure relief valves are functioning.

.4 System is operated with a minimum pressure of 35 kPa(g) at highest point.

3.2 CLEANING PROCEDURE

.1 Flush system to remove loose debris and solder slag.

END OF SECTION

1. General

1.1 REFERENCE DOCUMENTS

.1 Canadian Standards Association (CSA):

.1 CAN/CSA-B45 Series-02 (R2008), Plumbing Fixtures.
.2 CAN/CSA-Z317.1-09, Special Requirements for Plumbing Installations in Health Care Facilities.

.2 Plumbing fixtures shall meet or exceed CAN/CSA-B45 Series-02, Plumbing Fixtures

1.2 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Section 01 62 00 for requirements pertaining to product options and substitutions.

1.3 REGULATORY REQUIREMENTS

.1 Plumbing fixtures shall be approved by the authority having jurisdiction.

1.4 CERTIFICATIONS

.1 Plumbing fixtures shall be tested, certified and labelled in accordance with a certification program accredited by the Standards Council of Canada. Where a product is not so labelled, provide written approval by the authority having jurisdiction.

1.5 SOURCE OF SUPPLY

.1 Each of the following products shall be by a single manufacturer:

.1 Fixtures of the same type or group.
.2 Fittings of the same type.

1.6 COORDINATION

.1 Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

2. Products

2.1 FIXTURE BRASS AND ACCESSORIES

.1 Visible parts of fixture brass and accessories shall be heavily chrome plated.

2.2 WC-1: WATER CLOSET – SIPHON ACTION, WITH FLUSH VALVE

.1 Bowl: Floor mounted siphon jet action, vitreous china closet bowl with elongated rim, 4.8 lpf, 40 mm top spud. American Standard Madera Flowise Elongated #3451.001.020 HET Toilet.

.2 Flush Valve: Exposed chrome plated, diaphragm type 4.8 lpf with escutcheon, bumper, integral screwdriver stop and vacuum breaker. Wall mounted infrared sensor with stainless steel wall plate, manual override button. Sloan Royal Optima #111-1.28 ES-S-CP.

.3 Seat: Extra heavy duty, solid white plastic, elongated bowl, open front, extended back, less cover, complete with self-sustaining hinge. Centoco #500STSCCSS.001.

2.2 WC-2: WATER CLOSET – SIPHON ACTION, WITH FLUSH VALVE – BARRIER FREE

.1 Bowl: Floor mounted siphon action, vitreous china closet bowl with elongated rim, 4.8 lpf, 40 mm top spud. American Standard Madera Flowise Right Height Elongated #346.001.020 HET Toilet.

.2 Flush Valve: Exposed chrome plated, diaphragm type 4.8 lpf with escutcheon, bumper, integral screwdriver stop, vacuum breaker and extended seat bumper. Wall mounted infrared sensor with stainless steel wall plate, manual override button. Sensor to clear seat cover. Sloan Royal Optima #111-1.28 ES-S-CP-YG.

.3 Seat: Extra heavy duty, solid white plastic, elongated bowl, open front, extended back, with cover, complete with self-sustaining hinge, Centoco #820STSS.001.

2.3 WC-3: WATER CLOSET – SIPHON ACTION, WITH FLUSH TANK

.1 Bowl: Floor mounted, 4.8 lpf, vitreous china, reverse trap, close coupled closet combination with regular rim, insulated tank, flapper type flush valve, bolted tank cover, and china bolt caps. American Standard Cadet Pro Round Front #215DA.174.020 Toilet.

.2 Seat: Extra heavy duty, solid white plastic, regular bowl, open front, extended back, less cover, complete with check hinge. Centoco #300CC.001.

2.4 LAV-1: WASH FOUNTAIN

.1 Three station, off-floor, wall outlet, solid surface material, heavy gauge type 304 stainless steel bottom enclosure, with overflow, grid strainer, heavy gauge type 304 stainless steel sprayhead, sensor operation (plug-in transformer), ASSE 1070 compliant temperature/pressure balancing mixing valve with strainers and integral check, 38 mm ptrap, liquid / lotion Soap Dispenser, wall carrier. Acorn 3793-1-SO-DV

2.5 LAV-2: LAVATORY

.1 Lavatory: Wall hung, 540 x 520 mm minimum, vitreous china lavatory, with drillings on 100 mm centres, rear overflow, for carrier with concealed arms, recessed faucet ledge, semi pedestal P-trap cover, wall carrier. American Standard Murro #0954.004EC/0062.000EC.

.2 Trim: Chrome plated cast brass faucet, 100 mm centres, with 1.9 lpm spray head and integral infrared sensor, filtered solenoid valve, vandal proof box, thermostatic mixing valve with screwdriver adjustable temperature valve, transformer and grid strainer. Sloan EFT-600-LT.

2.6 LAV-3: LAVATORY

.1 Lavatory: Self-rimming, countertop 533 x 457 mm minimum, 304 stainless steel lavatory, with drillings on 100 mm centres, overflow, back ledge, undercoated, seal of putty, caulking or concealed vinyl gasket. Franke Commercial V1821 Series #V1821/5/3.

.2 Trim: Chrome plated cast brass faucet, 100 mm centres, with 1.9 lpm spray head and integral infrared sensor, filtered solenoid valve, vandal proof box, thermostatic mixing valve with screwdriver adjustable temperature valve, transformer and grid strainer. Sloan EFT-600-LT.

2.7 SK-1: CLASSROOM STAINLESS STEEL SINK

.1 Bowl: 630 x 554 x 203 mm O.D., Type 304SS, self-rimming, single compartment with two adjoining faucet ledges, undercoating, 90 mm crumb cups, 3 hole 200 mm drilling in ledgeback, and 1 hole bubbler in side ledge (right or left side to suit location). Franke Commercial #LB (L/R)S7008P-1/4.

.2 Trim: Two handle faucet, chrome plated, 200 mm centerset, lead free cast brass body, 1/4 turn ceramic disc valve cartridges, vandal resistant 5.7 LPM pressure compensating Softflo aerator outlet, 254 mm projection 360 degree swing gooseneck spout, 60 mm metal vandal proof lever handles with blue and red index buttons. Chicago Faucets #1100-GN10ASWG-E35VP-369-XK-ABCP

.3 Point of Use Thermostatic Water Mixing Valve: nickel plated bronze body, temperature adjusting spindle, 10 mm inlets and outlet FNPT connections, integral checks, offer temperature range between 35 °C and 46 °C Set valve temperature at 46 °C. Connect to hot water side of faucet. Lawler #570-86820.

.4 Bubbler: Deck mounted metering drinking bubbler, polished chrome plated solid brass body, self closing metering cartridge, 2.8 l integral flow. Chicago Faucet 748-665TBABCP.

2.8 SK-2: KITCHEN STAINLESS STEEL SINK

.1 Bowl: 794 x 521 x 203 mm O.D., Type 304SS, self-rimming, double compartment with ledgeback, undercoating, 90 mm crumb cups, 3 hole 200 mm drilling in ledgeback, Franke Commercial #LBD6408P-3.

.2 Trim: Two handle faucet, chrome plated, 200 mm centerset, lead free cast brass body, 1/4 turn ceramic disc valve cartridges, vandal resistant 5.7 LPM pressure compensating Softflo aerator outlet, 254 mm projection 360 degree swing gooseneck spout, 60 mm metal vandal proof lever handles with blue and red index buttons. Chicago Faucets #1100-GN10ASWG-E35VP-369-XK-ABCP

.3 Point of Use Thermostatic Water Mixing Valve: nickel plated bronze body, temperature adjusting spindle, 10 mm inlets and outlet FNPT connections, integral checks, offer temperature range between 35 °C and 46 °C Set valve temperature at 46 °C. Connect to hot water side of faucet. Lawler #570-86820.

2.9 SK-3: ART ROOM STAINLESS STEEL SINK

.1 Bowl: 991 x 635 x 356 mm O.D., Type 304SS, self-rimming, double compartment with ledgeback, undercoating, 90 mm crumb cups, 3 hole 200 mm drilling. Franke Commercial #LB (L/R)S7008P-4.

.2 Trim: Two handle faucet, chrome plated, 200 mm centerset, lead free cast brass body, 1/4 turn ceramic disc valve cartridges, vandal resistant 5.7 LPM pressure compensating Softflo aerator outlet, 254 mm projection 360 degree swing gooseneck spout, 60 mm metal vandal proof lever handles with blue and red index buttons. Chicago Faucets #1100-GN10ASWG-E35VP-369-XK-ABCP

.3 Point of Use Thermostatic Water Mixing Valve: nickel plated bronze body, temperature adjusting spindle, 10 mm inlets and outlet FNPT connections, integral checks, offer temperature range between 35 °C and 46 °C Set valve temperature at 46 °C. Connect to hot water side of faucet. Lawler #570-86820..4 Bubbler: Deck mounted metering drinking bubbler, polished chrome plated solid brass body, self closing metering cartridge, 2.8 l integral flow. Chicago Faucet 748-665TBABCP.

.4 Sediment Trap: Construct from epoxy finished welded steel and provide gasketed cover and removable stainless steel sediment basket, floor mounted. Watts SI-742-X.

2.10 SH-1: CABINET SHOWER

.1 Cabinet: 1524 x 914 x 1950 mm high cabinet made of fibre reinforced plastic, L-shaped fold-up seat, two grab bars, textured floor, curtain rod, built in soap dish, solid brass drain with SS grid strainer. MAAX Outlook BFS-6036F.

.2 Trim: Pressure balancing shower valve with 171 mm diameter wall trim face plate, on/off and temperature control, single lever handle, integral service stops and adjustable high limit stop. Hand shower, 5.7 lpm, 1500 mm long hose, in-line vacuum breaker, bracket and wall supply. Chicago Faucet SH-PB1-00-030.

2.11 WF-1: DRINKING FOUNTAIN

.1 Fountain: Wall mounted water cooler, 8 gph at 10^{O}C, stainless steel / ABS cabinet, bi-level, bottle filler, touchless sensor activation, wall carrier. Elkay EZH2O Bottle Filling Station Versatile Bi-level Filtered LZ Cooler #LZSTL8WSSP.

2.12 MS-1: SERVICE OR MOP SINKS

.1 Bowl: 610 x 610 x 305 mm terrazzo, floor mounted sink with SS top cap and strainer. Stern Williams #SB-900.

.2 Trim: Exposed wall type supply with ¼ turn lever handles, spout wall brace, vacuum breaker, end spout, strainers, bucket hook, integral screwdriver stops, 914 mm of 20 mm plain end reinforced rubber hose, hose clamp, mop hanger. Chicago Faucet # 897CP

3. Execution

3.1 INSTALLATION

.1 Install each fixture with its own trap, easily removable for servicing and cleaning. At completion thoroughly clean plumbing fixtures and equipment.

.2 Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers and escutcheons.

.3 Install wall mounted lavatories, urinals and water closets with approved wall carriers, model to suit installation.

.4 Solidly attach floor mounted water closets to floor with lag screws. Lead flashing shall not hold closet in place.

.5 Install hose and faucets and hose connections with vacuum breakers.

3.2 PROTECTION

.1 Protect fixtures against use and damage during construction.

3.3 FIXTURES ROUGH-IN SCHEDULE

.1 Rough-in fixture piping connections in accordance with following table of minimum sizes or as required for particular fixtures.

	Hot Water	Cold Water	Waste	Vent
Lavatories	15 mm	15 mm	40 mm	30 mm
Service Sink	15 mm	15 mm	50 mm	40 mm
Kitchen Sink	15 mm	15 mm	40 mm	30 mm
Drinking Fountain	-	15 mm	30 mm	30 mm
Water Closet (Flush Valve)	-	25 mm	100 mm	50 mm
Water Closet (Tank Type)	-	15 mm	100 mm	50 mm
Urinals (Flush Valve)	-	20 mm	50 mm	40 mm
Urinal (Tank Type)	-	15 mm	50 mm	40 mm
Floor Drains	-	-	100 mm	40 mm
Hose Bibbs	20 mm	20 mm		

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Mechanical General Requirements: Section 20 00 13.

1.2 REFERENCE DOCUMENTS

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

.1	ASTM B209M	Specification for Aluminum and Aluminum Alloy Sheet and Plate
.2	ASTM C335	Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation
.3	ASTM C411	Standard Test Method for Hot-Surface Performance of High Temperature Thermal Insulation
.4	ASTM C423	Standard Test Method for Sound Absorption and Sound Absorption Coefficients by Reverberation Room Method
.5	ASTM C449	Standard for Specification for Mineral Fiber Hydraulic–Setting Thermal Insulating and Finishing Cement
.6	ASTM C553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
.7	ASTM C921	Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
.8	ASTM C1071	Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
.9	ASTM G21	Standard of Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

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

.1	ASHRAE 90.1-2010	Energy Standard for Buildings Except Low-Rise Residential Buildings

.3 National Research Council of Canada

.1	NECB-2011	National Energy Code of Canada for Buildings

.4 National Fire Protection Association (NFPA):

.1 NFPA 255 Standard Method of Test of Surface Burning Characteristics of Building Materials

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

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible

.6 Thermal Insulation Association of Canada (TIAC)

.1 TIAC Mechanical Insulation Best Practice Guide

.7 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S102-10 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 01 33 23 – Shop Drawings, Product Data and Samples.

.1 Submit product data and test reports when requested to substantiate that insulation and recovery assemblies meet flame/smoke development ratings and performance requirements for the assembly and thickness used.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 23 – Shop Drawings, Product Data and Samples.

.1 Submit an insulation schedule, for each application include the following information:

.1 Materials
.2 "k" value
.3 Thickness
.4 Density
.5 Finish
.6 Jacketing

.3 Submit information showing installed insulation thicknesses meet the minimum performance requirements of the National Energy Code of Canada for Buildings 2011 (NECB-2011).

1.5 DEFINITIONS

.1 For the purposes of this section, the following definitions apply:

.1 Concealed: ductwork and equipment in shafts, furring, suspended ceilings and attics.

.2 Exposed: ductwork and equipment in mechanical rooms or otherwise not "concealed".

.3 "k" Value: thermal conductivity of insulating material per unit of thickness (W/m.°C) to ASTM C553.

1.6 FLAME/SMOKE DEVELOPMENT RATINGS

.1 Duct insulation, recovery materials, vapour barrier facings, tapes and adhesives shall have maximum flame spread rating of 25 and maximum smoke developed less than or equal to 50, when tested in accordance with CAN/ULC S102.

.2 Insulating materials and accessories shall withstand service temperatures without smoldering, glowing, smoking or flaming when tested in accordance with ASTM C411.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

1.8 QUALITY ASSURANCE

.1 Insulation materials shall be new, undamaged and of the respective types specified for each specific application.

.2 Installer to be specialist in performing work of this section and have at least 3 years successful experience with work of similar complexity and size as required for this project.

.3 Contractor and tradespeople hold a recognized credential to work as insulator in Alberta, and is a member of TIAC.

.4 Installation conforms to TIAC Mechanical Insulation Best Practices Guide.

2. Products

2.1 HOT DUCT INSULATION

.1 Hot Duct Insulation - Round and Oval:

.1 Material: flexible mineral fiber blanket insulation to ASTM C553 faced with factory applied vapour retarder jacket.
.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.
.3 Service Temperature: 20°C to 65°C.

.2 Hot Duct Insulation - Rectangular

.1 Material: rigid mineral fiber insulation to ASTM C612 with factory applied vapour retarder jacket.
.2 "k" Value: maximum 0.035 W/m.°C at 24°C mean temperature.
.3 Service Temperature: 20°C to 65°C.

2.2 COLD DUCT INSULATION

.1 Cold Duct Insulation - Round and Oval:

.1 Material: flexible mineral fiber blanket insulation.
.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.
.3 Service Temperature: -40°C to 65°C.
.4 Jacket: factory applied reinforced aluminum foil vapour barrier.

.2 Cold Duct Insulation - Round (Exposed to Outdoors):

.1 Material: semi-rigid mineral fiber in roll form.
.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature
.3 Service Temperature: -40°C to 65°C.
.4 Jacket: factory applied reinforced aluminum for vapour barrier.

.3 Cold Duct Insulation - Rectangular:

.1 Material: rigid mineral fiber insulation .
.2 "k" Value: maximum 0.038 W/m.°C at 24°C mean temperature.
.3 Service Temperature: 20°C to 65°C.
.4 Jacket: factory applied reinforced aluminum foil vapour barrier.

2.3 ACOUSTIC DUCTWORK INSULATION

.1 Material: rigid mineral fiber acoustical insulation to ASTM C1071, Type 2.

.2 Density: 48 kg/m^3 (minimum).

.3 Acoustic Properties: minimum NRC of 0.70 for 25 mm thickness based on Type A mounting to ASTM C423.

.4 "k" Value: maximum 0.035 W/m°C at 24°C mean temperature when tested in accordance with ASTM C177.

.5 Service Temperature: -40°C to 65°C.

.6 Surface Finish: air stream side coated to prevent fibre erosion with surface roughness not exceeding 0.58 mm.

2.4 BREECHING INSULATION

.1 Material: Semi-rigid mineral fiber with glass mat.
.2 "k" Value: Maximum 0.038 W/m°C at 24°C mean temperature.
.3 Service Temperature: 65°C to 450°C.

2.5 ACCESSORIES

.1 FSK Tape: vapour barrier tape consisting of laminated aluminum foil, glass fiber scrim and paper, with pressure sensitive self adhesive.

.2 ASJ Tape: vapour resistant tape consisting of all service jacket material with pressure sensitive self adhesive.

.3 Contact Adhesive: quick setting, adhesive to adhere flexible or rigid mineral fibre insulation to ducts.

.4 Lap Seal Adhesive: quick setting adhesive for joints and lap sealing of vapour barriers.

.5 Canvas Adhesive: dilute, washable, fire retardant lagging adhesive for cementing canvas jacket to duct insulation.

.6 Pins: welding pins 4 mm diameter shaft with 35 mm diameter head for installation through the insulation. Length to suit thickness of insulation with 32 mm square nylon retaining clips.

.7 Insulating Cement: hydraulic setting type for use on mineral fiber, meeting requirements of ASTM C449.

2.6 RECOVERY MATERIALS

.1 Canvas: ULC listed, 220 g/m^2 plain weave cotton fabric treated with fire retardant lagging adhesive to ASTM C921.

.2 Aluminum Jacket: ASTM B209, 0.5 mm thick stucco embossed with aluminum alloy butt straps and vapour barrier secured with mechanical fastener.

3. Execution

3.1 INSTALLATION, GENERAL

.1 Ductwork dimensions shown on drawings are clear inside free area measurement regardless of insulation placement or thickness. Fabricate ducts accordingly.

.2 Apply insulation after required duct system tests have been completed and inspected by the Province.

.3 Ensure duct surfaces are clean and dry before installing insulation.

.4 Install in accordance with TIAC Mechanical Insulation Best Practices Guide.

.5 Install in accordance with manufacturers recommendations.

.6 Install insulation over entire surface of duct, for full length of duct run including portions of duct passing penetrations through walls and floors.

.7 Install insulation in a manner to insure hangers and standing duct seams do not penetrate insulation.

.8 Locate finished seams in least visible location.

.9 Do not insulate ductwork with external thermal insulation where acoustic duct insulation has been specified.

.10 Install insulation at ambient temperatures within acceptable temperature ratings for tapes, sealants and adhesives.

3.2 HOT DUCT INSULATION APPLICATION

.1 Adhere insulation to round and oval ductwork with contact adhesive applied in 150 mm wide strips on 400 mm centres. Band on outside with wire to set adhesive.

.2 Butt insulation and seal joints with lap seal adhesive; cover joint ASJ tape.

.3 Secure rigid insulation on rectangular ducts with 50% area coverage using contact adhesive, impale on pins located 400 mm on centre, secure in place with retaining clips.

.4 Butt rigid insulation on rectangular ducts and seal joints with lap seal adhesive; cover joints with 100 mm strips of open mesh cloth imbedded between two coats of lap seal adhesive.

3.3 COLD DUCT INSULATION APPLICATION

.1 Adhere mineral fibre insulation to round and oval ductwork with adhesive applied in 150 mm wide strips on 400 mm centres. Band on outside and remove bands when mastic sets.

.2 Butt mineral fibre insulation and seal joints with lap seal adhesive; cover joint with FSK tape.

.3 Secure rigid insulation on rectangular ducts with 50% area coverage of adhesive and impale on pins located 400 mm on centre and secure in place with the retaining clips.

.4 Butt rigid insulation on rectangular ducts and seal joints with lap seal adhesive; cover joints with 100 mm strips of open mesh cloth imbedded between two coats of lap seal adhesive.

3.4 ACOUSTIC DUCT INSULATION APPLICATION

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

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

.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres.

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

.1 Bed tape in sealer.
.2 Apply two coats of sealer over tape.

.4 Replace damaged areas of liner at discretion of the Province.

.5 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

3.5 BREECHING INSULATION APPLICATION

.1 Face breeching with 10 mm rib lath turn out to provide 13 mm space between insulation and hot surface and 13 mm mesh expanded lath on the outside.

.2 Butt insulation firmly together and secure with 1.6 mm galvanized wire.

.3 Lace metal mesh together.

.4 Coat with 13 mm thick insulating cement.

.5 Finish with a final 13 mm coat of insulating. Trowel to a smooth hard finish.

.6 Recover with aluminum jacket.

3.6 EXPOSED DUCTS

.1 Provide recovery jackets on indoor exposed insulation throughout including equipment rooms:

.1 Mechanical rooms: canvas.
.2 Occupied spaces: aluminum.
.3 Equipment rooms: canvas.

.2 Cover insulation exposed to outdoors throughout with aluminum jacket secured with aluminum bands on 200mm centres. Seal all joints on jacket for weathertight finish with compatible water proof lap cement. Locate longitudinal joints in least weather exposed position. Slope top to prevent ponding on duct.

3.7 INSULATION TYPE AND THICKNESS SCHEDULE

Service Type	Insulation Type	Insulation Thickness (mm)
Exhaust and relief ducts within 3 m of exterior openings	Hot duct	50
Relief ducts and plenums	Hot duct	25
Supply ducts and plenums	Hot duct	25
Combustion air	Cold duct	50
Outside air	Cold duct	100
Mixing plenums	Cold duct	50
Supply air plenums	Cold duct	25
Medium pressure supply ducts	Cold duct	25
Low pressure supply ducts	Cold duct	25
Supply and return ducts exposed to outdoors	Cold duct	150
Supply and return ducts in cold attic spaces	Cold duct	100
Ventilation equipment	Cold duct	50
High and Medium pressure supply ducts	Acoustic	25
Low pressure supply and return	Acoustic	25
Plenums	Acoustic	25
Boilers	Breeching	50
Domestic hot water heaters, atmospheric burners	Breeching	25
Domestic hot water heaters, forced air burners	Breeching	50

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1	Contractor Start-Up Report Forms:	Division 01.
.2	Mechanical Equipment Starting and Testing:	Section 23 08 23.
.3	Mechanical System Starting and Testing:	Section 23 08 33.
.4	Balancing and Adjusting of Mechanical Equipment and Systems:	Section 23 08 83.
.5	EMCS Start-up and Testing:	Section 23 08 95.

1.2 MINISTER'S WITNESSING OF TESTS

.1 Minister may witness selected starting, testing, adjusting, balancing and cleaning procedures.

.2 Advise the Minister in advance that starting, testing, adjusting, balancing or cleaning processes are ready to commence. Consult with the Minister to determine which procedures he may elect to witness. Provide advanced notice prior to commencement of each procedure or series of procedures to allow Minister to arrange for witnessing of tests.

1.3 STARTING AND TESTING COSTS

.1 Pay costs associated with starting, testing, adjusting, balancing and cleaning, including supply of instruments, equipment, supplies, and consumable materials.

1.4 START-UP REPORTS

.1 Prepare Start-Up report using forms available from the Minister.

.2 Where forms are not available from the Minister for specific systems or equipment, prepare appropriate forms.

.3 Submit Start-Up reports as part of Operation and Maintenance Manual specified in Section 20 01 06.

1.6 QUALITY ASSURANCE

.1 Use personnel for starting, testing, adjusting and balancing procedures who have experience in mechanical equipment and systems commissioning, and are able to interpret results of readings and tests and report state of systems in a clear and concise manner.

1.7 MANUFACTURER'S RECOMMENDATIONS

.1 Prior to starting equipment or systems, obtain and review manufacturer's installation, starting and operating instructions. Read in conjunction with procedures specified herein.

.2 Use manufacturer's and supplier's trained personnel where necessary to maintain validity of manufacturer's warranty.

.3 Compare actual installation with manufacturer's recommended installation. Record discrepancies. Correct deviations detrimental to equipment performance prior to starting equipment.

1.8 REGULATORY REQUIREMENTS

.1 To facilitate expedient turnover of facility at Interim Acceptance of the Work, arrange for regulatory authorities to witness those specified starting procedures that duplicate tests required by regulatory authorities.

.2 Obtain certificates of approval and for compliance with regulations from authorities having jurisdiction. Include copies of certificates with start-up reports.

2. Products

2.1 TESTING INSTRUMENTS AND EQUIPMENT

.1 Provide testing instruments and equipment and ancillary equipment such as two-way radios and ladders required to perform starting, testing, adjusting and balancing of mechanical equipment and systems.

.2 Submit a list of testing instruments and equipment proposed for use to the Minister for approval.

.3 Use instruments supplied or calibrated by approved laboratory or manufacturer. Show the Minister original calibration certificate for each instrument to be used. Include copy of calibration certificates with test reports.

.4 Recalibrate instruments at frequency recommended by instrument manufacturer or, in absence of manufacturer's recommendations, as required by Associated Air Balance Council (AABC).

.5 Use testing instruments and equipment which meet following accuracy requirements:

Device	Range	Accuracy
Air Temperature	-40 to 75°C	±0.l0°C
Hydronic temperature	-40 to l20°C	±0.l0°C
Stack Temperature	-40 to 300°C	±1.00°C
Air Velocity Pressure	0 to 250 Pa	±2% of reading
Air Pressure	0 to 2500 Pa	±12.5 Pa
Hydraulic Pressure	0 to 1400 KPa	±2% of gauge
Air Velocity	0.1 to 20 m/s	±2% of gauge
Sound Meter	35 to 130 dB	ANSI S 1.4 Type 2
Octave Band Filters	63 to 8000 Hz	ANSI S 1.11 Class II
Humidity	10 to 90% RH	±3.0%

.6 Following testing instruments and equipment makes and models are also acceptable:

Equipment	Make	Model
Sound Level Meter	Quest	2700
Octave Band Filters	Quest	OB-50
Flue Gas Analyzer	Kane May	KM 9002
Stack Thermometer	Bacharach	12-7018
Tachometer (contact)	Ono-Sokki	HT-331
Tachometer (strobe)	Ono-Sokki	HT 441
Ammeter	Amprobe	ACD-2
CO Detector	G.C.Industries	GC 401
Sling Psychrometer	Bacharach	12-7018
Digital Humidity Sensor	Vaisala	HM 131 with HMP 31UT probe
Belt Tension Tester	Woods	
Inclined Manometer	Dwyer	400-10
Air Pressure Gauge	Magnahelic	
	-125 to 125 Pa	2300-250 Pa
	0 to 250 Pa	2000-250 Pa
	0 to 1000 Pa	2000-1 KPa
	0 to 1500 Pa	2000-1.5 KPa
Fluid Pressure Gauge	Marsh	0 to 60 psi
	Marsh	0 to 160 psi
	Marsh	30"Hg - 60 psi
Thermometer	Palmer	MS-13
Digital Thermometer	Fluke Multi-meter	8062A with 80T-150 surface probe 80PK-5 piercing probe
Digital Anemometer	ITM Instruments	DA 4000
Micromanometer	Shortridge	8420
Flow Hood	Shortridge	8400 with 8420 meter
Air Quality Monitor	Armstrong	AMC-l0l3P

3. Execution

3.1 USE OF INSTRUMENTS SUPPLIED UNDER CONTRACT

.1 Instruments for testing, adjusting and balancing supplied under this contract may be used provided the Minister is satisfied that instrument accuracy complies with requirements specified above and calibration certificate has been provided with each instrument.

.2 Use “Calibrated Air Flow Measuring Stations” to measure air flow during system balancing and coil performance testing.

.3 Use balancing valve pressure tappings, orifice plates, pitot tube fittings, etc. to measure fluid flow rates.

.4 Calibrated EMCS temperature, humidity and pressure sensors may be used to gather Contractor Start-up Program system performance data provided the Minister confirms that EMCS sensor calibrations have been completed and approved.

3.2 INSPECTION

.1 Do not conceal or cover equipment or systems until inspected, tested and approved by Minister.

3.3 COMPLIANCE WITH DEFINED PROCEDURES

.1 Failure to follow specified instructions pertaining to correct starting procedures may result in re-evaluation of equipment by independent testing agency selected by the Minister at Contractor's expense. Should results reveal equipment has not been started in accordance with specified requirements, equipment may be rejected. If rejected, remove equipment from site and replace. Replacement equipment will also be subject to full starting procedures, using same procedures specified for originally installed equipment.

3.4 CHECK SHEETS, FIELD REPORTS AND DATA

.1 Record all data gathered on site on start-up report forms.

.2 Make copies of all starting and testing data before equipment and system start-up personnel leave site. Maintain one copy of all data taken during starting on site.

.3 Maintain one copy of all final starting, testing, adjusting and balancing reports on site up to Interim Acceptance of the Work for reference purposes.

3.5 COORDINATION

.1 Prior to commencement of each particular testing procedure, coordinate all sub-trades, manufacturers, suppliers and other specialties to ensure all phases of work are properly completed. Establish necessary manpower requirements.

3.6 STARTING AND TESTING PHASES

.1 Starting and testing program generally consists of following five distinct phases:

.1 Pre-Starting: visual inspection
.2 Starting: actual starting procedure.
.3 Post-Starting: operational testing, adjusting or balancing and equipment run-in phase.
.4 Pre-Interim Acceptance of the Work: final cleaning, re-testing, balancing and adjusting and maintenance.
.5 Post-Interim Acceptance of the Work: retesting and fine-tuning of system to prove all deficiencies have been corrected.

.2 After each distinct phase of work has been completed, correct deficiencies before commencing the next phase.

END OF SECTION

1. General

1.1 INTENT

.1 Inspect, start and test each piece of mechanical equipment. Verify that equipment has been properly installed and is operating at a level which meets specified requirements.

1.2 RELATED REQUIREMENTS

.1	Contractor Start-Up Report Forms:	Division 01.
.2	Mechanical General Requirements:	Section 20 00 13.
.3	Operation and Maintenance Manuals:	Section 20 01 06.
.4	General Mechanical Starting and Testing Requirements:	Section 23 08 13.
.5	Balancing and Adjusting of Mechanical Equipment and Systems:	Section 23 08 83.

1.3 FACTORY TRAINED REPRESENTATIVES

.1 Use factory trained representatives and submit manufacturer's check sheets for starting following specialty equipment:

.1 Air handling units.
.2 Boilers.
.3 Variable speed drive units.
.4 Air flow measuring stations.
.5 Control components.
.6 Chemical cleaning and treatment.

.2 Use manufacturers factory trained personnel where required to maintain manufacturer's warranty.

2. Products

Not Used

3. Execution

3.1 FUEL FIRED EQUIPMENT - BOILERS

.1 Pre-Starting:

.1 Verify that installation is as drawn and specified and in accordance with manufacturer's recommendations.

.2 Complete manufacturer's installation and start-up check sheets and include following items on check sheets:

.1 Boiler is level on housekeeping base.

.2 Flue and chimney installed without visible damage.

.3 No visible damage to boiler jacket.

.4 No visible damage to refractory or combustion chamber.

.5 Check PRVs for correct operation and specified relief pressure. Adjust as required.

.6 Clearances have been provided and piping is flanged for easy removal and servicing.

.7 Heating circuit pipes have been connected to correct ports.

.8 Labels are clearly visible.

.9 Boiler, burner and flue completely clean and free of construction debris.

.10 Burner blower rotates in correct direction.

.11 Pressure and temperature gauges installed.

.12 Controls completed.

.3 Ensure pumps are operational.

.4 Check for proper operation of pressure reducing valve on gas train, including venting.

.5 Ensure boiler fluid level, flow switch and high temperature interlocks are in place.

.6 Obtain following from manufacturer and submit as specified in Section 20 00 13:

.1 All equipment performance selection tables.
.2 Manufacturer's equipment start-up sheets.

.2 Starting:

.1 Start pumps.

.2 Perform starting of boilers and adjustment of burners using manufacturer's factory trained personnel.

.3 Fill out start-up sheets and attach copy with Contractor Start-Up Report.

.4 Check and record performance of all factory provided boiler protection devices, and firing sequences.

.5 Check and record performance of boiler fluid level, flow switch and high temperature interlocks.

.6 Run-in as recommended or required by manufacturer.

.3 Post Starting:

.1 Perform following tests for each firing rate for high/low burners and for 100%, 66%, and 33% load for modulating burners. Adjust boiler combustion efficiency (%) at each firing rate to that specified or advertised by manufacturer, if latter is higher.

.1 Measure gas pressure on manifold**.**

.2 Measure combustion air temperature at inlet to burner.

.3 Measure flue gas temperature at boiler discharge.

.4 Perform flue gas analysis. Measure and record flue gas CO^2 and O^2 concentration.

.5 Measure natural flue draft.

.2 Measure water flow rate, pressure drops, and temperature rise through each boiler.

.3 Inspect expansion tank**,** make-up water meter, tank pressure, PRV, water level and backflow preventer.

.4 Pre-Interim Acceptance: - Not applicable.

3.2 FUEL FIRED EQUIPMENT - SERVICE WATER HEATERS

.1 Pre-Starting:

.1 Verify that installation is as drawn and specified and in accordance with manufacturer's recommendations.

.2 Complete manufacturer's installation and start-up check sheets and include following items on check sheets:

.1 Heater is level on housekeeping base.

.2 Flue and chimney installed without visible damage.

.3 No visible damage to heater jacket.

.4 No visible damage to refractory or combustion chamber.

.5 Check PRVs for correct operation and specified relief pressure. Adjust as required.

.6 Clearances have been provided and piping is flanged for easy removal and servicing.

.7 Labels are clearly visible.

.8 Heater, burner and flue completely clean and free of construction debris.

.9 Burner blower rotates in correct direction.

.10 Controls completed.

.11 Tank has dielectric unions on piping connections.

.3 Verify that chemical sterilization of piping system is completed.

.4 Ensure circulation pump is operational.

.5 Check for proper operation of pressure reducing valve on gas train, including venting.

.2 Starting:

.1 Ensure pilot is operating.

.2 Ensure tank is full of water, vented and flushed.

.3 Ensure thermostat is set at 50°C.

.4 Start as recommended by manufacturer.

.5 Fill out start-up sheets and attach copy with Contractor Start-Up Report.

.6 Check and record performance of all factory provided protection devices, and firing sequences.

.7 Run-in as recommended or required by manufacturer.

.3 Post-Starting:

.1 Measure gas pressure on manifold.

.2 Measure combustion air temperature at inlet to burner.

.3 Measure flue gas temperature at boiler discharge.

.4 Perform flue gas analysis. Measure and record flue gas CO^2 and O^2 concentration.

.5 Measure natural flue draft.

.6 Adjust heater combustion efficiency (%) to that specified, or advertised by manufacturer if latter is higher.

.7 Fill tank with cold domestic water and determine tank recovery time.

.4 Pre-Interim Acceptance:

.1 Drain tank, refill and vent.

3.3 FLUID HANDLING EQUIPMENT - PUMPS

.1 Pre-Starting:

.1 Verify that installation is as drawn and specified and in accordance with manufacturer's recommendations.

.2 Complete manufacturer's installation and start-up check sheets and include following items on check sheets:

.1 Pump is level.

.2 Isolation valves, strainers, check valve, pressure gauges, by-pass filter and flow meter are installed properly.

.3 Pump suction has sufficient length of straight run piping.

.4 Air has been completely bled off piping system.

.5 Expansion tank is charged and on-line.

.6 Strainers have clean screens in place.

.7 Where specified for large pumps, check pump base vibration isolation and flexible connections on water pipes are properly installed.

.8 Nameplate is readily visible.

.9 Check clearance space is adequate for pump servicing and removal.

.2 Starting:

.1 Start as recommended by manufacturer.

.2 Fill out start-up sheets and attach copy with Contractor Start-Up Report.

.3 Check impeller is rotating in correct direction.

.3 Post Starting:

.1 Run-in pumps for minimum 12 continuous hours.

.2 Ensure flows through parallel pumps are equally balanced.

.3 Ensure mechanical seals do not leak, or packing gland type seals are wetted.

.4 Check pump NPSH - net positive suction head.

.5 Where vibration isolation is specified, check for correct static deflection of unit vibration isolators, and that start up and shut down deflection is within resilience limits of isolators and flexible connections.

.6 Verify that motor has sufficient air flow through casing to provide cooling.

.4 Pre-Interim Acceptance:

.1 Clean strainers.
.2 Replace shaft seals if pump has been used to degrease system.

3.4 FLUID HANDLING EQUIPMENT - HEAT EXCHANGERS

.1 Pre-Starting:

.1 Verify that installation is as drawn and specified and in accordance with manufacturer's recommendations.

.2 Complete manufacturer's installation and start-up check sheets and include following items on check sheets:

.1 Vessel is level on housekeeping base.

.2 PRVs are properly installed and operational.

.3 Clearances have been provided and piping is flanged for easy removal and servicing.

.4 Primary and Secondary circuit pipes have been connected to correct ports.

.5 Nameplate and labels are clearly visible.

.6 Unit is clean of foreign matter. Remove heads to inspect for cleanliness as required.

.7 Control valve piping is connected for correct flow through valve body and for required fail safe action of valve.

.8 Insulation is complete.

.3 Ensure Primary and Secondary side pumps are complete and operational.

.2 Starting: not applicable.

.3 Starting: Refer to Section 23 08 83 - Balancing and Adjusting of Mechanical Equipment and Systems.

.4 Pre-Interim Acceptance: not applicable.

3.5 FLUID HANDLING EQUIPMENT - COILS

.1 Pre-Starting:

.1 Verify that installation is as drawn and specified and in accordance with manufacturer's recommendations.

.2 Complete manufacturer's installation and start-up check sheets and include following items on check sheets:

.1 Pipe connections have been correctly made for counter current heat exchange between air and fluid.

.2 Clearances have been provided and piping is flanged for easy removal and servicing.

.3 Coil air vent and drain valve and deadleg drain valves have been provided.

.4 Coil is sloped to ensure complete drain down.

.5 Pressure and temperature tappings, Pete's plugs, have been provided.

.6 Fins inspected and combed straight as required.

.7 Cooling coil drain pan and trapped drain line installed correctly.

.8 Labels are clearly visible

.9 Control valve piping is connected for correct flow through valve body and for required fail safe action of valve.

.2 Starting:

.1 Check operation of cooling coil condensate drain with supply fan at maximum air flow. Ensure that condensate will drain away against maximum suction pressure of supply fan. Check for and eliminate condensate carry over at maximum air velocity.

.3 Post-Starting: refer to Section 23 08 83 - Balancing and Adjusting of Mechanical Equipment and Systems.

.4 Pre-Interim Acceptance: not applicable.

3.6 FLUID HANDLING EQUIPMENT - MISCELLANEOUS

.1 Gauges and Thermometers:

.1 Confirm all gauges and thermometers can be read from the floor level and are installed as recommended by manufacturer.

.2 Calibrate.

.2 Verify following equipment is installed as recommended by manufacturer. Fill out manufacturer's start-up sheets:

.1 PRVs.
.2 Air eliminators.
.3 Strainers.
.4 Check valves.
.5 Balancing valves.
.6 Plumbing fixtures.
.7 Backflow preventers.
.8 Vacuum breakers.

3.7 AIR HANDLING EQUIPMENT - AIR HANDLING UNITS

.1 Pre-Starting:

.1 Check that installation is as drawn and specified and in accordance with manufacturer's recommendations.

.2 Complete manufacturer's installation and start-up check sheets including following:

.1 Air blender, mixing baffles.

.2 Fresh, Exhaust and Recirculation air motorized dampers, operation and size.

.3 Filters.

.4 Check that fan base vibration isolation and flexible connections to ductwork are properly installed.

.5 Special features, access doors, liners, inlet vanes, labels.

.6 For variable volume systems, ensure variable volume/speed controller is operational.

.7 Ensure silencers are installed.

.2 Lubricate bearings on fans as recommended by manufacturer. Ensure fan wheels rotate in correct direction without binding. Adjust belts to proper alignment and tension.

.3 Vacuum clean air systems.

.4 Ensure temporary filters are installed. **Never** operate system without filters installed.

.5 Ensure all balancing and fire dampers are open and ductwork is complete. For VAV systems ensure at least 60% of boxes are open.

.6 Ensure all coils are in operation. If outside air temperature is less than 2°C ensure coils are dry or filled with glycol.

.7 On parallel fan systems ensure backdraft dampers are installed.

.8 Ensure electrical connections are complete and system disconnects are within sight of unit.

.9 Ensure controls are operational.

.10 Ensure inlet and discharge duct geometry is correct.

.2 Starting:

.1 Follow manufacturer's recommendations.

.3 Post-Starting:

.1 Start fan, for variable speed fans run up to maximum speed, and check for vibration free operation.

.2 Check for correct static deflection of unit vibration isolators, and that start-up and shut down deflection is within resilience limits.

.3 Run for one day and check filters, coils, and humidifier for bypass. Seal as required.

.4 Check that bearings are not overheating.

.4 Pre-Interim Acceptance:

.1 Replace temporary filters with permanent filters.
.2 Vacuum clean heating and cooling coils.
.3 Lubricate bearings.
.4 Check belts for tension and wear.

3.8 AIR HANDLING EQUIPMENT - FANS

.1 Pre-Starting:

.1 Check that installation is as drawn and specified and in accordance with manufacturer's recommendations.

.2 Complete manufacturer's installation and start-up check sheets including following:

.1 Backdraft dampers.
.2 Accessories.
.3 Special features.
.4 Check that fan base vibration isolation and flexible connections to ductwork are properly installed.

.3 Lubricate bearings on fans as recommended by manufacturer.

.4 Ensure fan wheels rotate in correct direction without binding.

.5 Adjust belts to proper alignment and tension.

.6 Ensure ductwork and fan casing is free of dirt or foreign material.

.7 Ensure electrical connections are complete and disconnect is within sight of fan.

.8 Ensure inlet and discharge duct geometry is correct.

.2 Starting:

.1 Follow manufacturer's recommendations.

.3 Post-Starting:

.1 Start fan, for variable speed fans run up to maximum speed, and check for vibration free operation.

.2 Check for correct static deflection of unit vibration isolators, and that start-up and shut down deflection is within resilience limits.

.3 Check that bearings are not over heating.

.4 Pre-Interim Acceptance:

.1 Lubricate bearings.
.2 Check belts for tension and wear.

3.9 AIR HANDLING EQUIPMENT - AIR FLOW MEASURING STATIONS

.1 Pre-Starting:

.1 Check that installation is as drawn and specified and in accordance with manufacturer's recommendations. Check following:

.1 Manufacturer's recommended length of duct ahead and behind flow station.

.2 Straightening vane installed before flow station.

.3 Flow station located away from fan discharges, silencer outlets, duct branches, etc.

.4 No take off branches have been placed ahead of measuring station location.

.5 Straight section of duct adjacent to flow station to take air flow measurement duct traverses.

.6 Air flow measuring station sized for adequate velocity pressure range, and transducer range is compatible with design velocity range of flow station.

.2 Starting: not applicable.

.3 Post-Starting: refer to Section 23 08 83.

.4 Pre-Interim Acceptance: not applicable.

3.10 AIR HANDLING EQUIPMENT - VAV BOXES

.1 Pre-Starting:

.1 Check that each installation is as drawn and specified and in accordance with manufacturer's recommendations. Check following:

.1 Inlet duct connection:

.1 shall have four duct diameters to box inlet.

.2 shall not have more than 150 mm flexible connection between duct and box.

.3 shall not have flow straightening vanes.

.2 Access to controls.

.3 Completeness of control connections.

.4 Silencer/acoustic duct.

.5 No damage to exterior casing or controls.

.6 Box support adequate.

.7 Nameplate and identification tag is visible.

.2 Starting: not applicable.

.3 Post-Starting: refer to Section 23 08 83.

.4 Pre-Interim Acceptance: not applicable.

3.11 AIR HANDLING EQUIPMENT - UNIT AND CABINET HEATERS

.1 Pre-Starting:

.1 Check each installation is as drawn and specified and in accordance with manufacturer's recommendations. Check following:

.1 Piping connections.
.2 Unit vibration isolation.
.3 Ducting connections.
.4 Controls.
.5 Disconnect switches.
.6 Unit clean.

.2 Starting: as recommended by manufacturer.

.3 Post-Starting: refer to Section 23 08 83.

.4 Pre-Interim Acceptance: not applicable.

3.12 AIR HANDLING EQUIPMENT - MISCELLANEOUS

.1 Refer to Section 23 08 83.

3.13 MISCELLANEOUS EQUIPMENT - VARIABLE SPEED DRIVE UNITS

.1 Pre-Starting:

.1 Obtain following from manufacturer and submit as specified in Section 20 00 13.

.1 All equipment performance selection tables.
.2 Manufacturer's equipment start-up sheets.

.2 Verify that installation is as specified and in accordance with manufacturer's recommendations.

.2 Starting:

.1 Start variable speed controllers and motor powered from each drive using manufacturer’s factory trained personnel.

.2 Fill out start-up sheets and attach copy with Contractor Start-Up Report.

.3 Check and record operation of all factory provided protection devices.

.4 Run-in as required and recommended by manufacturer.

.3 Post Starting:

.1 Run motor up to maximum speed, check ampere draw. Check and set overloads.

.2 Check manual override control and manual speed control of motor

.3 Put speed controller in automatic, command motor to full speed and check that motor speed ramp operates correctly accelerating motor to maximum speed without tripping. Command motor to minimum speed and observe controlled deceleration of motor.

.4 Pre-Interim Acceptance: not applicable.

3.14 MISCELLANEOUS EQUIPMENT - TANKS

.1 Pre-Starting:

.1 Verify that installation is as drawn and specified and in accordance with manufacturer's recommendations. Check following:

.1 Tank is level on housekeeping base.

.2 No visible damage to vessel.

.3 Check PRVs for correct operation and specified relief pressure. Adjust as required.

.4 Clearances have been provided and piping is flanged for easy removal and servicing.

.5 Labels are clearly visible.

.6 Controls, gauges, alarm devices, etc. are operational.

.7 Access ports/manholes provided.

.8 Piping sizes - inlet/outlet are correct.

.9 Lining is intact and not damaged.

.10 Tank has dielectric unions on piping connections.

.2 Starting: not applicable.

.3 Post-Starting:

.1 Verify operation of:

.1 Drain line.
.2 Make-up line if applicable.
.3 Gauge glass.
.4 Diaphragm if applicable.

.4 Pre-Interim Acceptable: not applicable.

3.15 MISCELLANEOUS EQUIPMENT - AIR COOLED CONDENSERS

.1 Pre-Starting:

.1 Check that installation is as drawn and specified and in accordance with manufacturer's recommendations.

.2 Complete manufacturer's installation and start-up check sheets including following:

.1 No physical damage to unit has occurred.

.2 All access doors move freely and are weathertight.

.3 Unit is free of foreign debris.

.4 All bolts, screws are tight.

.5 Condenser base vibration isolation and flexible connections on refrigerant pipes are properly installed.

.6 Controls complete.

.7 Check acoustic insulation.

.8 Fan guards are installed.

.3 Lubricate bearings on fans as recommended by manufacturer.

.4 Ensure fan wheels rotate in correct direction without binding.

.5 Adjust belt to proper alignment and tension.

.2 Starting:

.1 Start in accordance with manufacturer's instructions.
.2 Complete manufacturers starting check sheet.

.3 Post-Starting:

.1 Ensure all fan guards are tight.
.2 Check air flows over coils.
.3 Check operation of condenser capacity control device.
.4 Ensure vibration isolation and flexible connections to unit properly damp vibration transmission to structure.

.4 Pre-Interim Acceptance:

.1 Lubricate bearings.
.2 Adjust belt tension.

3.16 MISCELLANEOUS EQUIPMENT - FIRE EXTINGUISHERS

.1 Check the number, make, model and capacity of each portable fire extinguisher.

.2 Check the pressure drop on each extinguisher over 20 day period. Replace units loosing charge.

.3 Check that all cabinets are clean and door latch functions correctly.

END OF SECTION

1. General

1.1 INTENT

.1 Inspect, start-up and commission each system to prove that each system meets its specified operating criteria.

1.2 RELATED REQUIREMENTS

.1	Construction Schedules:	Division 01.
.2	Contractor Start-up Report Forms:	Division 01.
.3	Cleaning Domestic Water Systems:	Section 22 11 20.
.4	General Mechanical Starting and Testing Requirements:	Section 23 08 13.
.5	Mechanical Equipment Starting and Testing:	Section 23 08 23.
.6	Pressure Testing:	Section 23 08 43.
.7	Balancing and Adjusting of Mechanical Equipment and Systems:	Section 23 08 83.
.8	Mechanical Equipment and Systems Demonstration and Instruction:	Section 23 08 93.
.9	EMCS Start-up and Testing:	Section 23 08 95.
.10	Energy Management and Control System (EMCS) General Requirements:	Section 23 09 23.
.11	EMCS Control Sequences:	Section 23 09 93.
.12	Cleaning and Chemical Treatment - General Requirements	Section 23 25 02.
.13	Cleaning and Chemical Treatment of Hydronic System:	Section 23 25 13.
.14	Cleaning and Chemical Treatment of Glycol Systems:	Section 23 25 26.
.15	Fire Alarm System Verification:	Division 26.
.16	Sewer System	Section 33 30 10.

1.3 REFERENCE DOCUMENTS

.1 Canadian Standards Association (CSA):

.1	NFPA 13-2010	Standard for the Installation of Sprinkler Systems
.2	NFPA 14-2010	Standards for the Installation of Standpipe and Hose Systems
.3	NFPA 20-2010	Standards for the of Stationary Pumps for Fire Protection

1.4 FACTORY TRAINED REPRESENTATIVES

.1 Use factory trained representatives for starting of the following specialty systems:

.1 Controls
.2 Sprinkler

.2 Use manufacturers' representatives where required to maintain manufacturers' warranties.

2. Products

Not Used.

3. Execution

3.1 OPERATIONAL TESTS

.1 Conduct operational tests after mechanical installations have been completed and pressure tested to demonstrate that equipment and systems meet specified performance requirements. Conduct these tests as soon as conditions permit. Make changes, repairs, adjustments, and replacements required as tests may indicate.

.2 Conduct pre-operational tests, processes and inspections in presence of the Minister, if so requested by the Minister.

.3 Conduct final operational tests in presence of the Minister. Vary loads to illustrate start-up and shut down sequences. Simulate emergency conditions for safety shut downs, with automatic and manual reset. Repair and retest defects until satisfactory results are achieved. Make final adjustments to suit exact building conditions.

3.2 AIR SYSTEMS

.1 Inspect air systems including ductwork layout, support, and vibration isolation before pressure testing any section of ductwork. Notify Minister when work is ready for inspection.

.2 Power vacuum all ducts 900 mm and larger.

.3 Pressure test sections of ductwork, in accordance with Section 23 08 43, prior to application of insulation or concealment. Notify Minister two working days prior to any system pressure test.

.4 Test drop fire dampers in accordance with Section 23 08 83. Notify Minister two working days prior to fire damper testing.

.5 Air Handling Unit: start-up and performance verification using manufacturer's representative. Provide two working days notice to the Minister.

.6 Start up coil circulators, humidifier spray pumps, exhaust air systems, etc.

.7 Variable Volume Air Systems:

.1 Performance test and calibrate Air Flow Measuring Stations in accordance with Sections 23 08 83 and 23 08 95.

.2 Prove that fan variable volume controls are operational including EMCS control software.

.8 Demonstrate operation of mixing section, blender, filters, freeze protect, fire alarm interlocks, etc.

.9 Performance test fans, coils, humidifier, etc. in accordance with Section 23 08 83.

.10 Balance air systems in accordance with Section 23 08 83. Complete and submit Air Systems balance report to Minister.

.11 If necessary change pulley drives to correct volume up or down on constant volume systems, and to correct volume up on variable volume systems.

.12 Perform acoustic survey in accordance with Section 23 08 83. Rectify any noise problems encountered.

.13 Complete and submit Air Systems Start-up report as specified in Section 23 08 13.

.14 Conduct Mechanical Systems Demonstration and Instruction in accordance with Section 23 08 93.

3.3 HYDRONIC SYSTEMS

.1 Inspect piping layout, pipe support, expansion provisions, slope for draining and venting, vibration isolation, etc. before pressure testing any section of pipework. Notify Minister when work is ready for inspection.

.2 Pressure test sections of pipework, in accordance with Section 23 08 43, prior to application of insulation or to concealment.

.3 Pressure test each completed system, in accordance with Section 23 08 43, before any equipment is started. Notify Minister two working days prior to any system pressure test.

.4 Start-up pumps.

.5 Heating appliance: perform start-up and performance verification using manufacturer's representative. Provide two working days notice to the Minister.

.6 Rough balance system to ensure fluid circulation in every circuit. Rough balance cooling systems by velocity or pressure drop measurements at each circuit or component. Rough balance heating systems by temperature drop measurement.

.7 Chemically clean water filled system in accordance with Section 23 25 13 and glycol filled systems in accordance with 23 25 26. Notify Minister two working days prior to any system cleaning.

.8 Chemically treat water filled systems in accordance with Section 23 25 13 and glycol systems in accordance with Section 23 25 26.

.9 Fine balance systems in accordance with Section 23 08 83. Complete and submit Hydronic Systems balance report to Minister.

.10 Check system for fluid or pump noise in pipes. Rectify as necessary.

.11 Provided the flow rate exceeds that specified, shave impeller on pumps larger than 1.5 kW if current draw exceeds motor full load amps or if there is excess flow which results in excessive pipe noise in adjacent occupied areas.

.12 Complete and submit Hydronic systems Start-up report as specified in Section 23 08 13.

.13 Conduct Mechanical Equipment and Systems Demonstration and Instruction in accordance with Section 23 08 93.

3.4 CONTROL SYSTEMS

.1 Pressure test completed pneumatic system, in accordance with Section 23 08 43, before any equipment is started. Notify Minister two working days prior to system pressure test.

.2 Start-Up and performance test control air compressor and drier.

.3 Load Physical Point Data Base, start/stop schedules, alarms, run time logs, trend logs, etc. into EMCS control panels in accordance with Section 23 08 95.

.4 Commence 30 day trial use period by Minister.

.5 Perform EMCS Physical Point verification and calibration in accordance with Section 23 08 95. Complete and submit Control Systems verification report to the Minister.

.6 Load and debug custom control software in accordance with Section 23 09 93.

.7 Calibrate room thermostats.

.8 Provide Operator training at EMCS terminal in accordance with Section 23 09 23.

3.5 DOMESTIC WATER SYSTEMS

.1 Inspect domestic water systems including piping layout, pipe support, expansion provisions, and slope for draining and venting, before pressure testing any section of pipework. Notify Minister when work is ready for inspection.

.2 Pressure test sections of pipework, in accordance with Section 23 08 43, prior to application of insulation or to concealment.

.3 Pressure test each completed system, in accordance with Section 23 08 43, before any equipment is started. Notify Minister two working days prior to any system pressure test.

.4 Start domestic hot water systems' circulator pumps.

.5 Domestic hot water heating appliance: perform start-up and performance verification using manufacturer's representative. Provide two working days notice to the Minister.

.6 Balance Domestic Hot Water system return circulation circuits by temperature drop measurement.

.7 Sterilize Domestic water systems in accordance with Section 22 11 20. Notify Minister two working days prior to any system sterilization.

.8 Ensure all air chambers and expansion compensators are properly installed.

.9 Ensure entire system can be completely drained.

.10 Check operation of water hammer arrestors. Let one outlet run for ten seconds, then shut water off quickly. If water hammer occurs, replace water hammer arrestor. Repeat for each outlet and flush valve.

.11 Complete and submit Domestic Water systems Start-up report as specified in Section 23 08 13.

.12 Conduct Mechanical Equipment and Systems Demonstration and Instruction in accordance with Section 23 08 93.

3.6 PLUMBING DRAINAGE SYSTEMS

.1 Refer to Section 33 30 10 for inspection of Sewer Systems below ground, and Section 33 34 05 for pressure testing of Sanitary Sewage Force Mains.

.2 Inspect plumbing drainage systems including above ground drainage piping layout, pipe support, slope, venting, before pressure testing or concealing any section of the work. Notify Minister when work is ready for inspection.

.3 Hydraulically test above ground installations within buildings in accordance with Section 23 08 43. Notify Minister two working days prior to any system pressure test.

.4 Ensure all traps are fully primed.

.5 Ensure all fixtures are properly anchored and connected to system.

.6 Flush each valve, drain each sink and operate each fixture to ensure drainage and trap anti-siphon venting is effective.

.7 Open each cleanout, cover with linseed oil and reseal each cleanout. Ensure each cleanout is fully accessible and access doors are properly installed.

.8 Ensure roof drain metal domes are installed. Ensure storm piping is free of debris or roof insulation ballast. Remove caps as required. Verify insulation on piping is as specified in Section 20 20 30.

.9 In addition to pressure tests on chemical waste piping check the following:

.1 Chemical dilution [pit] [tank] installation.
.2 Manhole at street.
.3 Bottle traps properly installed and accessible.

.10 In addition to pressure tests check following on kitchen waste systems:

.1 Piping is installed to withstand 82°C discharge from dishwashers, boiler blowdown, etc.

.2 Grease trap is accessible and properly installed.

.11 Complete and submit Drainage systems Start-up report as specified in Section 23 08 13.

.12 Conduct Mechanical Equipment and Systems Demonstration and Instruction in accordance with Section 23 08 93.

3.7 SPRINKLER SYSTEMS

.1 Inspect standpipe and sprinkler systems including piping layout, pipe support, slope for draining, before pressure testing any section of pipework. Notify Minister when work is ready for inspection.

.2 Pressure test Standpipe and Sprinkler systems, in accordance with Section 23 08 43, before any equipment is started. Notify Minister two working days prior to any system pressure test.

.3 Ensure all equipment used has ULC labels visible.

.4 Start fire and jockey pumps as specified in Section 23 08 23.

.5 Ensure all valves in sprinkler system are monitored and are clearly visible.

.6 Ensure all flow switches are installed and are operational.

.7 Flush systems as follows:

.1 Fill with water, let stand at full operating pressure for one week. Drain each riser separately, then drain main.

.2 Repeat above procedure three times.

.8 Perform flow tests required by:

.1 Alberta Building Code.
.2 Authorities having jurisdiction.
.3 NFPA 13 - Standard for the Installation of Sprinkler Systems.

.9 Record incoming water pressure to building once a day for ten days prior to activating system.

.10 Adjust PRV on pump discharge to achieve maximum pressure of 620 kPa at top hose station. Adjust PRVs at lower hose stations to 550 kPa maximum.

.11 Test and place sprinkler valve into operation. Adjust pressure switches.

.12 Coordinate verification of fire alarm system with Division 26.

.13 Record flow and pump pressure for fire and jockey pumps and inlet water pressure.

.14 Complete and submit Standpipe and Sprinkler systems Start-up report as specified in Section 23 08 13.

.15 Conduct Mechanical Equipment and Systems Demonstration and Instruction in accordance with Section 23 08 93.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Operation and Maintenance Manuals: Section 20 01 06.
.2 General Mechanical Starting and Testing Requirements: Section 23 08 13.

1.2 REFERENCE DOCUMENTS

.1 Canadian Standards Association (CSA):

.1 CAN/CSA-Z305.1-92 (R2001) Nonflammable Medical Gas Piping Systems

.2 National Fire Protection Association (NFPA):

.1 NFPA 96-2008 Standard for Ventilation Control and Fire Protection of Commercial Cooking Equipment

1.3 QUALITY ASSURANCE

.1 Pressure test ducts, piping, equipment and systems where required by specification or by authority having jurisdiction to demonstrate that equipment and systems are safe to operate.

.2 Use pressure test procedures published by ASME, ASHRAE, and other industry recognized organizations.

.3 The Minister may witness pressure tests at the Minister's discretion.

.4 Do not conceal or cover piping, ductwork, fixtures or equipment until inspected, pressure tested and approved by the Minister. Provide ample written notice to the Minister before concealing any part of any system.

1.4 CERTIFICATIONS

.1 Obtain certificates of approval or compliance with rules and regulations from authorities having jurisdiction. Provide copies for inclusion in the Operating and Maintenance Manuals.

.2 Provide a certificate for each test. Provide copies of certificate for inclusion in Operation and Maintenance Manuals.

.3 Include following information on pressure test certificate:

.1 Project name and location.
.2 System, sub-system or portion of system tested.
.3 Time and date.
.4 Test pressure and duration of test.
.5 Results of test.

2. Products

Not Used

3. Execution

3.1 PRESSURE TESTS

.1 Provide equipment, materials, testing media and labour for pressure testing and pay all expenses. Use pressure test instruments meeting requirements specified in Section 23 08 13.

3.2 PRESSURE TESTING OF PIPED SYSTEMS

.1 Verify that:

.1 All valves are accessible.
.2 Instrument tappings are accessible, and adequate clearance has been provided to attach instruments.
.3 All pipe expansion has been allowed for.

.2 Carry out pipe and system pressure tests for 8 hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and retest.

.3 Heating water/glycol system: test to minimum of 1.5 times maximum working pressure or 1050 kPa water pressure at lowest point of system/section being tested.

.4 Domestic water system: test to minimum of 1.5 times maximum working pressure or 1050 kPa water pressure at lowest point of system/section being tested.

.5 Drainage systems: test by filling with water to produce water pressure of 30 kPa minimum and 75 kPa maximum. Use ball test to check for proper grade and that system is free of obstructions.

.6 Gas piping: test as required by authorities having jurisdiction.

.7 Sprinkler system: test as required by authorities having jurisdiction.

.8 Refrigerant piping: test with nitrogen to 2100 kPa on high pressure side and 1050 kPa on low side.

.9 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air or nitrogen test medium and halide torch for refrigerant medium.

.10 When using water as test medium for system not using water or steam, evacuate and dehydrate piping and certify that lines are dry. Use agency specializing in this type of work.

.11 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct defects. Correct leaks by remaking joints in screwed fittings, cutting out and re-welding welded joints, remake joints in copper lines. Do not caulk.

3.3 PRESSURE TESTING OF DUCT SYSTEMS

.1 Low pressure - test for tightness such that leakage is inaudible and not detectable by feel.

.2 Medium and high pressure - test for tightness as specified by SMACNA manuals, with maximum leakage of not more than 0.5% of maximum design volume at 3 kPa static pressure. Ensure system is free of audible leaks.

.3 High pressure fume extraction - test for zero leakage at 3 kPa static pressure on discharge side of fans, and maximum leakage of not more than 0.5% of design volume at 3 kPa on suction side of fans.

.4 Dust extraction - test for maximum leakage of not more than 0.5% of design volume at 3 kPa static pressure.

END OF SECTION

1. General

1.1 INTENT

.1 Test, adjust and balance mechanical equipment and systems so that entire system produces the results for which it was designed.

.2 Air and water balancing performed by the same firm.

1.2 RELATED REQUIREMENTS

.1	Contractor Start-Up Report Forms:	Division 01.
.2	Mechanical Operation and Maintenance Data:	Section 20 01 05.
.3	Mechanical Operation and Maintenance Manual:	Section 20 01 06.
.4	General Mechanical Starting and Testing Requirements:	Section 23 08 13.
.5	Mechanical Equipment Starting and Testing:	Section 23 08 23.
.6	Mechanical Systems Starting and Testing:	Section 23 08 33.
.7	EMCS Start-up and Testing:	Section 23 08 95.

1.3 TESTING/ADJUSTING/BALANCING REPORT DATA

.1 Organize balancing data in accordance with AABC - Associated Air Balancing Council, report format. Report data in SI units.

.2 Air Systems: Include both specified and measured data.

.1 Air Handling Equipment:

.1 Maximum air flow volume.
.2 Fan total pressure.
.3 Motor volts, amps and power.
.4 Minimum outside air volume.
.5 Fan rotational speed.
.6 Fan Power, calculate fan efficiency.
.7 Inlet and outlet dry and wet bulb temperatures.
.8 Equipment static pressure profile.

.2 Duct Air Quantities - Mains and Branches:

.1 Duct size.
.2 Number of pressure/velocity readings per traverse.
.3 Sum of velocity measurements.
.4 Average velocity.
.5 Duct air flow volume.
.6 Barometric pressure and duct air temperature.

.3 Air Outlets:

.1 Outlet location and designation.

.2 Manufacturers catalogue identification and type.

.3 Air outlet flow factors. Use 1.0 when flowhood is used.

.4 Air flow volumes.

.5 Deflector vane or diffuser cone settings.

.3 Hydronic Systems: Include both specified and measured data.

.1 Pumps:

.1 Discharge and suction pressures, at design flow and no flow.

.2 Fluid flow rate. Calculate from pump curves if metering not provided.

.3 Motor volts, amps, power.

.2 Heating Equipment:

.1 Equipment type, location and designation.

.2 Fluid used. Identify fluid used; water, % water/ethylene glycol mixes, steam, etc.

.3 Fluid flow rate.

.4 Fluid Specific Heat, at mean temperature.

.5 Fluid Specific Gravity, at mean temperature.

.6 [Fluid entering and leaving temperatures and pressures]. [Steam pressure, and condensate temperature].

.7 Heat transfer rate.

.3 Heat Exchanger:

.1 Heating fluid used. Identify fluid used; water, % water/ethylene glycol mixes, steam, etc.).

.2 Heating fluid flow rate.

.3 Heating fluid Specific Heat, at mean temperature.

.4 Heating fluid Specific Gravity, at mean temperature.

.5 [Heating fluid entering and leaving temperatures and pressures]. [Steam pressure, and condensate temperature].

.6 Primary side heat transfer rate.

.7 Heated fluid used. Identify fluid used; water, % water/ethylene glycol mixes, etc.).

.8 Heated fluid flow rate.

.9 Heated fluid Specific Heat, at mean temperature.

.10 Heated fluid Specific Gravity, at mean temperature.

.11 Heated fluid entering and leaving temperatures and pressures.

.12 Secondary side heat transfer rate.

.4 Air Heating and Cooling Coils:

.1 Coil type and identification, location and designation.

.2 Entering and leaving air dry and wet bulb temperatures.

.3 Air static pressure drop.

.4 Air flow volume.

.5 Barometric pressure.

.6 Air side heat transfer rate.

.7 Fluid used. Identify fluid used; water, % water/ethylene glycol mixes, steam, etc.

.8 Fluid flow rate.

.9 Fluid Specific Heat, at mean temperature.

.10 Fluid Specific Gravity, at mean temperature.

.11 [Fluid entering and leaving temperatures and pressures]. [Steam pressure, and condensate temperature].

.12 Fluid side heat transfer rate.

.5 Unit and Cabinet Heater:

.1 Start unit and check for noise or vibration.

.2 Check unit performance for each fan speed:

.1 Air flow and temperature rise.
.2 Water temperature drop.

.4 Sound Pressure Level Data:

.1 Overall A-weighted Sound Pressure Level readings.

.2 For outdoor equipment or community noise measurements provide a diagram or description of relationship of sound source to measuring instrument.

2. Products

Not Used

3. Execution

3.1 BALANCING AND ADJUSTING PREPARATION

.1 Perform testing, adjusting and balancing work after equipment and systems starting procedures have been properly completed in accordance with Sections 23 08 23 and 23 08 33.

.2 Perform balancing during heating and cooling season of first year of operation, and at times when directed by Province, to ensure proper settings of controls under both summer and winter peak load conditions.

.3 Vary load to verify operation of system under partial load conditions. Test start-up, shut-down, emergency conditions, safety controls operation and automatic and manual resets and interlocks.

.4 Perform work using measuring instrumentation conforming to requirements specified in Section 23 08 13.

3.2 GENERAL PROCEDURES

.1 Perform balancing to following accuracy:

.1	Air - terminal outlets	± 10%
.2	Air - central equipment	± 5%
.3	Hydronic - terminal outlets	± 10%
.4	Hydronic - pumps and central equipment	± 5%

.2 Permanently mark settings on splitters, valves, dampers or other adjustment devices.

.3 Subsequent to correcting work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.4 As a prerequisite to the Province's acceptance of balance report demonstrate random points in balance selected by the Province. The Province will witness these checks.

3.3 FIRE DAMPER/FIRE STOP FLAP VERIFICATION

.1 Visually inspect all fire dampers/fire stop flaps to verify that:

.1 Installation is straight and level.

.2 Wall angles are properly installed.

.3 Duct has break away connection.

.4 Fire stopping material, where used, is properly installed.

.5 Access is adequate.

.6 Adequate clearance exists between sleeve and wall.

.7 ULC label is visible.

.8 Blades are out of air stream.

.9 Temperature rating of linkages are correct.

.2 Inspect and clean all fire damper blades and tracks prior to function test.

.3 Function test each damper, by detaching fusible link chain. Verify that damper blade drops properly and is tightly sealed within frame. Reset each damper.

.4 If fire damper does not close properly, repair installation and retest.

.5 All fire damper tests shall be witnessed by two parties, certified by Contractor and endorsed by testing personnel.

.6 Write to authority having jurisdiction prior to testing dampers. Invite authority to witness tests as required.

3.4 AIRFLOW MEASURING STATIONS

.1 Measure air flow by duct traverse at five different air volumes equally spaced between design minimum and maximum for each station.

.2 Use EMCS trend logs to record air volume flow during time that each duct traverse is performed. Average trend log readings over this time period.

.3 Compare duct traverse and averaged trend log readings for each of the five air volume measurements taken. Calculate calibration correction equation.

.4 Document each calibration on Province approved Contractor Start-up Program “Flow Measuring Station Calibration” sheets.

3.5 AIR SYSTEM PROCEDURE

.1 Perform testing, adjusting and balancing only after all suspended ceilings and partitions are complete, with doors and windows in place and closed.

.2 Adopt following procedures for central systems:

.1 Test drop and reset all fire dampers.
.2 Verify that dampers and volume control devices are in fully open position.
.3 Initially balance central plant to ± 10% air flow.
.4 Calibrate air flow measuring stations.
.5 Balance mains and branches to ± 10% air flow.
.6 Recheck central plant.
.7 Balance all terminal air outlets to ± 10%.
.8 Rebalance central plant to ± 5%.
.9 Recheck all air outlets.
.10 Measure performance of coils and humidifier.
.11 Measure air pressure change across each component of central plant.
.12 Take sound pressure level readings.

.3 Take air flow measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. Take the number of readings as set out in ASHRAE Fundamentals Chapter 13 "Measurement and Instruments". If readings are inconsistent across duct, relocate by two duct diameters / widths and redo traverse.

.4 Following precedence applies to air flow measuring devices and methodology:

.1 Pitot tube traverses in straight sections of duct have precedence over anemometer or velometer traverses of filters, coils, ducts, etc.

.2 Micromanometer flowhood measurements at air outlets have precedence over anemometer or velometer readings at air outlets.

.3 A pitot tube traverse in a straight duct section at inlet to a variable volume box has precedence over a box air flow sensor reading.

.4 Variable volume box air flow sensor may be used to set up box maximum and minimum air volumes but, unless otherwise agreed with the Province, the sum of micromanometer flowhood readings at all air outlets has precedence over a box flow sensor reading.

.5 Use volume control devices at air outlets to regulate air quantities only to extent that adjustments do not create objectionable air motion or noise. Effect volume control primarily by duct internal devices such as dampers and splitters.

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

.7 Balance air systems at design minimum supply air temperature.

.8 When balancing constant volume systems:

.1 Rough balance furthest outlet and then balance sequentially back to source,

.2 Fine balance furthest outlet back to source.

.9 When balancing variable air volume systems:

.1 Check factory settings and reset each box maximum and minimum air volumes as necessary.

.2 Measure inlet static pressure to box at maximum volume.

.3 Individually set each box to maximum, rough balance furthest outlet and then balance sequentially back to box.

.4 Fine balance from furthest outlet back to box.

.5 Check damper stroke over box range, minimum to maximum.

.6 With all boxes at minimum volume progressively open boxes in a clockwise direction until maximum design air volume is achieved, or until branch static pressure can no longer be maintained. Check that each opened box is delivering specified maximum volume by checking and recording if the inlet static pressure is adequate to operate the box at maximum volume. Record airflow measuring station volume. Determine minimum duct static pressure at sensor that will provide adequate inlet pressure at every box.

.7 With all boxes at maximum volume, progressively close boxes in a clockwise direction until branch static pressure is achieved. Check that each opened box is delivering specified maximum volume. Record system volume. Determine minimum duct static pressure at sensor that will provide adequate inlet pressure at every box.

.10 Upon completion of balancing, recheck and record data from central Air Handling Unit (refer to Section 23 08 23) including following:

.1 Motor data.
.2 Coil, filter, humidifier data.
.3 Static pressure profile across all components.
.4 Damper controls.

.11 Final balanced condition of each area shall include testing and adjusting of pressure conditions. Test, adjust and record building and zone pressurization levels. For variable volume systems check pressurization throughout full range of fan delivery for both heating and cooling conditions. For multi-story buildings test pressure conditions at ground, intermediate and upper levels. Check front doors, exits and elevator shafts for air flow so that exterior conditions do not cause excessive or abnormal pressures. Document abnormal building leakage conditions noted.

.12 Complete balancing to achieve positive building pressure unless otherwise instructed.

3.6 MISCELLANEOUS AIR HANDLING DEVICES

.1 Motorized Smoke and Gravity/Barometric Dampers:

.1 Review installation to ensure:

.1 No cracks around damper frame.
.2 Blades close and seals engage completely.
.3 Damper strokes fully open to fully closed with no binding of blades at any part of stroke.
.4 Suitable access and identification.

.2 Air Outlets:

.1 Review installation to ensure:

.1 Air outlet is clean.
.2 Air outlet is located as shown on drawings.

.3 Balancing Dampers:

.1 Check installation to ensure:

.1 Damper can open and close fully.
.2 Access is clearly marked.
.3 Damper is not located in a turbulent air stream.

3.7 COMBUSTION AIR

.1 With all heating appliances, within the boiler room, operating on high fire, measure:

.1 Combustion air volume entering boiler room from outside.

.2 Differential pressure to:

.1 Outside
.2 Adjacent areas of the building.

.2 With all heating appliances on high fire, check each natural draft appliance diverter for any back draft.

3.8 ACOUSTIC MEASUREMENTS

.1 Acoustic Measurement Procedure:

.1 Use Sound Level Meter as specified in Section 23 08 13.

.2 Calibrate microphone and sound level meter before use.

.3 Hold Sound Level Meter in front of body of observer and as far away as is practicable or attach instrument to a tripod stand.

.4 Height of measuring microphone from floor shall be 1200 mm ±50 mm unless otherwise noted.

.5 Measurement locations shall be minimum of one metre away from any large vertical or horizontal surface, ie. walls, columns, floors.

.6 Take measurements with meter on “SLOW” response or follow manufacturer’s instructions for L_{eq} “equivalent energy level” averaging.

.7 Do not take readings until noise created by extraneous equipment, people or other sources, which would interfere with specific acoustic measurements, have ceased.

.2 HVAC Noise Inside Building:

.1 The objective is to measure Sound Pressure Level within each **occupied** room created by entire HVAC system and to evaluate these in terms of the recommended maximum background noise levels for each type or area. Investigate areas found to be in excess of recommended maximum levels and take corrective action.

.2 Follow testing procedures specified under "Acoustic Measurement Procedure".

.3 Measure overall A-weighted Sound Pressure Level

.4 Take minimum of one reading per 30 m^2 of floor area, but no less than one reading in any one enclosed room or open area which will be occupied.

.5 Take measurements with system operating in its loudest normal condition which is typically the summer mode.

.6 Take measurements in rooms equipped with exhaust fans or unit heaters or cabinet heaters with fan “on” and fan “off” conditions.

.7 Measure sound pressure levels in rooms directly beneath roof top towers, condensers, furnaces, etc. with units running at maximum speed or capacity.

.8 Compare results with following maximum noise criteria:

.1	Conference Room, Classroom:	37 dB(A)
.2	Private Office, Library, Open Plan Office, Gymnasium:	42 dB(A)
.3	Cafeteria, Washrooms, Circulation/Waiting Areas:	47 dB(A)
.4	Computer Equipment Room:	52 dB(A)

3.9 BALANCING OF HYDRONIC SYSTEMS

.1 Fully open all valves, except the pressure bypass valve which must be closed, including balancing valves, isolation valves and control valves.

.2 Measure and record pump flows.

.3 Adjust flows through each boiler or chiller to ensure equal flow.

.4 Install pressure gauges across each coil or use balancing valve pressure tappings if provided. Read pressure drop through coil or balancing valve and set flow rate for full flow through coil. Set pressure drop across bypass valve at full flow to bypass to match coil full flow pressure drop.

.5 Distribute flow through radiation using circuit balancing valve pressure drop to apportion flow to each zone, and temperature drop to apportion flow through each run of radiation.

.6 Terminal reheat coils of constant or variable volume systems can not be hydronically balanced, by the method of air side temperature rise across the coil, until after air balance has been completed.

.7 Position and lock all balancing valves and mark all hand valves for design flow through all coils, coil by-passes, branch circuits, heat exchangers, chiller evaporators, etc. Record flow measurement data for all major circuits and each terminal device.

.8 After making all coil and terminal unit adjustments remeasure flow and head for each pump, for both single and parallel operation. Check flows through boilers, chillers, heat exchangers, etc. under following situations:

.1 With two pumps operating.

.1 Controls demanding maximum heating or cooling.
.2 Controls demanding no heating or cooling.

.2 With one pump operating - repeat for each pump:

.1 Controls demanding maximum heating or cooling.
.2 Controls demanding no heating or cooling.

.9 For each pump, plot maximum and minimum flows on curve for both single and parallel operation.

.10 Verify pressure drops and flows through pressure control by-pass valves over full operating range.

.11 Calibrate all pressure and temperature gauges.

3.10 BALANCING AND ADJUSTING OF DOMESTIC WATER SYSTEMS

.1 Adjust PRV on main line to 570 kPa maximum.

.2 Balance domestic hot water circulating system piping to ensure flow from all points in system. Ensure all hot and cold supply shut off valves are fully open.

3.11 BALANCING REPORT

.1 Submit draft copies of final reports prior to Interim Acceptance of the Work. Provide four copies of final report for inclusion in Operation and Maintenance Manual.

.2 Include types, serial number and dates of calibration of instruments.

.3 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and manufacturer's flow factors.

.4 Organize report as follows:

Air Systems

.1 Summary
.2 Procedure
.3 Instrumentation
.4 Drawings
.5 Equipment Summary
.6 Fan Data Sheets
.7 Fan Curves
.8 Air Handling Unit Profile Data
.9 Air Flow Measuring Station Data
.10 Traverse Data and Schedule
.11 Terminal Unit Summary
.12 Outlet Data Summary and Schematic, per system
.13 Building Pressurization Data
.14 Diagnostic

Hydronic Systems

.1 Summary
.2 Procedure
.3 Instrumentation
.4 Drawings
.5 Equipment Summary
.6 Pump Data Sheets
.7 Pump Curves
.8 Pump Profile Data
.9 Terminal Unit Summary
.10 Diagnostic

Acoustics

.1 Summary
.2 Procedure
.3 Instrumentation
.4 Drawings
.5 Sound Pressure Level Data

END OF SECTION

1. INTENT

.1 Provide instruction and demonstration sessions to familiarize the Minister with the building's mechanical systems.

2. RELATED REQUIREMENTS

.1 Equipment and System Demonstration and Instruction: Division 01.

3. DEMONSTRATIONS

.1 Demonstrate specific starting and general maintenance requirements for each piece of equipment. Ensure all labelling and identification is completed.

.2 Demonstrate following systems:

.1 Air Systems
.2 Controls Systems
.3 Fire protection Systems
.4 Heating Systems
.5 Plumbing Systems

4. SEMINARS

.1 Present Operator Training Seminar(s) including content specified in Section 01 79 00.

5. SITE TOURS

.1 Provide a series of guided tours of facility to allow operators to familiarize themselves with building's mechanical systems.

.2 Coordinate timing of tours with the Minister. Allow for tours at approximately the following times:

.1 75% complete stage.

.2 90% complete stage.

.3 At Interim Acceptance of the Work.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 23 09 23, EMCS General Requirements and other related EMCS Sections.

1.2 RELATED SECTIONS

.1 EMCS Field Sensing Devices and Actuators: Section 23 09 29.
.2 EMCS Control Sequences: Section 23 09 93.

1.3 START-UP SHEETS

.1 Provide "Physical Point Confirmation" sheets as follows:

.1 Basic form of sheets shall follow ordering and layout of point sheets in section 230930. Provide sample for review prior to commencement of Start-up checks.

.2 Include the following information/fields:
- .1 System description and mnemonic
- .2 Point description and mnemonic
- .3 RCU number or identifier
- .4 Point Type and Specified accuracy
- .5 Tagged (tick box indicating presence of properly affixed identification tag/s)
- .6 Verified (tick box indicating successful end-to-end wiring check)
- .7 EMCS displayed value
- .8 Field measured value
- .9 Calibration offset value
- .10 Identifier/name of graphic containing EMCS displayed value
- .11 Contractor's initials
- .12 Verifier's initials (Minister's Representative)
- .13 Remarks

.2 Provide "Analogue Output Device Range" sheets as follows:

.1 These sheets are to be used in addition to the Physical Point Confirmation sheets and shall include all EMCS analogue output devices. Order of devices shall follow ordering of analogue outputs as found on the Physical Point Confirmation sheets. Provide sample for review prior to commencement of Start-up checks.

.2 Include the following information/fields:
- .1 System description and mnemonic
- .2 Point description and mnemonic
- .3 RCU number or identifier

.4 Specified range
.5 FCE state at EMCS output value of 0% of range
.6 FCE state at EMCS output value of 20% of range
.7 FCE state at EMCS output value of 80% of range
.8 FCE state at EMCS output value of 100% of range
.9 FCE state at EMCS output value of 80% of range
.10 FCE state at EMCS output value of 20% of range
.11 FCE state at EMCS output value of 0% of range
.12 Actual range of device
.13 Verified FCE end-of-travel @ 0% (tick box indicating successful check)
.14 Verified FCE end-of-travel @ 100% (tick box indicating successful check)
.15 Failsafe position (NO/NC, OFF/ON, etc.)
.16 Verified (tick box indicating successful failsafe check)
.17 Contractor's initials
.18 Verifier's initials (Minister's Representative)
.19 Remarks

NOTE 1: FCE state refers to the position or value of the Final Control Element affected by the analogue output. Examples: damper or valve position, fan speed, setpoint reset value, etc.

NOTE 2: FCE end-of-travel refers to the end condition achieved by the FCE. Examples: dampers/valves achieve full open or tight shut off, fan achieves specified min/max speed, setpoint achieves specified max/min reset value, etc

.3 Provide "Flow Measuring Station Calibration" sheets as follows:

.1 These sheets are to be used in addition to the Physical Point Confirmation sheets and shall include all EMCS analogue input devices used for flow rate measurement. Provide a sheet for each station. Sort sheets to follow ordering of these inputs as found on the Physical Point Confirmation sheets. For each flow station type, provide sample for review prior to commencement of Start-up checks.

.2 Include the following information/fields:
.1 System description and mnemonic
.2 Point description and mnemonic
.3 RCU number or identifier
.4 Type, make, model and serial number of each measuring instrument used
.5 Flow station type, make, model, size and serial number if available
.6 Transducer:
- type, make and model
- operating range
- serial number if available
- zeroed (tick box indicating device was checked for proper zero reading)
.7 Start and stop times of measurement sequence
.8 Media (air, water, glycol) temperature

.3 For Air-Flow Stations: Provide fields to record traverses according to recommendations of the 2005 A.S.H.R.A.E. Fundamentals Handbook (SI version), chapter 14 "Measurement and Instruments", page 14.17 “Measuring Flow in Ducts”. Use the Log-Tchebycheff Rule dimensions, for both rectangular and round ducts as given in Figure 7 on page 14.18. Include field to record atmospheric barometric pressure at time of testing.

.4 For Fluid-Flow Stations: Provide fields to record data according to the station manufacturer’s recommended calibration procedures. Include fields to record fluid type, density and application.

.5 Provide space for performing required calculations. Include all flow calculation formula used as well as fields for correction factors applied.

.6 Include fields to record EMCS trend data and the calculations used in determining the average of the displayed flow rates over the duration of the tests.

.7 Provide a summary area for the calculation of a flow station calibration equation that will be entered into the EMCS database or via programming.

.4 All values and calculations shall be in MKS (metric) units.

1.4 DOCUMENTATION

.1 Submit complete system documentation before start of testing, including:

.1 programmer's instruction manuals.
.2 CCU operating system software manuals and original diskettes.
.3 application software program manuals and original diskettes.
.4 operating manuals for terminals and end devices.
.5 interlock and control schematics for each system controlled, identifying each EMCS physical point by mnemonic.
.6 table of operating set points and alarm limits for each system.
.7 device calibration methods and procedures.
.8 list of all real and virtual mnemonics, with full English description of each mnemonic.
.9 well documented User Control Language software with comment lines to explain control strategies. Alternatively, written description of control strategy for each software module.
.10 backup disks for User Control Language Software.

2. Products

Not Used

3. Execution

3.1 HARDWARE

.1 Verify that each hardware component has been properly installed as recommended by manufacturer and is functioning correctly.

.2 Verify that all circuits are complete and all terminal wiring connections are tight.

.3 Electronic hardware:

.1 Start-up electronic hardware as recommended by manufacturer.
.2 Replace defective components.
.3 Prove proper operation, use software diagnostic.

.4 Interfaces:

.1 Test to ensure interfaces with Division 25 and 26 and other control packages are complete.
.2 Verify that interface cabinets comply with applicable codes and specified requirements.

.5 Check operation of system under failure modes:

.1 Power failure.
.2 RCU failure.
.3 Network failure.
.4 Sensor failure.

3.2 POINT CHECK OUT

.1 Verify point mnemonic, hardware address, correct physical location and proper functioning of each hardware point on system. Record verification of each point on "Physical Point Confirmation" sheets.

.2 Calibrate all analogue input/output devices, actuators, transducers and sensors as recommended by manufacturer.

.3 Achieve end-to-end (between field device and actual value displayed on screen) calibration accuracy over full expected operating range as specified for each analogue point type in Section 23 09 29:

.1 Calibration may be performed on the hardware device if this feature is available, or may be entered into database/software provided correction is not greater than five (5) times specified accuracy for device. Device must be replaced and calibrated again if correction is outside this band. Combination coarse hardware and fine database/software calibration is allowed.

.2 Simple offset calibration is acceptable where the operating range is less than 25% of the device span. Slope calibration is required for devices operating over larger spans. A two-point slope calibration, where the samples are about 20% from each end of the operating range is acceptable if the resulting offset at the middle of the operating range falls within the specified accuracy.

.2 All database/software calibrations must be entered even if these fall within the specified accuracy.

.3 Document each calibration correction on "Physical Point Confirmation" Sheets.

.4 Check range and repeatability of each analogue output point. Ensure tight shut-off of dampers and valves.

.5 Variable Air Volume systems with Air Flow Measuring stations:

.1 Statically adjust each pressure transducer to zero with both ports at ambient pressure. Check each transducer's span for linearity and range using an inclined manometer or a Shortridge Air Data Multi-meter in parallel with the transducer.

.2 Dynamically calibrate each Air Flow Measuring station using the procedure defined on "Flow Measuring Station Calibration" sheets. Document the results on "Flow Measuring Station Calibration" sheets. For air systems flowing less than 5000 l/s, it is acceptable to use two calibration points at 60% and 85% vane/speed position. For small air systems flowing less than 2000 l/s, it is acceptable to use a single calibration point at 75% vane/speed position.

.3 If, at any flow setting, the EMCS displayed flow rate differs by more than 5% from the measured flow rate, add an air flow measuring station calibration correction equation to the controls software or point database. The equation must go through the origin. Any zero offset usually corresponds to an improper zeroing of the velocity pressure transducer. A linear equation that provides a simple slope correction to achieve final accuracy to better than 5% is preferred.

.6 Dial-out Alarm and Watch-Dog Timer

.1 Verify watch-dog timer operation by creating a power fail condition in the controller containing the watch-dog timer output point.

.2 Verify end to end operation of each dial out alarm by creating an alarm condition for each alarm as specified under 23 09 93 "Critical Dial-out Alarms".

3.3 TRIAL USE

.1 Fifteen days before Interim Acceptance of the Work provide the Minister with full access to EMCS for Minister's trial use of system.

.2 Trial use is to determine EMCS's compliance with Specifications, and to permit Minister to verify installation and accuracy of calibration of all physical points connected to EMCS.

.3 Provide a qualified EMCS representative for five days on-site to assist with the Minister's trial use of system. NOTE: Contractor correction and repair of deficiencies does not constitute verification. Time taken for this corrective work shall not be counted towards the specified period of on site assistance.

3.4 DEMONSTRATION OF SYSTEM INTEGRITY

.1 Prior to Interim Acceptance of the Work, demonstrate the following EMCS features to Minister:

.1 Power fail and restart of CCU, RCU, TCU
.2 Network failure and restart
.3 Sensor failure and recovery in RCU and TCU
.4 Fail-safe modes for all valves, dampers and equipment.
.5 Fail-safe and emergency modes for systems.

.2 Prior to Interim Acceptance of the Work, demonstrate to the Minister all control sequences for equipment not directly controlled by EMCS, including component hard wired interlocks.

3.5 MINISTER'S POINT VERIFICATION

.1 The Minister will verify all EMCS physical points for correct connection, calibration and operation after Contractor prepared “Physical Point Confirmation” sheets have been reviewed by the Minister.

.2 The Minister's point verification will be carried out during the Minister's trial usage of the system.

.3 All required trend logs and screen graphics shall be complete and fully functional prior to Minister’s Point Verification.

3.6 APPLICATION SOFTWARE

.1 Ensure all hardware is installed and started and fully operational before software start-up.

.2 Enter each physical point into database and include following:

.1 Set up run time capture for each digital output.
.2 Enter engineering units for each analogue point.
.3 Set up an alarm point for each digital input/output pair, with delay before alarm is enunciated.
.4 Set up an alarm point for each analogue input with high and low limits. Provide a reset differential.
.5 Enter physical point calibration corrections.
.6 Enter analogue input conversion equations for fluid velocity measuring devices.

.3 Enter start/stop schedules for all systems not required to run continuously.

.4 Trend Logs:

.1 Enter trend logs for each physical analogue input and output point in EMCS database.
.2 Trend logs shall retain a minimum of four readings per hour for 24 hours.
.3 Trend logs shall be continuous and shall overwrite information that is 24 hours old.
.4 Provide an additional trend log of 120, ten second interval, readings for each P.I.D. loop controlling and controlled variable.
.5 Grouping of trend log points on print outs shall be agreed with the Minister.

3.7 DEMONSTRATION OF APPLICATION SOFTWARE

.1 Demonstrate following to the Minister:

.1 Man/machine interface to EMCS system, including operator access, all monitoring functions and command of points.

.2 Saving and reloading of database. Provide a checklist describing the procedures to be followed.

.3 The use of disk backup utilities by creating bootable CDs containing a complete image backup of the hard disk. Save must be performed at the highest rewrite speed available on CD-RW drive. Provide a checklist describing the procedures to be followed.

.4 User Control Language program entry and editing.

.5 Operation of specific application software such as:
.1 demand limiting.
.2 peak shaving.
.3 night setback.
.4 optimum start of heating/cooling systems.
.5 building dynamic control.
.6 alarm conditions and printouts.

.7 automatic report generation.

3.8 USER CONTROL SOFTWARE IMPLEMENTATION

.1 Demonstrate User Control Language software operation, start up and shut down sequences, software interlocks, fail safe, emergency shut down and alarm condition control strategies in accordance with the requirements of Section 23 09 93.

3.9 REVIEW OF DEFICIENCIES BEFORE INTERIM ACCEPTANCE

.1 Review all deficiencies and agree upon a deficiency list with the Minister, before Interim Acceptance of the Work.

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies general requirements common to all energy management and control system (EMCS) work. Read this Section in conjunction with all Sections that specify EMCS work.

1.2 RELATED SECTIONS

.1	Electrical General Requirements:	Section 260510.
.2	Conduit:	Section 260534.

1.3 PRODUCTS OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 ABBREVIATIONS

1.	BACnet:	ASHRAE Standard Building Automation & Control Network Protocol
2.	BIBB:	BACnet Interoperability Building Block
3.	Blu_Ray:	High density digital video/data disk
4.	CCS:	Central Control Station
5.	DDC:	Distributed Digital Control
6.	DVD:	Digital Video Disk (-R, +R, -RW etc)
7.	EEPROM:	Electrically Erasable Programmable ROM
8.	EMCS:	Energy Management Control Systems
9.	EPROM	Ultraviolet Erasable Programmable ROM
10.	LonWorks:	ANSI/EIA 709.1 Control Networking Standard
11.	LonMark:	LonWorks devices certified by the LonMark Interoperability Association
12.	Objects:	Data constructs containing information including, but not limited to, physical or virtual points and attributes. Examples: analogue or digital inputs, outputs and calculated values, occupancy schedules, control loops, alarms, commands, programs, etc.
13.	PCS:	Portable Control Station
14.	PID:	Proportional Integral Derivative
15.	RAM:	Random Access Memory
16.	RCU:	Remote Control Unit
17.	ROM:	Read Only Memory
18.	TCU:	Terminal Control Unit
19.	UCL:	User Control Language

1.5 PRE-CONTRACT SUBMISSIONS AND DEMONSTRATIONS

.1 Prior to the commencement of the contract, demonstrate the system's capability to interoperate with the specified BACnet or LonMark devices as follows:

.1 At the local vendor's office create a network consisting of a CCS, PCS, RCU and one of each type of TCU that will be supplied for this project.

.2 For each BACnet device submit a Protocol Implementation Conformance Statement (PICS). For each LonMark device submit functional profiles and device interface (XIF) file listings.

.3 Demonstrate the ability of the networked CCS or locally connected PCS, to read, write and override the TCU inputs/outputs/variables as specified under section 230927.

.4 Create programming in the RCU to demonstrate the ability of the RCU to manipulate, under automatic control, the TCU inputs/outputs/variables as specified under section 230927.

.5 Demonstrate the ability of the system to use TCU data in dynamic trending, point history logs, alarming functions and other requirements as specified in sections 230926 and 230927.

.2 Provide a sign off sheet, for inclusion in the system documentation manuals, which will be signed by the Contractor and the Minister's representative at the completion of each demonstration.

1.6 CONSTRUCTION SCHEDULE

.1 Comply with requirements of Division 01.

.2 Include EMCS installation schedule as part of the construction progress schedule. Include start and finish dates for:

.1 equipment ordering and delivery.
.2 hardware installation.
.3 start-up and point calibration
.4 software loading and testing
.5 system testing and trial use by Minister.

.3 Coordinate EMCS schedule with construction schedule.

1.7 CONSTRUCTION PROGRESS MEETINGS

.1 Comply with requirements of Division 01.

1.8 SHOP DRAWINGS AND INFORMATION

.1 Comply with requirements of Division 01 and as follows:

.1 Within 30 days of contract award, provide:
- .1 CAD drawings of the proposed system architecture. Include all CCSs, RCUs and TCUs as well as LAN devices.
- .2 point layouts of all RCUs as well as wiring diagrams for attached devices. Include Logical Point Mnemonics.
- .3 technical data sheets for all equipment and devices.

.2 Within 60 days of contract award, provide:
- .1 control software descriptions, by module, explaining EMCS control sequences and logic. Include Logical Point Mnemonics for all virtual points as well as print out or code for each module.
- .2 dynamic graphic displays, for key plan, each mechanical system and floor plan.

1.9 PROJECT RECORD DOCUMENTS

.1 Comply with requirements of Division 01.

1.10 EMCS MANUALS, CATALOGUES AND BACKUPS

.1 Operators' Manuals: Provide operators' instruction manuals. Manuals shall guide operators through all menu options, with an explanation of each option. Manuals shall describe the use of operator's interface including all function keys, "hot" keys, reporting features, start/stop scheduling , etc.

.2 Programmers' Manuals: Provide programming instruction manuals for the User Control Language. Manuals shall list all procedures, functions, operators and reserved words together with a description and examples of their use in programming. Provide login and password for administrator access to all programming software.

.3 Application Program Manuals: Provide instruction manuals for any brand-name or proprietary software used for terminal emulation, communication, graphics generation, etc. Provide administrator login to all application program.

.4 Computers, Peripheral and Device Manuals: Provide instruction and maintenance manuals for all CCSs, PCSs, printers and modems as well as any other peripheral or electronic device supplied under this contract. Provide administrator login and password to operating system and other network devices such as router and network adapter.

.5 Proof of ownership: Provide proof-of-ownership in the form of licensed disks, software manuals, registration cards, or, in the case of proprietary software, formal letter of transmittal, for all software that is required to fulfill contract requirements.

.6 EMCS Catalogue: Provide a current catalogue and price list that includes the components provided under this contract as well as related system components and accessories.

.7 Backup Packages: Download all RCU and TCU databases and programs onto the primary CCS hard disk prior to performing a comprehensive backup. Provide three (3) complete system backup packages. Each package shall contain everything necessary to restore the EMCS to full operation should a catastrophic failure occur and as follows:

.1 Include an image backup of the complete CCS hard disk, onto removable media, using the system backup software specified in Section 230925 "EMCS Central Control Units and Peripherals".
.2 Include a copy of the software required to restore the hard drive from the image backup.
.3 Include hardcopy and text files of the CCS's CMOS settings as well as any important configuration files such as config.sys and autoexec.bat.
.4 Include a hardcopy sheet describing the exact steps required to restore the hard drive.
.5 Include a hardcopy sheet describing the exact steps required to restore an RCU or TCU.
.6 Compile each package into a suitably labeled D-ring binder. CD/DVD/BD backup disks shall be archival quality, adequately labeled, protected in paper sleeves and inserted into archival quality plastic binder pages.
.7 One backup package shall be left at the primary CCS location. Another is to be included in the Operation & Maintenance Manual that will remain on site. The final package shall be turned over to the contract manager for filing.

1.11 OPERATION & MAINTENANCE MANUALS AND O&M DISK

.1 Provide three (3) complete copies of an EMCS Operation and Maintenance Manual..

.1 Organize manual as follows:

.1 Operations Division: EMCS Hardware (Configuration/Installation)
.2 Operations Division: EMCS Software (Database/Programming)
.3 Operations Division: Pneumatic/Electric (Non-EMCS Subsystems)
.4 Maintenance Division
.5 Contract Documentation Division
.6 O&M Disk (full manual and system backup in electronic format)

.2 Split manual into two or more binders if content exceeds 75mm in thickness.

.3 At the beginning of each binder, provide a table of contents listing divider tabs in all binders making up the full manual.

.4 D-ring binders with two plastic sheet lifters and clear outside overlay pockets are acceptable if total contents are less than 35mm in thickness. Otherwise provide

binders that are silk screened, commercial quality, fabric coated, three post, with hard covers attached to spine with metal piano hinges.

.5 Each binder cover and spine shall display the following information:
- .1 City/Town
- .2 Building Name
- .3 Project Title
- .4 Binder Name, examples:
  - .1 EMCS Operations and Maintenance Manual
  - .2 EMCS Operations and Maintenance Manual (Operations Division: Hardware and Software)
  - .3 EMCS Operations and Maintenance Manual (Maintenance and Contract Divisions)
- .5 Date (month and year only)

.2 Operations Division - EMCS Hardware (Configuration/Installation):

.1 Organize the information into sections, with index and divider tabs, as follows:

- .1 EMCS Configuration (include explanations of architecture)
- .2 TCU Cross References
- .3 System Schematics
- .4 RCUs/TCUs

.2 EMCS Configuration: Provide a basic configuration diagram showing each CCS, peripheral devices and RCU with information as to their locations. Provide lists or diagrams showing which TCUs are connected to what RCU. Provide an explanation of system architecture. Describe each hardware component and the networks that manage system communications.

.3 TCU Cross References: Provide two cross referenced TCU listings. One listing to be sorted by TCU identifier, the other to be sorted by room number. Each listing to have the following columns:

- .1 TCU identifier
- .2 RCU sub-network if this data is not in TCU identifier
- .3 TCU type and model number
- .4 Terminal equipment identifier (box number etc.)
- .5 Room number

.4 System Schematics: Provide schematics of each mechanical system indicating point locations, mnemonics and hardware address. Include any wiring details and equipment schematics showing where and how equipment is interfaced to EMCS. Drawings must be clear and of adequate size for easy reading. If necessary, fold larger sheets into binder.

.5 RCUs/TCUs: Provide a divider tab for each RCU. Under each RCU provide the following information separated with coloured sheets:

.1 RCU panel directory showing point mnemonics, termination addresses and wiring numbers.
.2 Panel directory of each associated equipment cabinet.
.3 Panel directories of each associated TCU showing point mnemonics, termination addresses and wiring numbers.

.3 Operations Division - EMCS Software (Database/Programming):

.1 Organize the information into sections, with index and divider tabs, as follows:

.1 Point Lists
.2 Graphics
.3 Descriptions and Procedures
.4 TCU General
.5 RCUs/TCUs
.6 CCS Setup

.2 Point Lists: Provide two complete lists containing all the physical and virtual points/objects in the facility as well as a suitable description as to their function. The first listing to be sorted by logical point mnemonic, the second to be sorted by hardware address. Each listing to have the following columns:

.1 Logical point mnemonic
.2 Description
.3 Hardware or virtual point address

.3 Graphics: Provide a hardcopy of all dynamic graphic display screens if a graphical user interface has been provided. Good quality screen dumps may be used for this purpose.

.4 Descriptions and Procedures: Provide a brief description of overall control philosophy. Describe all hardware interlocks with other equipment that may affect or override action of software control modules. Provide procedures for operating staff to interface with software control modules, to override system or component operation, to adjust system or building control setpoints, etc. Name virtual points provided in software for this purpose and recommend adjustment increments and limits where applicable

.5 TCU General: Provide a divider tab for each **type** of TCU and include the following information separated with coloured sheets:

.1 A short general description of the TCU and intended application followed by a listing and description of every available parameter, input and output.
.2 A detailed description of each configurable module, object, function, procedure and related sequence of operation.
.3 For LonWorks based TCUs, provide functional profile diagrams and descriptions of all Mandatory and Optional Network Variables.

.6 RCUs/TCUs: Provide a divider tab for each RCU. Under each RCU provide the following information separated with coloured sheets:

.1 List of physical and virtual point mnemonics, with a description of the meaning of each mnemonic.

.2 For each User Control Language Program module in the RCU provide:
.1 a description of purpose and logic of module.
.2 a hardcopy listing of the program module.

.3 Complete hardcopy listing of the RCU database. Include each hardware point, virtual point, schedule, report, trend, controller etc.

.4 Provide a divider sub-tab for each associated TCU and include the following information separated with coloured sheets:

.1 References to any common configurable modules described under the TCU General section and a listing of the configuration data for the respective TCU.
.2 List of any physical and virtual point mnemonics, with a description of the meaning of each mnemonic.
.3 For any User Control Language Program in the TCU provide:
.1 a description of purpose and logic of module.
.2 a hardcopy listing of the program module.
.4 Complete hardcopy listing of the database. Include each hardware point, virtual point, schedule, report, trend, controller etc.

.7 CCS setup: Provide hardcopy listings of all configuration information including CMOS setup, directory listing showing all installed files and locations as well as user interface program configuration data.

.8 All listings to be laser printed.

.4 Operations Division: Pneumatic/Electric (Non-EMCS Subsystems)

.1 Provide system configuration, schematic diagram, detailed operating sequence and component listing for each non-EMCS controls subsystem.

.5 Maintenance Division:

.1 Summarize data for this section from supplier and sub-trade maintenance submissions, supplemented by appropriate additional material. Organize the information into sections, with index and divider tabs, as follows:

.1 Maintenance
.2 Spare Parts
.3 Suppliers and Contractors

.2 Maintenance: Provide a description of maintenance procedures for all equipment and systems. Include a schedule for recommended planned and preventative maintenance work and intervals.

.3 Spare Parts: Provide a list of recommended spare parts.

.4 Suppliers and Contractors: For each piece of equipment, provide a list of resources to call upon for maintenance and servicing of equipment. Include the supplier's name, address and phone number as well as the service contact.

.6 Contract Documentation Division:

.1 Organize the information into sections, with index and divider tabs, as follows:

.1 Drawings List
.2 Shop Drawings and Product Data
.3 Certifications and Reports
.4 Warranties and Bonds

.2 Drawings List: Provide a list of all drawings used in performance of the contract.

.3 Shop Drawings and Product Data: Provide final reviewed copies of all shop drawings and product data. Provide copies of all manufacturers' data sheets, installation and maintenance brochures pertaining to each installed device, piece of equipment or system. Organize by system with a separate divider tab for the common devices and components.

.4 Certifications and Reports: Provide copies of Contractor certifications for performance of products and systems. Collect and include field reports:

.1 EMCS physical point confirmation and calibration reports as specified in Section 230895.
.2 Start-up and testing reports as specified in Sections 230895

.3 EMCS software verification reports as specified in Section 230993.
.4 EMCS Quality Assurance Logbook as specified in Section 230923.
.5 Any other test report verifying performance of EMCS products and systems.

.5 Warranties and Bonds: Provide one copy each of the EMCS Contractor's warranty, EMCS Manufacturers' warranties, and any EMCS service contracts provided by the Contractor. Provide a copy of the bond only in contracts where the EMCS contractor is the general.

.7 O&M Disk (full manual and system backup in electronic form):

.1 In addition to the hardcopy manuals, provide the Operation and Maintenance Manuals in electronic form as follows:

.1 O&M data shall be organized exactly as specified for the hardcopy manuals.
.2 Data shall be compiled into Adobe portable document format and assembled into as few files as practical. (NOTE: It would be preferable if there were no more than one file per division.)
.3 Include table of contents links that allow direct access to data as per the divider tabs required in the hardcopy manual.

.2 Provide the O&M Disk, in the form of a CD/DVD/BD for each hardcopy manual and backup package. CD/DVD/BD backup disks shall be archival quality, adequately labeled, protected in paper sleeves and inserted into archival quality plastic binder pages.

.3 Provide an electronic copy of the O&M Disk onto each CCS and PCS hard drive under the **C:\O&M_Manual** directory.

.4 Install a shareware copy of the latest version of Adobe Acrobat Reader on each CCS and PCS and create desktop shortcuts to the .pdf files to ease access.

1.12 QUALITY ASSURANCE

.1 Provide and install a fully proven system as described, including field tested hardware, operating system and applications software.

.2 Demonstrate capability to service system from service departments or organizations located within Alberta. Provide names, call out phone numbers and resumes for applicable service personnel.

.3 Provide a Quality Assurance Logbook at location of primary CCS. Logbook shall have holes appropriate for inclusion in O&M Manual binder. On completion of high speed trunk wiring and RCU installation, begin recording each RCU, TEC or unexplained failure (glitch). Provide the date, device identifier, type of failure, cause and how problem was resolved. Include all hardware failures as well as software/firmware problems such as panel lock-ups and loss of programming.

1.13 CONTRACT ACCEPTANCE PROCEDURES

.1 Comply with requirements of Division 01.

.2 Prior to Interim Acceptance of the Work provide all EMCS Manuals and Backups as well as the Operations and Maintenance Manuals.

.3 Prior to Interim Acceptance of the Work, complete all requirements of Section 230895 "EMCS Start-up and Testing". Submit a copy of the completed point checkout sheets. Provide reports or electronic copy on diskette of all trend logs and other data generated to prove correct function of each control module and tuned PID loop.

.4 Prior to Interim Acceptance of the Work, the installed system must be of acceptable quality by having:
- .1 no RCU failures over the previous 60 days of continuous operation.
- .2 not more than one TEC failure for every 300 installed TECs in the previous 40 days of continuous operation.
- .3 no significant unexplained failures (glitches) over the previous 20 days of continuous operation.

1.14 WARRANTY

.1 Correct all defects in workmanship, material or software during the duration of the warrantee period.

.2 Correct all system failures occurring during warranty period. After each occurrence:
- .1 Reload software lost as a result of system failure.
- .2 Record changes made to software in site log.
- .3 Download any changed databases and programs onto the CCS hard disk.
- .4 Backup RCU and TCU databases onto removable disk.

.3 Proprietary parts/components required for any warrantee work (i.e. RCUs, TCUs, expansion/accessory boards), shall be stocked in Alberta. As a minimum, parts shall be available in Edmonton for projects north of Red Deer and from Calgary for southern projects.

.4 Service response time:
.1 For dial-in service, personnel must connect to the EMCS within two hours of receiving the request.
.2 For non-emergency call-out service, personnel must be on-site within two days of receiving the request.
.3 For emergency call-out service, personnel must be on-site within three hours of receiving the request.

2. Products

2.1 ELECTRONIC DEVICES

.1 All RCUs and TCUs, whether fully user programmable or just configurable, as well all engineering and user interface software provided under this contract, shall be current product from the same manufacturer.

.2 All user programmable devices such as RCUs and TCUs shall utilize a single identical User Control Language throughout the system. Systems that do not meet this requirement are NOT acceptable.

.3 BACnet devices shall be BACnet Testing Laboratory (BTL) Certified.

.4 LonWorks devices shall be certified by the LonMark Association and carry the LonMark logo.

2.2 TAGS, LABELS, NAMEPLATES AND DIRECTORIES

.1 Comply with the identification requirements of Section 230928 “Field Work”.

3. Execution

3.1 IDENTIFICATION

.1 Comply with the identification requirements of Section 230928 “Field Work”.

3.2 START-UP AND TESTING

.1 Start and test the EMCS system as specified in Section 230895 - EMCS Start-up and Testing

3.3 TRAINING OF OPERATORS

.1 Provide 40 hours of training for three operators according to the following schedule:

.1 Four, half-day training sessions, one to two weeks before Interim Acceptance of the Work, covering all aspects of system use as follows:
- .1 Operation of hardware components.
- .2 Tour of EMCS components.
- .3 System software configuration.
- .4 Man-machine interface.

.2 Four, half-day training sessions, two to three months after Interim Acceptance of the Work, covering all aspects of system use and maintenance as follows:
- .1 Basic review of earlier training.
- .2 Advanced man-machine interface.
- .3 Programming basics.
- .4 Calibration of sensors.
- .5 Trouble shooting of system and components.
- .6 Preventive maintenance.
- .7 Backup procedures
  - Backing-up and restoring control panels
  - Creating a hard drive image backup
  - Backup schedule and rotation

.3 Two, half-day training sessions, six to twelve months after Interim Acceptance of the Work for clarification of system operating techniques. Operators shall determine agenda.

.4 Provide a sign off sheet, for inclusion in the system documentation manuals, which will be signed by the Contractor and the Minister's representative at the completion of each phase of operator training.

3.4FINAL UPDATES, BACKUPS AND O&M DISKS

.1 Just prior to Total Completion of the Work, provide the latest versions of all software and firmware in all CCSs, PCSs, RCUs, and TCUs.

.2 Just prior to Total Completion of the Work, provide updated O&M Disks. Copy these updates to all CCS and PCS hard drives.

.3 Just prior to Total Completion of the Work, revalidate and test all CCS and PCS recovery disks. Provide updated backup packages.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 230923 - EMCS General Requirements and other related EMCS Sections.

2. Products

2.1 NETWORK COMMUNICATIONS

.1 Architecture:

.1 The EMCS shall support a two tiered network:

.1 The high speed primary network shall operate at 115 Kbps or higher.]

.2 The high speed primary network shall support multiple Remote Control Units (RCUs) and utilize a peer-to-peer protocol in a multi-drop architecture. Master-slave protocols are NOT acceptable. Any Central Control Stations (CCSs) or file servers, tied directly to this network, shall not significantly affect inter-RCU communications.

.3 Each RCU shall have a 9600 baud minimum speed sub-network to communicate with Terminal Control Units (TCUs) or protocol compliant equipment and smart devices.

.2 Logical point mnemonic:

.1 Each physical or virtual point, controller point or schedule, shall have a unique, user-definable, system-wide, logical point mnemonic. A length of at least 12 characters is required. Any combination of alphabetic or numeric characters shall be allowed plus a delimiter (at least one of the following: - _ , . /). The format of these point mnemonics shall conform to the Alberta Infrastructure EMCS Guideline for Logical Point Mnemonics.

.2 Once a logical point mnemonic has been defined, the point's hardware address shall not be required for control sequence programming or any man-machine interface function.

.3 Information passing:

.1 Support direct peer-to-peer data sharing between all RCUs on the primary network so that physical or virtual point values resident in one RCU are available to all other RCUs. All CCSs/PCSs shall have data access to all RCUs on the primary network.

.2 Support data sharing between the RCU and its sub-networked TCUs/equipment/devices so that all physical or virtual point values, resident in the host RCU, are available to all TCUs/equipment/devices. As well, all physical or virtual point values, resident in the TCUs/equipment/devices, shall be available to the RCU hosting the sub-network and thus also available to all CCSs/PCSs.

.3 Values, statuses and attributes of physical and virtual points from one RCU, TCU or protocol compliant equipment or smart device shall be available for use in any other RCU, TCU, CCS, PCS or protocol compliant equipment or smart device without change of logical point mnemonic. The use of such information within a RCU, TCU function or program, shall require only that the correct logical point mnemonic be used within the program. As well, the use of such information in CCS/PCS graphics, reports, trending, alarming or configuration/ programming of any other CCS/PCS function shall require only that the correct logical point mnemonic be used within the function's setup.

.4 Setup of data sharing for the functionality described in the above clauses shall be automatic, requiring no programmer or operator action. Any broadcast points, send-receive blocks, data binding, or other form of table that is required to initialize and accomplish this function shall be invisible to the programmer and be created automatically without user intervention. Systems that require any form of manual mapping of data transfer at any level are NOT acceptable.

.5 The system shall automatically discover what objects are available form any RCU, TCU or protocol compliant equipment or smart device connected to the high or low speed networks. This "auto discovery" shall occur, without manual intervention, whenever a new device restarts or is connected to a network.

.4 Network failure modes:

.1 On communication failure, retain the last legitimate value of global points. Continue to control the systems based on these values.

.2 Failure of any panel on the primary network or on any sub-network shall not affect the ability of all other panels to communicate over the network.

.3 A panel shall detect the failure of any other panel. This information shall be useable in custom control programming.

.4 A panel shall detect the failure of any point it receives from the network. This information shall be useable in custom control programming.

.4 Network Protocols:

.1 The RCU hosted sub-network protocol shall be BACnet compliant. Proprietary sub-network protocols are NOT allowed.

.2 The BACnet protocol shall be used for all communications among RCUs, CCSs and PCSs. Future BACnet RCUs shall be able to be connected to the system's high speed network, at any RCU location, without the need to provide additional protocol interface devices or related software/firmware.

.3 Wireless BACnet over ZigBee is allowed for TCUs and non-critical net-sensors. Proprietary protocol over ZigBee is NOT allowed. Communications amoung RCUs and CCSs is to be hard wire.

3. Execution

3.1 CONTROL LOOP CONFIGURATION

.1 Control loops shall be configured so the control loop, setpoint variable and all associated hardware points are in the same RCU.

.2 Control loops shall not be closed across inter-panel communications links.
- .1 A single BACnet or LonWorks sub-network from a single RCU, to individual field devices such as smart sensors and actuators and/or to individual field equipment such as a variable speed drives, boilers or chillers, is not considered to be an inter-panel link.
- .2 Such BACnet or LonWorks networks shall have a total length of less than 100 meters and be connected to no more than 16 devices.
- .3 Interposing gateways, protocol converters or network extenders are not allowed on such networks.

3.2 SYSTEM CONFIGURATION

.1 Provide a system configuration which complies with the general configuration shown on the diagram appended to this Section.

.2 Provide one CCS in Custodial Room. CCS shall comprise:
- .1 CCS, keyboard, monitor and mouse.
- .2 Continuous paper feed alarm printer.
- .3 Hard copy report printer.
- .4 Telephone modem.
- .5 Computer Desk

.3 Provide one RCU minimum:
- .1 in mechanical room.

.4 Provide one RCU for each air handling unit.

.5 Provide one TCU mounted on each air handling system terminal box.

.6 The TCUs of all terminal boxes served by a particular air system, shall be on the sub-network from the RCU controlling that air system.

3.3 INTEROPERABILITY

.1 Co-ordinate RCU sub-network communication protocols and functional requirements to allow specified device interoperability.

.2 Select/configure/create system parameters/variables/BIBBs/etc. as necessary to allow the following data to be: a) displayed on CCS/PCS graphic screens, b) manually accessed from the CCS/PCS via operator command, c) automatically accessed by the RCU under control of operating sequences created with the User Control Language:

.1 TCUs: As required under section 230927 “EMCS Terminal Control Units”.

.2 Variable Speed Drives:

.1 Drive enable (write)

.2 Motor speed setpoint (read/write/override)
.3 Motor speed (read)
.4 Motor current draw (read)
.5 Drive status (read) i.e. ON/OFF
.6 Local manual override (read) i.e. Auto/Manual
.7 Fault condition (read)]

3 Boiler Controls:

.1 Boiler enable (write)
.2 Supply water temperature setpoint (read/write/override)
.3 Supply water temperature (read)
.4 Gas valve position (read)
.5 Boiler status (read) i.e. ON/OFF
.6 Local manual override (read) i.e. Auto/Manual
.7 Fault condition (read)]

.4 Packaged Air Handler Controls:

.1 Unit enable (write)
.2 Supply fan status (read)

.3 Return fan status (read)
.4 Supply air temperature setpoint (read/write/override)
.5 Supply air temperature (read)
.6 Supply air relative humidity (read)
.7 Return air relative humidity setpoint (read/write/override)
.8 Return air relative humidity (read)
.9 Return air temperature (read)
.10 Mixed air temperature (read)
.11 Mixing damper position (read/write override)
.12 Gas valve or heating coil valve position (read)
.13 DX solenoid or cooling coil valve position (read)
.14 Unit status (read) i.e. ON/OFF
.15 Local manual override (read) i.e. Auto/Manual
.16 Fault condition (read)]

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 230923 - EMCS General Requirements and other related EMCS Sections.

.2 The Central Control Station (CCS) hardware consists of the IBM-PC compatible computer, alarm printer, report printer and power side protection.

.3 The external system serial interface device (modem or serial device server) is included to allow a Portable Control Station (PCS) to have off-site access to the EMCS. It is intended that this device be connected directly to an RCU so that operation of the CCS is not necessary to gain access to the system.

2. Products

2.1 CCS COMPUTER - HARDWARE FEATURES

.1 PC compatible computer, fitted in tower case, utilizing current industry standard CEB or ATX form-factor motherboard with the following features minimum:

- .1 Intel Quad Core 3.6 GHz. I7 microprocessor LGA2011 socket
- .2 Three x16 - PCIe slots.
- .3 8 Gbytes of RAM
- .4 Three USB 3.0 ports, (one to be front panel mounted).
- .5 One front panel mounted multi-card slot for (SD, miniSD, etc)
- .6 One external eSATA III 6Gb/s interface port
- .7 One Ethernet port (100 Mbps minimum)
- .9 Ability to boot from hard drive and Blu-Ray drive.

.2 Redundant mass storage devices in the form of TWO mirrored hard drives. Mirroring shall be accomplished using a Raid 1 capable hard drive controller specifically designed for this purpose. **Software-only mirroring solutions are not acceptable**. Both hard drives shall be identical (same make, model, speed and capacity) with the following features:

- .1 1 Tbytes minimum capacity.
- .2 7200 RPM minimum rotational speed.
- .3 6ms maximum average seek time.
- .4 6 Gb/s SATA interface
- .5 Enterprise RAID service rated for 24-7 operation (eg. WD RE4)

.3 Blu-Ray HD DVD drive capable of 12X BD-R read/write, 6X BD-RE rewrite, 16X DVD+/-R read/write, 40X CD-R read/write. Provide 5 BD-RE disks and 10 DVD+RW disks.

.4 Mass storage backup in the form of one external hard drive with the following features:

.1 USB 3.0 interface
.2 minimum 100g shock rating
.3 1 Tbyte minimum capacity
.4 padded carrying case

.5 Colour monitor and graphics card:
.1 LCD TFT Monitor, minimum screen size 558 mm (diagonal measurement).
.2 Minimum 1680x1050 pixel resolution.
.3 600:1 minimum contrast ratio, 160 degree minimum viewing angle
.4 250 cd/m2 minimum brightness , 8ms or better response time
.5 Screen brightness, contrast and image sizing controls.
.6 Video card to have compatible PCIe bus and capable of driving supplied monitor to its maximum resolution including 1680x1050, 1280x1024, and 1024x768 all in 32 bit colour as well as IBM SVGA and VGA in 16 bit colour.
.7 Screen image must be free of flicker, clear and sharp over entire screen area at all display resolutions.

.6 101 key keyboard with built in numeric keypad and 12 function keys.

.7 Optical wheel mouse with mouse pad. Wheel button to be programmed to act as double left click. Wheel to be programmed for scroll function.

.8 Safe shutdown of the CCS and mass storage components when power failure to the computer is detected. Provide for automatic restart of control system interface software once power has returned and has been stable for at least 1 minute.

2.2 CCS ALARM PRINTER

.1 Continuous paper feed printer with:
.1 120 characters per second print speed minimum.
.2 tractor paper feeder for minimum paper width of 250 mm.
.3 adjustable 80 to 132 characters per line.
.4 programmable control of top of form and variable (multiple) line skip capability.
.5 maximum noise level 65 dBA @ 1.0 meter.
.6 USB 2.0 interface.

.2 Provide raised stand to allow for paper storage under printer.

.3 Thermal printers not acceptable.

2.3 CCS REPORT PRINTER

.1 Paper sheet fed printer, HP III laser jet compatible, with:
.1 2.0 Mbytes memory minimum.

.2 12 page/minute minimum speed.
.3 250 sheet minimum capacity feeder tray.

2.4 CCS POWER SIDE PROTECTION

.1 For each CCS provide an uninterruptable power source (UPS) with:

.1 true continuous duty Delta-Conversion on-line design, 1500VA minimum. Inverter section rated for full load +10% short term overload. Standby models not acceptable.
.2 input harmonic current content less than 15%.
.3 pure sine wave output synchronized to utility line. Output harmonic current content less than 15%. Square, triangular or stepped output waveforms not acceptable.
.4 continuously regulated output 115 Vac +/- 5%, 60Hz +/- 0.1% for input voltages between 90 and 132 volts.
.5 isolated neutral and both normal and common mode transient protection with response time of less than 5 nanoseconds.
.6 dynamic clamping when tested against ANSI/IEEE C62.41-1991, and as follows:
.1 A Ringwave clamping 250V, peak 350V.
.2 B Ringwave clamping 250V, peak 350V.
.3 B Impulse clamping 400V, peak 450V.
.7 series or isolating design with silicon suppressors (transorbs, avalanche diodes). Devices that rely solely on MOVs not acceptable.
.8 over current and over temperature protection with failure indication.
.9 sealed maintenance free batteries with sufficient capacity to provide 20 minutes of on-battery power to the CCS, alarm printer and serial interface device.
.10 a recharge period, after 90% discharge, not exceeding 6 hours.]

2.5 SYSTEM SERIAL INTERFACE DEVICE AND REMOTE COMMUNICATIONS

.1 External auto dial/auto answer modem and software for remote communications with system over normal telephone lines. Modem shall have isolated power supply, auto adjust transmission rate to 56 Kbps and all necessary RS-232C serial port interface cabling.

.2 Provide a telephone line surge suppressor.

2.6 OPERATING SYSTEM AND BACKUP UTILITIES SOFTWARE

.1 For each CCS and PCS, provide the latest full version of an industry standard operating system such as Windows 7, complete with all available commands and functions.

.2 For each CCS and PCS, provide a complete set of the latest version of disaster recovery CD/DVD-RW drive utilities such as Symantec/Norton Ghost or Acronis True Image, capable of:

.1 creating a complete image backup of the CCS or PCS hard drive onto multiple spanned Blu-Ray or DVD disks, USB drive or an external backup hard drive.

.2 restoring hard drive contents by simply inserting the backup media and turning on CCS or alternatively inserting a recovery disk/device followed by image backup media.

.3 partitioning and formatting a newly installed hard drive.

.4 automatic unattended backup of selected EMCS data directories into a separate backup directory.

.3 For each CCS, provide utilities that allow one of the mirrored hard drives to be replaced should a failure occur. The utility shall be capable of automatically rebuilding a complete bootable image of the good hard drive onto the new replacement hard drive. If such capability is available via the computer's firmware, then additional utilities are not required.

.4 Provide complete installation CD/DVDs for each copy of system and utility software. Include all hardcopy manuals. If programs were delivered via download, then copy all such programs, required license files and serial numbers as well as installation notes, onto CD/DVD. Print installation notes and include with CD/DVDs in suitable marked binder.

2.7 GRAPHICAL OPERATOR INTERFACE APPLICATION SOFTWARE

.1 For each CCS and PCS provide an operator interface which allows:

.1 complete manual and automatic unattended saving, to the CCS's/PCS's hard drive, of ALL volatile and configurable information in every RCU and TCU. Battery backed RAM and EEPROM is considered volatile for these purposes.

.2 complete loading of all information specified above.

.3 editing of all programmable or configurable information including but not limited to database, passwords, User Control Language programs, control loop parameters, report setups, equipment start/stop schedules, etc.

.4 loading of User Control Language programs created and edited off line on a personal computer and transferred via USB Flash Drive or SD Card.

.2 The PCS operator interface shall:

.1 be able to interface to the EMCS locally through a hardwire connection at any RCU location or from off-site via the system serial interface device. Include all necessary interface cables and hardware devices.

.2 provide the same compliment of functions and be identical in look and feel to the CCS interface no matter the type of connection or method of access.

.3 be a complete software package unto itself. Screen/keyboard mimicking software such as "PC Anywhere" is not allowed.

.3 Basic features:
- .1 Windows style point and click operation with mouse, pull down menus or pop-up windows.
- .2 Integrated "Help" application with information on basic operating procedures etc.
- .3 Real time display of clock and operator identification.
- .4 Automatic logging of operator sign-on/off including time and operator ID.
- .5 Automatic display and logging of alarm occurrence including point mnemonic, message, time and date.
- .6 Minimum 256 colour capability.

.4 Real time dynamic graphing display of trend data:
- .1 Minimum of 4 points per graph with data from each point in a different colour.
- .2 Allow analogue and digital data from physical and virtual points on same graph.
- .3 Ability to select/deselect point data that is displayed.
- .4 Two vertical scales with automatic grouping of points with same units.
- .5 Automatic scaling on both axes to fit range of data displayed with ability to manually expand, under direct mouse control, any portion of the time scale to magnify data of interest.
- .6 Graphing shall be in real time so as to include new data as it is trended.
  NOTE: Trend definition and setup are defined as RCU functions.

.5 Allow user to **view** dynamic point data superimposed upon a schematic diagram, photograph or blank background as required by the type of information displayed. These dynamic graphic displays (graphics) shall have the following features:
- .1 Allowed number of graphics shall be no less than:
  6 + (number of TCUs) + (total number of RCU physical points / 15)
- .2 Graphics shall be linked so as to allow for logical navigation through the displayed information.
- .3 Each graphic shall be capable of displaying point mnemonic, value, units, alarm condition and operational status (auto/manual/failed) from at least 32 physical or virtual points. Data shall be logically positioned on the graphic screen.
- .4 Displayed points shall be able to be commanded to any allowed state or value directly through the graphic. A point and click shall reveal the states/value window for the selected point. A state selection or value entry followed by a confirming click should end the operation and place the point into the desired state.
- .5 Automatic update period for entire graphic shall be no longer than 10 seconds.

.6 Allow user to view documentation files for a displayed mechanical system by simply clicking upon a documentation link on the menu bar.

.7 Allow user to **create** and **edit** simple, text based, dynamic point data display pages as follows:
- .1 The number of available display pages shall be no less than:
  10 + (number of TCUs) + (total number of RCU physical points / 10)

.2 Each display page shall be capable of showing data from at least 20 physical or virtual points.
.3 Each point location shall display point mnemonic, value, units, alarm condition and operational status (auto/manual/failed).
.4 Automatic update period for the entire page shall be no longer than 10 seconds.
.5 Pages shall be able to be able to be linked in whatever order is necessary to allow for logical navigation through the information.

.8 Provide complete installation disks or CDs for each copy of operator interface software.

2.8 GRAPHIC SCREEN CREATION/EDIT APPLICATION SOFTWARE

.1 For [one [OR] each] CCS provide a dynamic colour graphics package which allows user to create, modify and delete dynamic graphics screens used within the Graphical Operator Interface.

.2 Basic features:

.1 Windows style point and click operation with mouse, pull down menus or pop-up windows.
.2 Allow creation of graphic links among screens and to trend graphs.
.3 Mechanism for copying, editing and saving graphics with similar layouts to create a custom library of generic schematics.
.4 Often used functions shall have a keyboard counterpart to improve the efficiency of the editing process.
.5 Minimum 256 colour capability.

.3 Creation and modification of graphics backgrounds shall allow:
.1 owner creation of symbols which can be stored in a custom symbol library.
.2 control of symbol scale, infill colour and location on screen.
.3 control of line and geometric shapes drawing.
.4 control of alpha numeric text and information windows.
.5 editing of text with search and replace feature.
.6 photographs to be used as graphics backgrounds or portions of backgrounds.

.4 Addition and modification of superimposed dynamic data shall allow:
.1 any combination of analog/digital information, graphic symbols or text, to be displayed at any location on the screen, minimum of 32 physical/virtual points per graphic.
.2 any combination of logical point mnemonic, descriptor, value, units and whether the point is in auto or manual operation, to be assigned for display at any point location.
.3 different symbol infill colours to be displayed based upon the state of a linked dynamic digital input or alarm point.

.5 Provide features to link Adobe Portable Document Format (.pdf) or text (.txt) based documentation files to graphic screens. Provide required editors to create and modify documentation file contents.

.6 Provide complete installation disks or CDs for each copy of graphics screen creation/edit software.

3. Execution

3.1 INSTALLATION

.1 Install all CCS hardware, software and peripheral devices at location specified. Neatly arrange all interconnect cabling. Loop and wire tie as necessary. Affix power bar and cabling to rear of desk as appropriate to ensure wiring remains off floor.

.2 CCS shall be connected to emergency power if such is available in the facility.

.3 All CCS hardware shall be powered from the same electrical outlet on the same circuit. The power side protection device (UPS or power line conditioner) shall serve all of the CCS hardware.

.4 Under no circumstances shall the CCS share the same circuit as motorized equipment. Provide a separate circuit if necessary.

.5 Install an optically coupled data communications isolation and surge suppression device if the CCS is connected to an RCU with a non-isolated connection (i.e. RS-232 etc.) and any one of the following conditions exist:
.1 The CCS and RCU are not on the same electrical circuit.
.2 The CCS to RCU communications cable is more than 30 meters long.

.6 Install system serial interface device (modem or serial device server) at any convenient RCU. Securely attach device inside RCU or adjoining equipment cabinet, neatly arrange and wire-tie all cables. Install all required communications software and setup system alarming/messaging structure. Device shall be powered from the same electrical circuit as the device to which it is connected. If specified above, install data line isolation device at modem end of the RS-232 connection.

.7 Where a modem is to be provided, arrange and pay for new dial up telephone line and connect to modem. Coordinate telephone line acquisition with the Minister. Transfer responsibility of the line to Minister on date of Interim Acceptance of the Work. Ensure that the transfer occurs without interruption of service by notifying the appropriate telephone utility group, in writing, of the transfer.

.8 Configure automatic backup and notification features of user interface and disk utilities as follows:

.1 Every two weeks, backup onto hard drive, ALL volatile and configurable information in every RCU and TCU.
.2 Every month, backup into separate hard drive backup directory, labeled by month (i.e. C:\Backup_Jan, C:\Backup_Feb, etc), the latest bi-weekly system backup.
.3 Every 3 months, send a notification message to the CCS screen as well as to the printer, requesting the operator to create a complete disk image backup onto DVD-R or removable hard drive.

.9 For each CCS and PCS, perform the driver validation tests provided with the backup utility software. If validation fails, create a custom disaster recovery DVD/CD disk for the CCS or PCS. Test proper functioning of all recovery disks.

3.2 SYSTEM GRAPHICS

.1 Every installed physical point, schedule, setpoint, user adjust point and alarm must appear at least once on an appropriate screen graphic. Locate points as close as possible to their graphical representations. Schedules and system user adjusts shall be located under the respective system title, left justified. Setpoints must be located under the sensed value but displayed in a different, less prominent colour.

.2 Selection of data shall be appropriate with regard to the underlying system schematic diagram and allow for complete operation and trouble shooting as determined by the sequence of operation. Virtual point data that is important to determining the proper operation of the system shall be included. These may be schedules, user adjusts, space condition information, control loop output values, etc.

.3 Air systems and major equipment shall be rendered as simple 2-dimensional or very flat 3-dimensional outlines with solid colour fill. The outline colour shall be similar to, but provide some contrast against the fill colour. Ductwork outlines, fans and pumps shall have a shape or arrow indicating direction of flow. In general colours shall be as follows:
.1 Acid: Purple
.2 Air systems: Grey
.3 Boilers, coils and related piping: Yellow
.4 Boiler feed water and condensate: Green
.5 Chillers, coils, cooling towers and related piping: Green
.6 Domestic cold water: Light Blue
.7 Domestic hot water: Green
.8 Freon equipment and piping: Grey
.9 Fire equipment and related piping: Red
.10 Glycol heat exchangers, coils and related piping: Vista Green
.11 Oil: Brown
.12 Steam heat exchangers, coils and related piping: Yellow

.4 Equipment outlines shall be sized to allow sufficient room for all required dynamic display information to be placed on the screen without creating a cluttered appearance. The graphic designer shall strive to create graphics that provide ease of operation, simplicity and a clean appearance. Text must be large enough for easy viewing and colours should be selected to match visual impact with the importance of the information being displayed. However, the use of too much or clashing colours, or colour combinations that cause eye strain because of incompatible perceptual depths, must be avoided.

.5 Units of ON/OFF shall be reserved for a device's actual input point operating status. The commanded condition of a device or virtual point flag shall be defined as Start/Stop, Enable/Disable, Yes/No, Go/NoGo, etc.

.6 Analogue input or output values with units of "%" shall be shown as % of product. This is to be the case regardless of the safe failed position of the final control element. Example: cooling coil valve at 100% means full flow through coil, heating coil valve at 100% means full flow through coil even though signal to valve may actually be zero.

.7 A depicted device, or portion of that device shall show green when the device command state and status are ON, grey if they are both OFF and flashing red when in an alarm condition. An alarm shall not be displayed unless command value and status do not match and then only after the allotted alarm timeout has expired.

.8 Every point on every graphic shall indicate, with colour change or appended letter, whether or not it is under manual override control.

.9 Floor plans are to be colour coded to the air handling unit serving that portion of the floor. Selecting (left clicking) the area shall bring up the air handler's graphic. Co-ordinate colour scheme with Minster.

.10 For facilities with large floor plates, provide a small key plan in the lower right hand portion of each screen to show the depicted floor plan as a shaded portion relative to the building outline. Include floor number if appropriate. Provide links in the key plan to allow navigating to other areas of the same floor, or to jump to the same portion on another floor.

.11 Graphic titles shall be located at the top center of each screen in a simple bold font of sufficient size to be obvious as a title. Colour shall be white or other neutral colour that provides sufficient contrast against background without detracting from the mechanical system portrayed.

.12 The date of the last revision shall be located in the very top right hand corner of the graphic. Format as yyyy/mm/dd using a small but legible font in a shade that has just enough contrast to be seen without making it obvious to a casual glance.

.13 Create a menu bar containing links at the bottom of each graphic screen with the exception of the Startup screen. The bar shall be placed in exactly the same location on every graphic and have link buttons of exactly the same size to allow logical browsing through the mechanical systems without moving the mouse. The bar shall provide the following links to standardize movement:

.1 MAIN: locate in first (furthest left position) on all but the Main screen. Selection of MAIN will cause Main screen to be displayed. On the Main screen, put "BYE" in this location. Selection of BYE will sign-off operator and display startup screen.

.2 PREVIOUS: locate in second position on all but the startup screen. Selection of this link button will bring up "last viewed" graphic.

.3 Custom Buttons: locate in center area of bar. Name and arrange to scroll through screens in logical order. Consult with Minister as to most suitable penetration scheme.

.4 MLOG: locate in second last position on every screen. Selection of MLOG will display and operator editable text file that can be used by the operators to enter useful maintenance information or to document equipment problems.

.5 DOC: locate in last position on all but the Main screen. Selection of DOC will display the documentation relating to the portrayed mechanical system. On Main screen, put "HELP" in this location. Selection of HELP will bring up the EMCS's help application

.14 As a minimum, create and link dynamic graphic display screens as follows:

.1 One or more graphic screens for each mechanical system under EMCS monitoring or control as well as for miscellaneous systems such as domestic hot/cold water, emergency generator, parking garages, lighting, parking lots, etc.

.2 Link the relevant portions of the electronic Operating and Maintenance Manual, located in the C:\O&M_Manual directory, to the "DOC" button on the menu bar of each graphic screen. As an acceptable alternative, create text based mechanical system documentation files for each mechanical system and link these to the relevant "DOC" buttons.

.3 One graphic screen for each Terminal Control Unit (TCU).

.4 Building floor plans showing location of TCUs and displaying each room temperature. Besides normal menu bar, provide suitably located links to each TCU graphic.

.5 TCU summary screens showing the space temperatures, setpoints, damper positions and flow rates (VAV) for a group of TCUs. Group TCUs as per the air system serving a particular area. Provide links to respective air systems and to individual TCU graphics.

.6 Alarm summary screens.

.7 Schedule summary screen.

.8 Main screen with overall building plan showing approximate locations of mechanical rooms. Title "MAIN SCREEN". Besides normal menu bar, provide suitably located links to floor plans, alarm summary and schedule screens as well as all mechanical systems depicted on the overall plan. Main screen must display outdoor air conditions.

.9 A startup screen that is displayed when no operator is signed onto the system. It shall consist of a photograph of the front of the building with the title being the building name. Outdoor air conditions may be displayed but nothing more. A selection (left mouse click) anywhere on the screen shall bring up the system's sign-on window. On proper sign-on, main screen shall be displayed.

.15 Provide a sample copy of a major heating, cooling and air system graphic as well as the main screen graphic, complete with all dynamic display data, for evaluation by the Minister. Incorporate recommended changes before creating draft versions of Graphics.

.16 Provide a draft copy of complete Graphics set for review by Minister before installation on site.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 23 09 23 - EMCS General Requirements and other related EMCS Sections.

2. Products

2.1 REMOTE CONTROL UNITS - GENERAL

.1 Each RCU shall:

.1 include a real-time operating system that:

.1 executes control, timing and sequencing of all programs.
.2 performs multi-tasking to run programs and concurrently communicate with other RCUs and the CCS over the high speed network, with TCUs connected its sub-network or with the serial ports.
.3 provides automatic means of sharing physical and virtual point information with rest of system.
.3 automatically restarts RCU when power is restored.
.4 has diagnostic software to test RCU integrity, and data transmissions.

.2 provide fully stand-alone operation by acquiring information from input points and locally processing this information to control output devices according to the User Control Language.

.3 record, evaluate and report changes of state/value that occur to physical or virtual points within the RCU.

.4 keep a record of security passwords, and supervise any local operator access to the EMCS.

.5 include all necessary hardware, software and firmware as required to interface to primary network and the sub-network as defined in Section 230924.

.6 allow the processing and execution of operator commands as well as the downloading of the complete RCU programming and database, from a Central Control Station (CCS), locally connected laptop computer (PCS) or from a remote PCS through serial interface device (modem).

.2 Any slave panel, sub module, or any form of point expansion panel that is connected to an RCU, and located within 1 metre of the RCU, shall be considered an integral part of the RCU.

.3 The data base and control strategies for any point connected to a slave panel, sub module or point expansion panel shall be resident in the RCU.

.4 Only BACnet devices are allowed.

2.2 REMOTE CONTROL UNITS - FEATURES

.1 Minimum 32 bit full floating point mathematics.

.2 Minimum 8 inputs and 8 outputs. Maximum of 128 input/output points.

.3 Minimum of one sub-network port.

.4 Minimum of two serial ports for communication with any two system peripherals, such as a printer or portable operator terminal and a modem or serial device server.

.5 Watchdog timer. Failure of RCU shall automatically switch outputs to a pre-selected fail-safe condition and initiate a cold restart.

.6 Real Time Clock accurate to one minute per month and capable of maintaining accurate time through a 72 hour power failure. Clock to be synchronized to a master timekeeping RCU or the CCS real time at least every 24 hours.

.7 Network monitoring routines. Failure of primary network or sub-network shall be detected. RCU shall continue to control environment using last reliable setpoint or operating mode. A read-only indicator of this failure shall be available for use within the custom controls programming.

.8 Hardware monitoring routines. Failure of any RCU physical point shall be detected. RCU shall continue to control environment using last reliable information. A point attribute or other read-only indicator of this failure shall be available for use within the custom controls programming.

.9 Permanently marked removable terminal block for the wiring of all sensors, control devices, network and RCU power.

.10 Free-standing or wall-mounted robust metal or plastic cabinets with hinged and key-locked front door with common keying for all RCU and equipment cabinets.

2.3 MEMORY

.1 User Control Language program and data base memory shall be EEPROM or 72 hour battery or capacitor backed RAM.

.2 Data/stack memory space shall be 72 hour battery or capacitor backed RAM.

.3 System firmware shall be in non-volatile EEPROM memory.

.4 Provide sufficient memory:

.1 to allow creation and execution of specified User Control Language programs. As a minimum, for each connected physical point, provide sufficient capacity to create programs containing the following:
.1 10 logical operators (eg. AND, OR, NOT)
.2 10 mathematical operators (+, -, /, *, ^)
.3 Five commands or functions (eg. START, STOP, MIN, MAX, SQRT)

.2 to create one PID controller for every available analogue output.

.3 to simultaneously maintain 256 trend samples for each physical point connected to the RCU.

.4 to contain the data base for all physical points and for two virtual points for each physical point connected to RCU as well as at least one annual schedule and 2 daily schedules.

2.4 SIGNAL PROCESSING

.1 Analog Input Processing:

.1 Each analog input shall be converted to digital format at a minimum frequency of 1 conversion per second.

.2 Analog to digital conversion shall have sufficient resolution to provide the minimum end to end accuracy defined in Section 230929 plus one bit, but shall not be less than 10 bits.

.3 Relative errors between analog inputs shall not exceed 0.25% of span.

.4 Each input shall be individually calibrated for zero and span in software.

.5 On board circuitry shall protect each input from short circuit and have a 500 volt minimum isolation.

.6 The following ranges are required:

.1 4 - 20 mA DC
.2 0 - 10 VDC

.7 A special range for direct input resistance temperature sensors is allowed.

.2 Analog Output Processing:

.1 Each analog output shall be converted to analog format at a minimum frequency of one conversion per second.

.2 Digital to analog conversions shall have 8 bit resolution minimum. The output signal shall be linear.

.3 Each output shall be individually calibrated for zero and span in software.

.4 On board circuitry shall protect each output from short circuit and have 500 volt minimum isolation

.5 The following ranges are required:

.1 4 - 20 mA DC
.2 0 - 10 VDC

.3 Digital Input Processing:

.1 Inputs shall accept dry contacts.

.2 Provide one pulse counter input per RCU which will accept pulse rates up to 1000 Hz.

.3 Provide minimum 500 volt isolation for each point through use of optical isolators or equivalent on termination board.

.4 Digital Output Processing:

.1 Provide outputs capable of switching a 120 VAC external power supply, or triac SCRs rated at 0.5 Amp 24 VAC minimum.

.2 Provide full protection to hardware and software from switching transients.

2.5 POWER SUPPLY

.1 For each RCU, provide:

.1 a line voltage isolation transformer.
.2 a power supply with fused over current protection and power on indication.
.3 transient surge suppression as part of the power supply or as a separate device.

.2 Transient surge suppression requirements:

.1 Provide protection from both Normal and Common Mode transients. Response time to Common mode transients shall be less than 5 nanoseconds

.2 Let-through voltages (L-N) when tested against ANSI/IEEE C62.41-1991 and C62.45, 1992 shall be as follows:

.1 Category A3 and B3 Ringwave (6000V, 200A) let-through less than 15V.
.2 Category B3/C1 Combination (Impulse) Ringwave (6000V, 300A) let-through less than 200V.

.4 Separate devices shall use hybrid circuits. Circuits that rely solely on MOV's or avalanche diodes will not be accepted.

.5 Separate devices shall have a minimum nominal capacity rating of 3 Amps at 120 VAC or three times the maximum current draw of the RCU and all connected components, which ever is greater. The device shall be either UL listed or CSA approved.

.6 Provide documentation or test results that show that transient suppression meets the specified requirements.

2.6 DATA BASE

.1 Provide data base creation and modification at a CCS, a PCS connected to any RCU serial port or from a remote location via the system's serial interface device. The user shall have data base manipulation capability, while on line, to add, modify and delete points, alarms, schedules, trend logs, custom point groups, start/stop sequences, engineering units, spring ranges and point maps.

.2 Each physical and virtual point shall be tagged with a unique name according to the most recently available "Alberta Infrastructure EMCS Guideline for Logical Point Mnemonics". Specialty points or functions such as alarms, totalizers, point groups, etc., shall be assigned a unique name closely resembling the point mnemonic of the associated points.

.3 Provide:

.1 virtual points which can store 32 bit floating point numbers and which can be manipulated in the same manner as analog or digital physical points.

.2 custom units, minimum 6 characters in length, assignable to any point or state of point operation (examples: L/s, KWhrs, High, Slow, Off, mA, Jouls)

.3 conversion tables or other mapping functions for analog input and output points that define how the input or output hardware values relate to the engineering units used. Accommodate non-linear relationships using a mathematical formula or a conversion table with a minimum of 10 individually definable segments.

.4 mapping functions for digital input, output and virtual points for assigning any pair of engineering units to the active/inactive or energized/de-energized states of the points (examples: Start/Stop, On/Off, Open/Closed, Alarm/Normal, Yes/No, Enable/Disable, Lead/Lag).

.5 totalization functions for digital input, output and virtual points capable of counting the accumulate hours or minutes of run time or contact status for at least 9999 minutes.

2.7 BASIC OPERATOR INTERFACE

.1 Provide a basic, RCU hosted, system/operator interface with:

.1 interrogation via a text based command line, a succession of menus, or a graphical user interface.

.2 basic creation and editing of physical and virtual point database.

.3 software grouping of points for monitoring and system control functions.

.4 dynamic data display of a selected grouping of points with all required functions to create or edit display data groups.

.5 operator override capabilities that allow manually command/override of any physical or virtual point to a desired state or value, so that User Control Language programs cease to control that point.

.6 at least three access security levels for a minimum of eight operators with hard-copy reporting of all authorized and unauthorized sign-on or sign-off events.

.2 Provide software packages and interface cables for each PCS to access the EMCS through the RCU via the basic operator interface. A minimum of one package shall be provided.

2.8 ALARMS

.1 Provide RCU operating system alarms for the following malfunctions:
- .1 Communications failure with any connected TCU or adjacent RCU.
- .2 Watch-dog-timer activation.
- .3 Input or output point failure.
- .4 Control program execution error (divide by zero, etc.)
- .5 Power interruption restore or other cold start

.2 Provide change of state alarms for digital physical or virtual points with user selection of which digital contact state is the alarm.

.3 Provide high and low limit alarms for analogue physical or virtual points with user defined high and low alarm limits as well as relative alarm limits (differential) referenced to a virtual set-point such that the alarm limits automatically adjust with change in set point value.

.4 Alarms shall be able to be directed to the CCS and/or a peripheral device at any user-defined RCU serial port.

.5 Provide ability to automatically disable an alarm or group of alarms based upon the status of any selected digital physical or virtual point.

.6 Each non-system alarms shall have user adjustable time delay settable within a range of 5 seconds to 30 minutes.

.7 Alarms shall be able to be categorized as critical or non-critical. Critical alarms shall require operator acknowledgement.

.8 Each non-system alarm shall include a user defined alarm message, 30 characters minimum length.

.9 All alarms shall be logged with:

- .1 current time, date and initials of on-duty operator.
- .2 point mnemonic and description.
- .3 current value or status, including engineering units.
- .4 nature of alarm - high or low, on or off, open or closed, etc.
- .5 critical or non-critical alarm designation.
- .6 alarm message

2.9 TREND LOGGING

.1 The RCU shall be able to trend log any physical or virtual point, controller output, or schedule result defined in the RCU or any TCU connected on its sub-network . Required features:

.1 User defined start and stop times or continuous sampling.
.2 User adjustable sampling frequency from 5 seconds to 24 hours.
.3 Number of samples per trend selectable from 1 to 128.
.4 User selectable sample initiation by time interval or change of state.

.2 RCU shall be able to automatically dump trend data to the CCS hard drive at user specified intervals or to clear allocated RAM when full. Stored data shall be in ASCII format.

.3 Trend reports shall display and print a minimum of four logged points across the page. RCUs with graphic interface shall be able to display trend data graphically.

2.10 SCHEDULING

.1 Provide a minimum of two annual/holiday schedules as well as 20 start/stop schedules for designated points or groups of points.

.2 Start/stop schedules shall allow defining a minimum of 4 starts and 4 stops per day to a resolution of 15 minutes. Each schedule shall include weekend, holiday and annual schedule skip features.

.3 Provide:
.1 time delays between successive commands (for groups of points).
.2 operator override of the schedule for each point.
.3 report of all time schedules and their associated commanded points.

2.11 REPORTING

.1 Reports and logs shall be able to be directed to the CCS and/or a peripheral device at any user-defined RCU serial port.

.2 Reports and logs shall:

.1 be capable of manual or automatic (time and date or event) initiation.
.2 include a header with a report title as well as the current time and date.
.3 include sufficient English language description to allow the contents to be understood by anyone with modest controls familiarity.

.3 For the RCU and any TCU connected on its sub-network, provide:
.1 summary reports with current list of:
.1 operator overridden points.

.2 points in alarm condition.
.3 points in trend logs.
.4 totalized points.

.2 reports listing current point value or status for any building, system, or user-defined group of points.

.3 database, alarm, trend and schedule reports that produce on-screen and hardcopy listings selectable by individual point, point type or database category. Listings to include current data and all information required to re-create the selected database elements.

.4 Provide operator access reports listing the operator's name, password, on-duty initials and system access level or access matrix,.

.5 Provide security log reports listing at least the last 500 system transactions including operator initials, command performed and time and date. Include all sign-on, sign-off and invalid system access attempts.

.6 Provide system diagnostics reports that list current and past system hardware and software errors.

2.12 USER CONTROL LANGUAGE (UCL)

.1 The User Control Language (UCL) shall allow the user to develop and program custom operational sequences, unique control algorithms, interactive point relationships, custom calculations using any combination of mathematical, relational and logical operators. UCL custom control sequences shall be able to:

.1 calculate flow rates, energy consumption, electrical demand and heating/cooling loads.
.2 determine equipment run times and durations of events.
.3 calculate operating setpoints.
.4 start and stop equipment.
.5 modulate or place dampers and valves in any calculated position.
.6 enable/disable alarm functions.
.7 enable/disable control loops and manipulate their bias values, gains and output ranges.

.2 The following UCL program formats are acceptable:

.1 Traditional text based languages that are styled upon a line by line "high level" computer programming language such as C, Pascal, Fortran or BASIC. Low level assembler or macro style languages are NOT acceptable.

.2 Block/object or graphic style languages that are formatted by linking predefined library modules, if and only if they feature at least one of the following enhancements:

.1 They allow the user to create and modify custom blocks/objects using a richly featured line by line text based "high level" computer programming language such as C, Pascal, Fortran or BASIC.
.2 They contain functions or procedures that allow an arbitrary number of attached Terminal Control Units (TCUs) to be polled for load information, mode, status and alarms without the need to explicitly program each data link between the TCUs and the RCU program requesting this data.

.3 Any block/object or graphic style language, if the total number of terminal boxes served by each air system is less than 20, OR, if the total number of connected physical points is less than 80. Terminal Control Unit points or simple alarm only points are not to be included for the purpose of this determination.

.3 The UCL shall be modular in construction allowing a minimum of one independent program or graphic programming screen page, for every 8 physical points connected to the RCU.

.4 The UCL shall allow comments to be embedded anywhere in the source code or on a graphic programming screen page.

.5 The traditional text based "high level" language, used to create the operational sequences or custom blocks or library routines, shall allow expressions (i.e. a program lines) :

.1 containing 5 levels of parenthesis
.2 containing at least 10 mathematical and/or logical and relational operators in any desired order and combination.
.3 containing mixed mode mathematics (combined use of math and logic operators), using normal order of mathematical precedence, not simply left to right.
.4 with a minimum line length of 128 characters.

.6 Provide mathematical operators for:

.1 addition, subtraction
.2 multiplication, division
.3 square roots, exponents

.7 Provide logical and relational operators for:

.1 and, or, not
.2 equal to, not equal to
.3 less than, greater than

.8 Provide branching features for:

.1 unconditional branching to another line, label or graphic entry point in the same program module.
.2 conditional branching in the form of IF...THEN...ELSE statements that can be nested to a minimum of 3 levels or graphic objects with similar capabilities.
.3 calling a subroutine, program module or graphic block/object with return to calling routine.

.9 Provide functions, procedures or graphic blocks/objects which calculate or obtain:
.1 current time, day of week and date in decimal or integer format.
.2 operational status of RCU network communications.
.3 operational status of TCU sub-network communications.
.4 operational status of any connected point (in/out of service, failed, alarm)
.5 minimum, average and maximum values of a minimum group of 5 variables, points or numeric expressions.
.6 value of a variable, point or expression, limited to a set range between limiting values or numeric expressions representing allowable minimum and maximum values.
.7 an interpolated value from a user defined set of coordinates defining at least 5 line segments. This is in addition to the spanning and ranging capabilities provided in analogue point database.
.8 the current value of a programmable count up/down seconds timer that can be reset or initialized under UCL control. Timers to be capable of counting a minimum of 10,000 seconds and shall hold when timed out.
.9 next scheduled ON or OFF time/date of any point, annual or holiday schedule
.10 duration that any binary point or status has been in the ON or OFF state.
.11 runtime or totalized value of any point thus configured.
.12 alarm status of any defined alarm point.

.12 Provide a minimum of ten local variables per control program module for use as temporary storage of intermediate calculation results. Variables shall be able to store 32 bit floating point numbers and are not to be global virtual points created by the user.

2.13 CONTROL SEQUENCE INTEGRATED DEVELOPMENT ENVIRONMENT

.1 Provide an integrated development environment for creating, modifying, interpreting/compiling, testing, executing and trouble shooting custom control sequences:

.1 in any RCU on the network from any CCS.
.2 in any RCU on the network from off-site via the control system's serial interface device
.3 in a particular RCU from a PCS locally connected to that RCU.

.2 For editing traditional text based UCL programs, provide a full screen editor with the ability to:

.1 insert, delete, overtype characters in any displayed line.

.2 copy or cut a line, or block of lines, and insert these before any displayed line in the current UCL program or another UCL program.

.3 search for an alphanumeric string and replace with another string.

.4 produce a hard copy of the edited program.

.2 For editing block/object or graphic style UCL programs, provide a full screen graphic editor with the ability to:

.1 insert or delete a graphic object anywhere on the screen.

.2 edit object names and all parameters within the graphic objects.

.3 copy or cut a graphic object, group of objects, or comment text and place these anywhere else on the screen or onto another graphic programming screen.

.4 connect graphic object inputs or outputs by simply drawing a line between them. Invalid connections shall not be allowed to be created.

.5 connect information across programming screens.

.6 produce a hard copy of the edited graphic including all object parameters.

.3 The integrated development environment shall:

.2 automatically change all program occurrences of a point mnemonic, if that point mnemonic is changed in data base.

.3 flag undefined point mnemonics if a point with that mnemonic has not yet been created or if the respective point has been removed from data base. Flag or indicator to be displayed in an easily visible location close to where the mnemonic is used whenever the program is viewed, modified or printed.

.4 detect syntax errors or unexecutable sequences and provide detailed English language messages and code flagging that allows quick localization of these errors.

.5 provide notification of runtime errors.

.6 allow values of physical or virtual points as well as local or global variables to be displayed during runtime to assist in trouble shooting.

.4 Hardcopy listings or graphic displays of control sequences shall refer to points and objects using the system's logical point mnemonics. Systems that can only produce listings containing hardware addresses are NOT acceptable.

.5 The complete development environment shall be available at every CCS as well as at every PCS, whether it be locally connected to an RCU or located off-site and connected via the control system's serial interface device.

.6 Provide at least [two] complete development packages, if the development environment software is not RCU resident. Install these on CCSs/PCSs as directed by the Minister. Provide all necessary interface hardware and cables to allow local or off-site connection.

2.14 CONTROL LOOPS

.1 Provide at least one, RCU resident, control loop for each available analogue output point or pair of digital outputs, plus one. All control loops shall be capable of three mode, proportional, integral and derivative, (PID) control.

.2 Provide the following parameters in each control loop:

.1 Direct or reverse acting.
.2 Output value
.3 Set point
.4 Proportional gain
.5 Integral gain
.6 Derivative gain
.7 Sampling time – adjustable from 1 to 20 seconds.
.8 Output low limit
.9 Output high limit
.10 Control loop bias

.3 Provide the ability to halt/resume loop calculation as well as change the set point, bias, gains and output limits in real time using custom control sequences created with the user control language (UCL).

.4 Provide a "bumpless" transfer between manual output override and automatic loop operation.

.5 Control loop algorithm shall be designed so as to limit integral windup. Internal integral offset value shall be manipulated so as to maintain calculated loop output value within bounds set by the output low and high limits.

3. Execution

3.1 INSTALLATION

.1 Each RCU shall be mounted so as to allow easy access for maintenance. There shall be no less than 1 metre between the RCU door and any obstruction. Door must be able to swing open 180 degrees or be removable. Mount RCU near eye level on vibration free walls or rigidly support RCU on free standing supports away from vibrating equipment. Confirm all locations with Minister.

.2 At every RCU location, install a line voltage duplex receptacle for powering operator devices such as the PCS. An individual receptacle is not required for every RCU so long as one is available within 2 meters of any individual RCU. A new receptacle is not required if an existing outlet meets these requirements.

.3 RCU and equipment cabinets located in an area with a known leak hazard or under or near piping with nearby fittings shall be drip proof with rain-tight fittings on all connected conduit.

.4 Transformers serving power supplies shall be sized such that output voltage droop is no greater than 10% with all connected devices powered up and output devices in motion. One transformer per RCU.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 23 09 23 - EMCS General Requirements and other related EMCS Sections.

.2 TCU's shall **not** be used to control major equipment such as boilers, chillers or air handling equipment over 1000 litres/sec

2. Products

2.1 TERMINAL CONTROL UNITS - GENERAL

.1 Each TCU shall:

.1 include a real-time operating system that:

.1 executes control, timing and sequencing of all programs.
.2 performs multi-tasking to run programs and concurrently communicate with either RCU over sub-network or with serial port, "intelligent" room temperature sensor or similar system/operator interface device.
.3 automatically restarts TCU when power is restored.
.4 has diagnostic software to test TCU integrity, and data transmissions.

.2 provide fully stand-alone operation by acquiring information from input points and locally processing this information to control output devices according to the User Control Language or configurable application-specific programming.

.3 share information with the rest of the system via the local RCU as well as process and execute commands from RCU and from locally connected PCS or operator terminal.

.4 allow downloading of User Control Language strategies or configuration of application-specific programs and all related databases from the Central Control Station (CCS), or laptop computer (PCS) connected directly to the TCU or connected indirectly at the RCU.

.2 For TCU resident points, all trending, alarm reporting, runtime recording and all other reports and logs specified in Section 230926, shall be supported in either the TCU or in the RCU that controls the sub-network on which the TCU resides.

.3 Only BACnet devices are allowed. Refer to Section 230924 Network Protocols regarding the use of Lon-Works compliant devices. Proprietary application-specific TCUs are not acceptable.

2.2 TERMINAL CONTROL UNITS - FEATURES

.1 Minimum 32 bit full floating point mathematics.

.2 Onboard hardware, software and firmware as required to interface to the sub-network as defined in Section 23 09 24.

.3 Firmware upgradable over the sub-network or via the interface port on the intelligent space sensor. Products requiring replacement of chips or requiring direct access to the TCU controller are not acceptable.

.4 Point configuration to suit application plus one spare universal input and one spare digital output.

.5 Watchdog timer. Failure of TCU shall automatically switch outputs to a pre-selected fail-safe condition and initiate a cold restart.

.6 Real Time Clock function. Clock to be synchronized to RCU real time at least every 24 hours. For clocks without battery backup, time shall also be synchronized after every power interruption or watch dog event.

.7 Sub-network monitoring routine. On failure of sub-network, TCU shall continue to control environment using last reliable setpoint and operating mode data received from the RCU.

.8 Permanently marked removable terminal block for the wiring of all sensors, control devices, network and TCU power.

.9 Removable metal or robust plastic enclosure.

2.3 INTELIGENT SPACE SENSOR AND INTERFACE

.1 Provide an “intelligent” room temperature sensor, with the following features as a minimum:

- .1 Three digit LCD or LED display.
- .2 Four programmable buttons providing setpoint increase/decrease and occupied/unoccupied mode operation.
- .3 Ability to set device to continuously display room setpoint or current room temperature.
- .4 Interface port to allow a laptop IBM-PC compatible computer to interface to TCU. Provide cables and all necessary software to allow:
  - .1 reading of all input/output point data.

.2 changing of setpoints, limits and calibration values as applicable.
.3 manually override of control outputs.

.2 Space temperature sensing shall meet the accuracy requirements of Section 23 09 29 device type Tr.

.3 Enclosure shall be neutral colour, vented, metal or robust plastic, with base to cover wall opening. In public areas where device will be subject to damage, provide vented resilient clear plastic tamper proof cover.

2.4 SIGNAL PROCESSING

.1 Analogue Input Processing:

.1 Each analogue input shall be converted to digital format at a minimum frequency of 1 conversion per second.

.2 Analogue to digital conversion shall have sufficient resolution to provide the minimum end to end accuracy defined in Section 230929 plus one bit, but shall not be less than 10 bits.

.3 Relative errors between analogue inputs shall not exceed 0.25% of span.

.4 Each input shall be individually calibrated for zero and span in software.

.5 On board circuitry shall protect each input from short circuit and have a 500 volt minimum isolation.

.6 The following ranges are required:
.1 4 - 20 mA DC
.2 0 - 10 VDC

.7 A special range for direct input resistance temperature sensors is allowed.

.2 Analogue Output Processing:

.1 Each analogue output shall be converted to analogue format at a minimum frequency of one conversion per second.

.2 Digital to analogue conversions shall have 8 bit resolution minimum. The output signal shall be linear.

.3 Each output shall be individually calibrated for zero and span in software.

.4 On board circuitry shall protect each output from short circuit and have 500 volt minimum isolation

.5 The following ranges are required:
.1 4 - 20 mA DC
.2 0 - 10 VDC

.3 Digital Input Processing:

.1 Inputs shall accept dry contacts.

.2 Provide minimum 500 volt isolation for each point through use of optical isolators or equivalent on termination board.

.4 Digital Output Processing:

.1 Provide outputs capable of switching a 120 VAC external relay, or triac SCRs rated at 0.5 Amp 24 VAC minimum.

.2 Provide full protection to hardware and software from switching transients.

2.5 POWER SUPPLY

.1 Each TCU shall have a power supply with fused over current protection and power on indication.

.2 Transient surge suppression shall be provided as part of the power supply or as a separate device. Let-through voltages (L-N), when tested against ANSI/IEEE C62.41-1991 and C62.45, 1992 category A3, B3 and B3/C1 ring-waves, shall not cause damage to the TCU or associated transmitters and output devices. Provide documentation proving compliance.

2.6 DATA BASE

.1 Provide data base creation and modification in accordance with Section 230926 EMCS Remote Control Units.

2.7 ALARMS

.1 Provide TCU operating system alarms for the following malfunctions:
.1 Watch-dog-timer activation.
.2 Input or output point failure.
.3 Control program execution error (divide by zero, etc.)
.4 Power interruption restore or other cold start

.2 Provide other alarming features in accordance with Section 230926 EMCS Remote Control Units.

2.8 SCHEDULING

.1 The TCU shall operate in accordance with the schedules defined in the RCU.

.2 Provide a default weekly schedule that defines at least one start time and one stop time per day to a resolution of 15 minutes. This schedule is to become active on loss of communication with the host RCU.

2.9 CONTROL LOOPS

.1 Provide point control loop creation and modification in accordance with Section 230926 EMCS Remote Control Units.

2.10 PROGRAMMABLE TCU - USER CONTROL LANGUAGE (UCL)

.1 For UCL programmable TCUs, provide User Control Language program creation and modification in an integrated development environment in accordance with Section 230926 EMCS Remote Control Units.

.2 The identical User Control Language shall be used in both the RCU and TCUs.

.3 Provide all engineering/programming tools required for the complete integrated development environment. Include all disks/CDs and manuals.

2.11 APPLICATION-SPECIFIC TCU

.1 TCU shall be configured to allow the following data to be: a) displayed on CCS/PCS graphic screens, b) manually accessed from the CCS/PCS via operator command, c) automatically accessed by the RCU under control of operating sequences created with the User Control Language:

.1 Operating mode (read/write/override)
.2 Occupied mode heating/cooling setpoints and limits (read/write/override)
.3 Unoccupied mode heating/cooling setpoints and limits (read/write/override)
.4 Operating Space temperature setpoint (read/write/override)
.5 Space temperature (read)
.6 Space temperature calibration offset (read/write)
.7 Control loop output value (read/write/override)
.8 Control loop proportional band (read/write/override)
.9 Control loop bias value (read/write)
.10 Box supply air temperature (read)
.11 Box supply air temperature calibration offset (read/write)
.12 Flow rate (read)
.13 Flow rate zero and span calibration factors (read/write)
.14 Damper and/or valve positions (read/write/override)
.15 TCU Time (read/write)

.16 All parameters required to set up internal schedule
.17 Intelligent sensor communications failure flag (read)
.18 TCU system alarms as per 2.7 above (read)

.2 Provide all engineering/set-up tools required to configure or re-configure these devices. Include all disks/CDs and manuals.

3. Execution

3.1 INSTALLATION

.1 Use one TCU for each terminal air volume/temperature control device.

.2 Terminal box TCUs shall be connected to the sub-network of the RCU that controls the air system serving the respective terminal boxes.

.3 Each TCU shall be mounted so as to allow easy access for maintenance. There shall be no less than 60 cm between the TCU cover and any obstruction.

.4 Each intelligent thermostat shall be securely fastened to wall in an easily accessible location not directly affected by supply air, radiant heat, sunlight, or heat from local equipment. Room furnishings shall not obscure device. Confirm all locations with Minister.

.5 Transformers serving power supplies shall be sized such that output voltage droop is no greater than 10% with all connected devices powered up and output devices in motion. No more than 8 TCUs are allowed per transformer.

3.2 OPERATING SEQUENCES

.1 Cycle variable air damper, reheat coil and radiant panel to maintain space set point.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 23 09 23 - EMCS General Requirements and other related EMCS Sections.

1.2 REGULATORY REQUIREMENTS

.1 Comply with Electrical Protection Act of Alberta and rules and regulations made pursuant thereto, including the Canadian Electrical Code.

.2 Unless otherwise indicated, all references to "Canadian Electrical Code" or "CEC" shall mean the edition of the Canadian Electrical Code, Part I, CSA C22.1, and the variations made thereto by Alberta regulation, which are in force on the date of bid closing for the Contract.

.3 All electrical products shall be approved by the Canadian Standards Association (CSA) and bear the CSA label. Alternatively, where a product does not bear a CSA label, it shall be approved in writing by the authority having jurisdiction.

.4 Submit to authority having jurisdiction and utility company, necessary number of drawings and specifications for examination and approval prior to commencement of work. Pay associated fees.

.5 Submit to Minister, copy of electrical permit obtained from authority having jurisdiction.

.6 If authority having jurisdiction conducts an electrical inspection, submit copy of certificate of acceptance provided by authority having jurisdiction.

2. Products

2.1 CONDUIT

.1 EMT: to CSA C22.2 No. 83-M1985. Provide rain-tight fittings in weatherproof and damp areas.

.2 Rigid Metal: to CSA C22.2 No. 45-M1981.

2.2 WIRE

.1 Wiring: to CSA C22.2 No. 75-M1983, copper conductor, 600 V RW90 X-link insulation. 300 V insulation allowed for conductors not entering enclosures containing line voltage.

.2 120 VAC Control Wiring: minimum #14 AWG.

.3 Low Voltage Field Wiring:

.1 Minimum #22 AWG.
.2 Twisted pairs.
.3 Stranded, except #18 AWG and larger may be solid.
.4 Shielded with drain wire, except for digital input/output wiring carrying less than 25mA and not installed in tray.
.5 Multiconductor wiring must have individually twisted and shielded pairs with a drain wire for each pair. Cable must have overall shield. Maximum 6 pairs.

.4 Plenum rated cable:

.1 FT4 rated.
.2 Refer to the CEC for other designations meeting FT4 criteria.

2.3 IDENTIFICATION MATERIALS

.1 Wiring Identification Materials:

.1 Use one of the following:

.1 Heat shrink sleeves, with thermally printed identifier. Label material and printing to be resistant to oil, mineral solvent and methyl alcohol.

.2 Snap-on or slide-on sleeves, or crimp-on pins with integral sleeve. Length to suit number of characters required in identification code, 6 (six) characters minimum. Marking elements to be removable yet secure when inserted into sleeve. Standard of quality: Grafoplast Wiremarkers Inc.

.3 Factory coded slip-on identification bead markers or sleeves.

.2 Size of sleeves to be selected so that they do not slip off when wire is removed from termination and shaken.

.3 Wrap-on adhesive strips not allowed. Hand written identifiers not allowed.

.2 Point Identification Tags: 0.75 mm thick plastic laminated luggage style tags containing imprinted information label. Printing on surface of plastic not allowed. Printing shall be 14 point font or larger.

.3 Engraved Plastic Nameplate: self-adhesive composite laminated plastic nameplates with one smooth white surface and core of black plastic designed to leave black lettering on a white background. Engraved lettering height as follows:

.1 RCU, TCU and Equipment Cabinets: 20 mm.
.2 Magnetic contactors for EMCS controlled equipment: 20mm.
.3 All other: 8mm.

.4 Wiring Directories: for each RCU and TCU provide a laminated sheet with a cross-reference listing of logical point mnemonic, descriptor, wiring label and hardware address for each wire terminated in cabinet. Order and placing of information shall mimic pattern of wiring terminations.

.5 Equipment Cabinet Directories: for each equipment cabinet provide a laminated sheet graphically showing location of each transducer, relay or other device in cabinet. Each device outline to be labeled and function of device indicated. Provide logical point mnemonic, descriptor, wiring label and hardware address for field wiring terminating at transducers and relays within cabinet.

3. Execution

3.1 CONDUIT

.1 Use EMT conduit:

.1 for all high speed communications trunk wiring between RCUs.
.2 for wiring that would be exposed to mechanical damage.
.3 for wiring in inaccessible areas.
.4 where indicated on drawings or otherwise required by CEC.

.2 Use rigid metal conduit for all wiring in areas designated as hazardous.

.3 Conduit sizing and installation shall comply with CEC requirements. Wire fill shall not exceed 50%.

.4 Wherever practical, conceal conduit in walls, floors and ceilings.

.5 Install conduit parallel or at right angles to building lines; minimize crossovers and conserve space and headroom.

.6 Do not install conduit in or under ground floor slabs.

.7 Do not use metallic or non-metallic sheathed cable except where otherwise indicated.

3.2 WIRING

.1 Neatly arranged panduit with snap on covers shall be used to restrain wiring inside cabinets larger than 300mm square.

.2 Neatly train and cable tie wiring in cabinets smaller than 300 mm square. Adhesive backed twist ties or adhesive backed cable tie holders are not allowed. Wiring shall be secured to cabinet back with mountable cable ties fastened with #8 or larger sheet metal screws.

.3 Each field device shall have its own signal and return wire individually terminated in the panel. The use of a common return wire or ground for more than one control point is not allowed.

.4 Plenum rated cable:

- .1 may be laid in existing cable tray.
- .2 shall follow building lines, close to the building structure, well above any ductwork or piping.
- .3 shall be secured to the building structure at intervals not exceeding 2 meters with bundles wire-tied every 1 meter. Cable shall not be attach to ceiling support system, piping or ductwork.
- .4 shall not be tied against sharp edges (sheet metal, redi-rod) without sufficient additional protection. Provide grommets at entry to boxes and into conduit.
- .5 shall not be kinked or bent to a radius less than 100mm. Provide a full loop of slack at entry to boxes and conduits.

.5 A single continuous non-spliced cable shall be used for connecting each field device. Joining of cables is only permitted as follows:

- .1 New points: Only one splice for every 100 meters of cable.

- .2 Existing points where the existing wire is allowed to be reused: Only if the final length of unspliced run exceeds 10 meters.

.3 The type of wire, gauge, colour and number of conductors to any device, shall remain the same right from the device through to the termination connectors in the control panel.

.4 Splices are only allowed within equipment cabinets or junction boxes. The shield drain wire for each pair must be connected. Splices shall expose no more than 2cm of unjacketed wire.

.5 Except as indicated next, only properly sized insulated spring wire connectors with plastic insulating caps or solderless pressure connectors with insulated covers by Marr, Ideal or 3M are allowed for splicing. The use of screw type terminal blocks is required for splicing ALL wiring entering a cabinet or junction box when any one of the following conditions exists:

.1 The panel or junction box contains more than 10 connections.
.2 Multi-conductor cables with more than 4 wires are to be spliced.

.6 Terminal blocks must be screw mounted with #8 or larger sheet metal screws in panels or junction boxes no smaller than 150mm square.

.7 Where hand/off/auto (HOA) switches are available on the MCC or are provided under this contract, the digital output points shall be wired such that the equipment is under EMCS control when the HOA switch is in the auto position. Confirm proper operation of equipment under hand and off operation. Correct wiring as necessary.

3.3 GROUNDING

.1 Provide a complete ground system for all EMCS equipment, including panels, conductors, conduit, raceways, connectors and accessories. Grounding shall be by means of electrical supply conductor bonding method. Separate grounding conductors not permitted.

.2 Grounding between control panels and field devices shall have a star configuration. The shield for a field device shall be grounded at the panel only.

.3 The shield for communications wiring must be contiguous throughout its full length and shall be grounded at one point only. For TCUs, the ground shall be at the RCU. Except for this single ground connection, when splicing to an RCU/TCU the shield drain wire must be connected through and not to the RCU/TCU ground. Splices shall expose no more than 2cm of unshielded wire.

3.4 IDENTIFICATION

.1 Conduit:

.1 Apply paint or colour banding tape in fluorescent orange for control wiring conduit in 35 mm wide bands all around conduit as follows:

.1 At least once in each 10 m of conduit run.
.2 Where conduit enters inaccessible ceiling, wall and floor spaces.
.3 At least once in each room or area through which a conduit passes.

.2 Applying fluorescent orange paint to all conduit fittings prior to installation is an acceptable practice. However, additional identification banding shall be added as required to meet all requirements of this article.

.2 Wiring:

.1 Wiring more than 1 meter in length must be labeled at both ends.

.2 Labels for all system point wiring shall, as a minimum, contain the following information:

.1 Panel end: panel terminal number or hardware address.
.2 Device end: panel number as well as panel terminal number or hardware address.

.3 Label panel power supply wiring with the panel connector number.

.4 Label communications port wiring with panel connector number and device name (e.g. “J1-modem”, “J2-printer”).

.5 Label communications trunk wiring with the panel number, router number etc. to which the other end of the cable is connected.

.6 Wiring on each side of a terminal block or splice shall be labeled with the information required for the device end of the wire.

.7 In retrofit situations the above labeling requirements are in addition to any existing labeling.

.2 Point Tagging:

.1 Identify all input sensors and devices as well as all EMCS controlled output actuators, motors and equipment, with Point Identification Tags. Provide multiple tags as necessary. Additional requirements as follows:

.1 Tag control wiring for major mechanical equipment at equipment terminal strip.
.2 Tag any input/output transducers not identified on an Equipment Cabinet Directory.
.3 Tag electric motors on power cable near motor end.

.2 Point Identification Tags shall be attached using two nylon cable ties. One tie is to provide a loose loop through the tag while the other tie is to hold this loop to the wire or conduit.

.3 All Point Identification Tags shall include the following minimum information:

.1 Logical Point Mnemonic (refer to Section 230930)
.2 Point Hardware Address (RCU/TCU and connection terminal identifiers)
.3 Associated System Identification
.4 Point Description

.3 Nameplates:

.1 Identify the following with engraved plastic nameplates:

.1 Magnetic contactors and related local disconnect switches.
.2 Space temperature sensors and intelligent thermostats.
.3 RCU cabinets, TCU cabinets, associated equipment cabinets.
.4 Front panel mounted switches, displays and devices; identify function of each item.

.2 Nameplates shall include logical point mnemonic as applicable. Refer to Section 230930.

.3 All nameplates to be easily visible without need to use ladder or extraordinary body position. Affix additional nameplates if necessary.

.4 Provide the Minister with an example of the contents of each type of nameplate as indicated in 3.2.1 above. Obtain approval prior to engraving.

.4 Directories:

.1 Permanently mount laminated Wiring Directories on door inside surface of each RCU and TCU cabinet.

.2 Permanently mount laminated Equipment Cabinet Directories on door inside surface of each equipment cabinet.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 23 09 23 - EMCS General Requirements and other related EMCS Sections.

.2 The letters under the "Type" column in the following Schedule are the same used in Section 23 09 30 “Point Database Schedule” and also on the drawings.

2. Products

2.1 SENSING DEVICES

.1 Provide field instrumentation and sensing devices, analog or digital as applicable, which measure temperature, humidity, pressure, flow, current, voltage, equipment states, etc. and which input signals to the RCU or TCU terminal strip that conform to the input requirements specified in Sections 23 09 26 and 23 09 27, "Signal Processing" articles.

.2 The end-to-end accuracy called for in the following Schedule includes the combined effect of all the errors in all the interposing devices and components between the measured variable and the value displayed at the Central Control Station.

.3 For all sensors in piping, provide stainless steel or bronze pipe wells and all required adaptors. For retrofit projects, existing wells may be reused if they are no longer required for any other purpose, are in good condition and are compatable with the new sensors.

2.2 ACTUATORS

.1 Provide output devices, motors and actuators which convert the digital or analog output signal from the RCU or TCU to activate relays or open and close valves, dampers, etc., that conform to the output requirements specified in Sections 23 09 26 and 23 09 27 “Signal Processing” articles.

.2 The end-to-end accuracy called for in the following Schedule includes the combined effect of all the errors in all the interposing devices and components between the value entered at the Central Control Station and the position of the final control element. In retrofit situations, where the final control elements or actuators are allowed to be reused, end-to-end accuracy refers only to the signal sent to the final control element or actuator.

.3 Actuators shall be gear driven with spring return to "fail safe" in normally closed position as dictated by freeze, fire or temperature protection. Actuator shall include a manual override allowing end device to be positioned and locked into place should the actuator fail.

.4 For dampers provide one actuator motor for approximately 4 m^2 damper section. Minimum of one damper motor per damper section.

.5 Standard of quality: Belimo

2.3 CONTROL VALVES

.1 Provide valves in accordance with general valve specification. Provide position indicators on valves.

.2 Valves shall "fail safe" in normally open or closed position as dictated by freeze, humidity, fire or temperature protection and as indicated in Section 23 09 30 “Point Database Schedule”.

.3 Two-way valves for liquids shall have equal percentage characteristics. Three way valves shall have linear characteristics. Size valve operators to close valves against pump shut off head.

.4 Steam valves shall have modified linear characteristics with stainless steel seats. Provide separate valves on individual coils. Two valves in parallel shall have 1/3 - 2/3 load capacities sequenced so that smaller valve opens first. The larger valve shall start openning just before the small valve’s fully open position.

2.4 DAMPERS

.1 Automatic dampers shall be 1.6 mm galvanized steel or extruded aluminum multiple blade mounted in 3.0 mm steel or extruded aluminum flanged frame. Individual blades shall not exceed 150 mm in width or 1200 mm in length with interlocking edges and compressible seals. Provide oil impregnated bronze or nylon bearings with additional thrust bearings for vertical blades. Prime coat steel dampers.

.2 Mixing dampers of opposed blade construction shall be arranged to mix air streams. Provide positive positioning on mixed air dampers where dampers are not mechanically linked. Damper leakage shall not be greater than 1%.

2.5 ANALOG INPUT SENSORS - TEMPERATURE

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Duct probe	Tp	0°C to 60°C	±0.3°C	Length to suit duct size.
Pipe well	Tw	0°C to 50°C 0°C to 100°C 50°C to 150°C	±0.3°C ±0.5°C ±0.5°C	C/w stainless or bronze wells, range to suit application.
Averaging	Ta	-30°C to 50°C	±0.5°C	C/w supporting wire and brackets.
Room/Space	Tr	10°C to 30°C	±0.3°C	C/w tamper proof cover.
Outside air	To	-50°C to 50°C	±0.5°C	C/w solar shield.
Surface	Ts	0°C to 50°C 0°C to 100°C 50°C to 150°C	±0.3°C ±0.5°C ±0.5°C	C/w anchor strap.

2.6 ANALOG INPUT SENSORS - PRESSURE

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Static	Ps	as required: 25 - 50% greater than max design	±2% full scale	Materials to suit medium in contact with device.
Differerntial	Pd	as required: 25 - 50% greater than max design	±2% full scale	Materials to suit medium in contact with device.
Velocity pressure	Pv	as required: 25 - 40% greater than max design or max measured velocity pressure at full flow rate.	±1.0% full scale	Air: Multi-point static & total pressure sensing element, self-averaging manifold, air equalizer and straightener, max pressure loss 36 Pa @ 10 m/sec. Water & Steam: Annubar or orifice plate.

2.7 ANALOG INPUT SENSORS - ELECTRIC

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Watt meter	Kw	as required	±0.25% full scale	3 current transformers 2 potential transformers as applicable for “Y” or “D” configuration.
Current transformer	Ct	as required	±0.25% full scale	

2.8 ANALOG INPUT SENSORS - MISCELLANEOUS

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Carbon Monoxide	Co	300 to 2000 PPM	±5% full range	Electrochemical devices ONLY Device must not be sensitive to ambient air temp or relative humidity.
Generic Analogue Inputs	AIi AIv	4 to 20 mA DC 0 to 10VDC	±0.25% full scale	

2.9 ANALOG OUTPUT DEVICES - ELECTRIC

Application	Type	Operating Range	End-to-End Accuracy	Remarks
To damper motors	Dm	4 to 20 mA DC 0 to 10 VDC	±2% full range	Match range if existing
To valve motors	Vm	4 to 20 mA DC 0 to 10 VDC	±2% full range	
Controller Setpoint reset	Csr	4 to 20 mA DC 0 to 10 VDC	±0.25% full scale	
Variable Speed Drive	Vsd	4 to 20 mA DC 0 to 10 VDC	±0.25% full scale	
Generic Analogue Outputs	AOi AOv	4 to 20 mA DC 0 to 10 VDC	±0.25% full scale	

2.10 DIGITAL INPUT DEVICES

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Dry Contact	Dc	N/A	N/A	Utilize existing device.
End Switch	Esw	N/A	N/A	Adjustable position.
Level switch	Lsw	N/A	N/A	Adjustable setpoint and differential. Pressure rating suitable to application.
Pressure switch	Psw	as required	±1.5% full scale	Adjustable setpoint and differential.
Temperature switch	Tsw	as required	±1°C	Adjustable setpoint and differential. Manual reset for freeze protection.
Current sensitive relay	Ri	as required	N/A	Adjustable trip setpoint and differential.
P/E Relay	Pe	0 - 120 kPa	N/A	Adjustable setpoint and differential.

2.11 DIGITAL OUTPUT DEVICES

Application	Type	Operating Range	End-to-End Accuracy	Remarks
Relays	Ry	N/A	N/A	DPDT, plug-in type terminal base. Contacts rated to suit motor starter.
E/P Relays	Ep	N/A	N/A	

3. Execution

3.1 INSTALLATION

.1 All transducers and devices are to be mounted in equipment cabinets with hinged doors. Unless specifically approved by the Minister in writing, equipment cabinets shall be installed near RCU cabinets, at eye level, in easily accessable areas, on solid walls or supported away from vibrating equipment. Cabinets not in mechanical rooms shall have locable doors keyed the same as RCU cabinets.

.2 For all sensors in piping, confirm locations of new wells and availability of any existing wells with Minister. Use thermal conductive compound when installing sensors to ensure proper thermal coupling of sensor to well. No more than 2 meters of flex shall be used between sensor housing and raceway. Flex to be secured within 1 meter of sensor.

.3 Install a pressure gauge on the signal line of each electro-pneumatic transducer (EPT) or pneumatic controller, excepting room temperature controllers.

.4 Install a brass tee in the high and low side lines of every air flow station and differential pressure transducer, excepting those on room VAV box controls. Cap off open end of tee with 10 cm stub and plug or brass coupling and rubber cap Tees to be located close to device in such a manner as to allow for easy access during commissioning procedures.

SPEC NOTE: Delete the following article for new works without existing devices OR for retrofit works where all new devices are required.

3.2 USE OF EXISTING DEVICES

.1 The use of existing devices are permitted.

.2 The contractor is responsible for ensuring that any reused device is suitable for the application and meets the requirements of this Section.

.3 Every reused device must be tested for proper operation. All adjustable analogue devices shall be recalibrated for zero and span.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 23 09 23 - EMCS General Requirements and other related EMCS Sections.

1.2 DEFINITIONS

.1 A point is a specific software address which is resident in either the RCU or TCU and which is identified with a particular field sensor, instrument, relay or actuator.

.2 The point schedule contains a list and description of the points to be connected.

.3 The relationships between the points, systems and building are described in the control sequences, Section 23 09 93.

1.3 SCHEDULES

.1 Following is appended to and forms part of this Section:

.1 Energy Management Control System - Point Database Schedule.

2. Products - Not Used.

3. Execution

3.1 POINT SCHEDULES

.1 Digital Inputs; refer to Section 23 09 29, "Digital Input Devices Schedule" and input type designation in schedule.

.2 Digital Outputs; refer to Section 23 09 29, "Digital Output Devices Schedule" and output type designation in schedule.

.3 Analog Inputs; refer to Section 23 09 29, "Analog Input Sensors Schedule" and input type designation in schedule. Consult with minister's representative during the system start-up for limits and alarm values to be entered.

.4 Analog Outputs; refer to Section 23 09 29, "Analog Output Devices Schedule" and output type designation in schedule.

.5 Use Alberta Infrastructure "**EMCS Guideline for Logical Point Mnemonics**" to identify each physical and virtual point in data base and User Control Language software in each panel.

.6 All points included under the same group letter must reside within the same panel. Any form of inter panel communications link to accomplish this is not allowed except as explicity stated under Section 23 09 24 "Control Loop Configuration".

.7 Consult with the Minister during the shop drawing stage to finalize the physical terminal address of each point within each RCU or TCU.

3.2 POINT INSTALLATION

.1 When two outdoor air temperature sensors are specified, locate the sensors so that the sun cannot shine on both sensors at once, and airborne waste heat cannot simultaneously affect both sensors.

.2 Locate duct temperature and humidity sensors a minimum of three metres downstream of humidifiers.

.3 Use averaging sensors for all mixed air temperature sensing applications.

.4 Use averaging temperature sensors for applications where the duct area is greater than 0.5 m2 AND the sensor is located downstream of a coil by a distance less than 4 times the diagional measurement of the coil.

.5 For all sensors in piping, use thermal conducting compound to ensure proper thermal coupling of sensor to well body.

3.3 DIAL-OUT ALARM AND WATCH-DOG TIMER

.1 Dial-out alarm and watch-dog timer. Provide a digital output relay and a resetable solid state timer with both normally open and normally closed mechanical contacts. (OMRON HC3A or equivalent). The timer shall be set so that, if it is not reset by the digital output relay within 3 minutes, it will time out and create a dial-out alarm. Programming within the RCU shall cause the output relay contact to be pulsed closed every 2 minutes to reset the timing relay. The arrangement shall cause a dial-out alarm on a failure of the output relay, timing relay, RCU or on RCU lockup. Provide additional components as may be required to interface to dial-out alarm panel input. The interface shall not interfere with the functioning of any existing hardwired dial-out alarms.
If spare inputs are not available in the dial-out alarm panel, then it is acceptable to tie into an existing alarm in a manner such that either the original alarm OR the new watch-dog alarm will cause a dial-out.

3.4 POINT SCHEDULE NOTES (REFER TO POINT SCHEDULE)

FUTURE
Configure each panel to accept the points remarked as "Future" under the remarks column in the point schedules. The panel shall include all hardware and firmware required to directly interface to these future points without subsequent additions.

NOTE 1
The building differential pressure is to be sensed between the main floor open area and the outside. Locate transducer in equipment cabinet near RCU. Transducer range -25 to 25 Pa.

NOTE 2
Locate outside air temperature sensor so that airborne waste heat cannot affect sensor. Provide Sun Shield.

3.5 POINT SCHEDULE

.1 Points schedule.

Description	DO			AO			DI			AI			Notes
General													
Outdoor Air Temperature											●		
Building Pressure											●		
Low space temperature		●											Alarm call out
Low boiler temperature		●											Alarm call out
Boiler Room Floor Water								●					
Boilers B-1/2													
Boiler 1 Enamble		●											
Boiler 1 Status								●					
Boiler 1 Alarm								●					
Boiler 2 Enamble		●											
Boiler 2 Status								●					
Boiler 2 Alarm								●					
HW Supply Temperature											●		
HW Return Temperature											●		
HW Supply Temperature Set Point					●								
Boiler Pumps BP-1/2													
Pump BP-1 Start/Stop		●											
Pump BP-1 Status								●					
Pump BP-2 Start/Stop		●											
Pump BP-2 Status								●					
Heating Water Pumps P-1/2													
Pump P-1 Start/Stop		●											
Pump P-1 Status								●					

Description	DO	AO	DI	AI	Notes
Pump P-1 VFD Setpoint		●			
Pump P-1 VFD Status				●	
Pump P-1 VFD Alarm			●		
Pump P-2 Start/Stop	●				
Pump P-2 Status			●		
Pump P-2 VFD Setpoint		●			
Pump P-2 VFD Status				●	
Pump P-2 VFD Alarm			●		
Building RW Temperature				●	
Heating Glycol Pumps P-3/4					
Pump P-3 Start/Stop	●				
Pump P-3 Status			●		
Pump P-4 Start/Stop	●				
Pump P-4 Status			●		
Glycol Heat Exchanger HEX-1					
GL Supply Temperature				●	
GL Return Temperature				●	
GL Supply Temperature Set Point		●			
HW Control Valve		●			
Domestic Hot Water Heaters DWH-1/2					
DWH-1 Start/Stop	●				
DWH-2 Start/Stop	●				
DWH Supply Temperture				●	
Domestic Recirc Pump P-5					
Pump P-5 Start/Stop	●				
Pump P-5 Status			●		
DHWR Temperature				●	
VAV Box / Radiant Panel (Typical for All)					
Supply Airflow				●	
Supply Air Temperature				●	
Damper Position		●			
Reheat Coil Valve		●			
Radiant Panel Valve		●			
Space Temperature				●	
Space Temperature Setpoint				●	
Unit/Cabinet Heaters (Typical for All)					
Fan Start/Stop	●				
Space Temperature				●	
Space Temperature Setpoint				●	
Gym Radiation					
Heating Valve		●			

Space Temperature											●		
Description	**DO**			**AO**			**DI**			**AI**			**Notes**
Space Temperature Setpoint											●		
Air Handling Unit AHU-1													
SF Start/Stop		●											
SF VFD Setpoint					●								
SF VFD Status											●		
High Supply Static Pressure								●					
RF Start/Stop		●											
RF VFD Setpoint					●								
RF VFD Status											●		
Supply Air Static Pressure											●		
Supply Air Temperature											●		
Return Air Temperature											●		
Mixed Air Temperature											●		
Heat Recovery Temperature Setpoint		●											
HTG Coil Valve					●								
CLG Coil Valve (Future)					●								
Freeze Protection											●		
Outdoor Air Damper Comand					●								
Mixed Air Damper Comand					●								
Outdoor Air Flow Monitoring Station											●		
Minimum Outdoor Air Setpoint		●											
SA Humidity Control (Future)					●								
SA Humidity (Future)											●		
RA Humidity (Future)											●		
Winter Pre-Filter Status								●					
Summer Pre-Filter Status								●					
Final Filter Status								●					
AHU-1 Alarm								●					
Air Handling Unit AHU-2													
SF Start/Stop		●											
SF VFD Setpoint					●								
SF VFD Status											●		
RF Start/Stop		●											
RF VFD Setpoint					●								
RF VFD Status											●		
Supply Air Static Pressure Setpoint		●											
Supply Air Static Pressure											●		
Supply Air Temperature Setpoint		●											
Supply Air Temperature											●		
Return Air Temperature											●		
Mixed Air Temperature											●		
HTG Coil Valve					●								
CLG Coil Valve (Future)					●								
Freeze Protection											●		
Outdoor Air Damper Comand					●								

Mixed Air Damper Comand					●							
Exhaust Air Damper Comand					●							
Description	**DO**			**AO**			**DI**			**AI**		**Notes**
CO2 Sensor										●		
SA Humidity Control (Future)					●							
SA Humidity (Future)										●		
RA Humidity (Future)										●		
Winter Pre-Filter Status								●				
Summer Pre-Filter Status								●				
Final Filter Status								●				
AHU-2 Alarm								●				
Afterhours Override								●				
Exhaust Fans EF-1, 3, 5, 6, 7, 8, 10, 11												
Fan Start/Stop		●										
Fan Status								●				
IT Room Cooling AC-1, CON-1												
Start/Stop		●										
Space Temperature										●		
Alarm								●				

END OF SECTION

1 General

1.1 INTENT

.1 Read this section in conjunction with Sections 23 09 23 - Energy Management and Control Systems (EMCS) General Requirements, 23 08 95 EMCS Start-up and Testing and other related EMCS Sections.

2 Products

.1 Not used

3 Execution

3.1 GENERAL REQUIREMENTS

.1 Provide the database for all physical points listed in the Point Schedule. Any physical points used in the sequences are shown in bold and capitalized .

.2 Provide the database for all virtual points identified in this section. Virtual points are shown in bold capitalized italic. Provide all necessary controllers, display screens, trend logs as well as any other item as may be required to create, test and modify the control strategies.

.3 Provide all programming required to implement the control sequences described in this section.

.4 Programming style is to be of a form that enables the control strategies to be easily followed. Clarity, simplicity and elegance are more important than program size.

.5 Programs shall be modular in nature and shall be as structured as the language will permit.

.1 Unconditional “GOTO” statements shall be used sparingly and shall always jump forwards. All jumps from the body of a module shall target the end of that module. Similarly, jumps from the body of a sub-module shall target the end of that sub-module.

.2 All conditional "GOTO" statements, which make a single choice from multiple choice sub-module options, shall form the opening lines of code of the module. Each succeeding conditional jump shall direct the execution of software to the relevant sub-module which shall be in the reverse order of the conditional jump statement. The exit from each sub-module shall jump to the end of the module.

.3 All conditional "GOTO" statements, for "AND"/"OR" choices between sub-modules, shall form the opening line of code in each sub-module which the conditional statement controls.

.6 All programs must include a sufficient number of comments to allow another person to make changes to the strategies at some later time.

.7 Additional programming may be provided by the Contractor as desired, so long as it does not affect the intended operation of the specified sequences. Ensure that all equipment will operate in a safe manner.

.8 Programming required for equipment safety may be installed by the Contractor as necessary. The Minister shall be notified of these changes as soon as practical.

.9 All deviations from the specified programming, except those related to equipment safety, must receive prior written approval from the Minister.

.10 All control loops shall be tuned such that they are stable through all seasons and operating conditions including startup.

.11 During the construction period through to the end of the warranty period, the Contractor shall be responsible for fine tuning the controls programming to ensure satisfactory operation. During this period the Contractor will also be responsible for any minor revisions requested by the Minister.

3.2 MISCELLANEOUS REQUIREMENTS

.1 Staggered starting - Motors must not be allowed to start at the same time. Under all conditions of startup, return from power failure or panel reset, there must be at least a 15 second delay between the time one motor starts and another is allowed to start.

.2 Single phasing – If a phase monitor alarm contact has been provided in the main switch gear, provide routines to stop all 3-phase motors within 60 seconds of contact activation.

.3 Ensure air handling system plenums are maintained above freezing at all times, either by overriding a heating coil or by periodically operating the return fan with dampers closed to outside air. In air systems containing water coils, or where downstream reheat coils can be affected by cold supply air, provide a dial-out-alarm should the supply temperature be below 3 degC for longer than 30 minutes.

3.3 BUILDING OPERATING MODES

.1 Two operating modes are required: Occupied and Unoccupied. Mode flags are required only for the occupied modes. By definition unoccupied mode occurs when occupied mode flags are not set (i.e. off).

.2 An optimum start routine shall be used to determine when the air systems are to begin operation such that adequate comfort conditions are reached just before occupancy begins.

.3 Occupied Mode:

.1 The beginning and ending time of this mode shall be determined by a weekly schedule. An annual holiday schedule shall be used to bypass statutory holidays.
.2 One weekly/annual schedule is required. Required flags: ***OCCUP*** (units yes/no).
.3 During this mode all spaces within the building are to be at occupied comfort conditions. Air systems are to be running. Heating and cooling are to be used as required.
.4 The optimum start routine enables the occupied mode flag prior to scheduled occupancy. This allows the air systems to condition the spaces such that they are comfortable at the time of scheduled occupancy.

3.4 GLOBAL PROGRAMS

.1 Define a space temperature objective value ***STOBJ***. Program it with a default value of 22.5 degC such that the value returns to 22.5 if the point is not manually commanded to some other value.

.2 Define a space temperature objective user adjust value ***STOBJ_UA*** (limited - 2 to +2 degC). Program it with a default value of zero degC such that the value returns to zero if the point is not manually commanded to some other value.

.3 Obtain some basic information from the room temperature sensors:
.1 ***STMAX*** warmest space temperature
.2 ***STAVG*** average of the two sensors
.3 ***STMIN*** coolest space temperature

.

.4 Define an effective space temperature ***STEFF***, for the building as follows:

.1 If the outside air temperature **OAT** is less than 5 degC then ***STEFF*** is the average of ***STMIN*** and ***STAVG***.
.2 If **OAT** is greater than 20 degC then ***STEFF*** is the average of ***STMAX*** and ***STAVG***.

.3 Otherwise ***STEFF*** equals ***STAVG***.
.4 Smooth ***STEFF*** so that it cannot change faster than about 1 degC per hour.

.5 Provide an outside air temperature prediction routine which provides the following data:
.1 ***OAPHT*** predicted high temperature
.2 ***OAPLT*** predicted low temperature
.3 ***OADH*** day's high temperature
.4 ***OAHDH*** hour that day's high occurred
.5 ***OADL*** day's low temperature
.6 ***OAHDL*** hour that day's low occurred
.7 ***OAYTD*** yesterday's temperature difference
.8 ***OAODH*** old (previous) day's high ***temperature***
.9 ***OAODL*** old (previous) day's low temperature

NOTE: An acceptable temperature prediction program module can be obtained from the Minister.

2 3.5 CRITICAL DIAL-OUT ALARMS

.1 Provide the following critical dial-out alarms:
.1 Low space temperature via ***STMIN*** < 12 degC
.2 Low boiler temperature (5 degC below setpoint) when outside air temperature is less than 5 degC.

.2 Link the alarms for implementation via the "Dial-out Alarm and Watch Dog Timer" defined under 230930.

3.6 SEQUENCE OF OPERATION

.1 Provide the following sequence of operation.

.2 Heating Water System

.1 The boilers are to come with packaged controls.
.2 BMS to provide connection to communication device provide with boilers, all available points associated with the boilers are to be available through the EMCS.
.3 When the outside air temperature is greater than 14 °C hot water system is to be de-energized. When the outside air temperature is less than 14 °C hot water system is to be energized.
.4 Hot water supply temperature is to reset based on outside air temperature.
.1 When outside air temperature is less than -37°C the supply water temperature set point is to be 93.3°C

.2 When the outside air temperature is between -37°C and 0 °C the supply temperature set point is to reset linearly between 93°C and 60°C
.3 When the outside air temperature is greater than 0 °C the supply temperature set point is to be 60°C

.5 The boilers (B-1/2) and their associated circulating pump (BP-1/2) are to be staged on as required to maintain the hot water supply temperature set point.
.1 The boilers are to alternate between lead, lag, based on run time or by based on operator override.
.2 All energized boilers are to modulate in parallel to maintain the common setpoint.
.3 The lead boiler is to be energized whenever the heating system is energized, and its associated circulating pump is to be energized.
.4 Prior to energizing any boiler the associated boiler pump is to be proven.
.4 Whenever a boiler is to de-energize, 5 minutes following the boiler de-energizing the associated boiler pump is to de-energized.
.5 If one Boiler is energized at 50% for a continuous 15 minute period the Lag boiler is to energize.
.6 The boilers are to be de-energized in the reverse manner.

.6 The hot water heating pumps (P-1/2) are to operate as lead, lag.
.1 If the hot water system is energized the lead pump is to be energized.
.2 The pumps are to alternate between lead, lag, based on run time or by based on operator override.
.3 The pumps are to modulate as required to maintain the remote building return water temperature sensor set point at 60°C.

.3 AHU Glycol Heating System

.1 The glycol heating pumps (P-3/4) are to operate as lead, lag.
.2 The pumps are to alternate between lead, lag, based on run time or by based on operator override.
.3 When the outside air temperature is less than 14 °C the lead pump is to be energized.

.2 The heat exchanger (HEX-1) control valve is to modulate as required to maintain air handling unit (AHU-1, AHU-2) heating control valves at less than 90% open flow to the heating coils, based on 2 minute average positions.

.4 Main Air Handler System AHU-1

.1 General Operation
.1 The AHU operates as a variable air volume system and consists of; a supply fan with variable frequency drive, return fan with variable frequency drive, enthalpy energy recovery wheel with variable frequency drive, outdoor air intake with air flow station, mixed air damper, exhaust

air, winter pre-filters, summer pre-filter, final filter, heating glycol coil, (future) DX cooling coil, and (future) steam humidification section.

.2 The AHU is scheduled for automatic operation through the EMCS system on a time of day basis for occupied and unoccupied modes.

.2 Occupied Mode

.1 Supply Fan operation - The supply fan variable frequency drive will maintain supply air duct static pressure control point. The damper position of each terminal unit associated with the AHU will be monitored and shall reset the supply air duct static pressure control point based on the zone requiring the most pressure. The static pressure control point shall be reset lower until two zone damper are 90% or less open. The static pressure control point shall be reset high until two zone damper are 90% or more open. The duct static pressure shall be limited to operate between 375 Pa (adj.) and 750 Pa WC (adj.) measured 2/3 downstream of the supply fan discharge. Supply fan motor speed shall not fall below 25% rated speed, and shall not exceed 100% rated speed.

.2 Return fan operation –The return fan is interlocked with the supply fan and shall not operate until supply fan status is proven. The return fan variable frequency drive will modulate as require to maintain building static pressure at 12 Pa (adj.). Return fan motor speed shall not fall below 25% rated speed, and shall not exceed 100% rated speed.

.3 The discharge air temperature set point will be reset as follows: When the outdoor air temperature is above 13°C (adj.), the supply air temperature will be maintained at 13°C (adj.). When the outdoor air temperature is below 13°C (adj.), the supply air temperature shall be reset between 13°C (adj.) and 17°C (adj.) based on the zone with the greatest cooling demand.

.4 Economizer operation – When the outdoor air temperature is below 18°C (adj.) economizer operation “free cooling” shall be allowed. The outdoor air and mixed air dampers, energy recovery section, heating glycol coil control valve and (future) cooling coil control valve in sequence and without overlap to maintain discharge air temperature. If the energy recovery section cannot provide sufficient energy transfer then heating glycol coil control valve shall modulate as required to provide additional heat to maintain supply air control point. If the energy recovery wheel is providing too much heat then the mixed air damper shall modulate closed and the outdoor air damper modulate open. When the outdoor air temperature is above 18°C (adj.), economizer is disabled. During economizer operation, outdoor air airflow rate shall not fall below minimum outdoor air airflow control point.

.5 Energy Recovery Section operation – The AHU shall have a packaged controller to operate the energy recovery section as required to maximize energy recovery. The energy recovery section shall maximize energy

recovery prior to allowing the heating coil to operate. The energy recovery section shall maximize energy recovery during mechanical cooling (future) by allowing the cooling coil to operate during economizer. The energy recovery wheel shall also operate whenever the outdoor air temperature exceeds the return air temperature, incorporating a 1°C (adj.) differential to prevent the wheel from excessive starting and stopping. The energy recovery section shall incorporate a "frost control" mode when the outdoor temperature is below 0°C (adj.), to prevent the energy recovery wheel from accumulating too much frost by modulating the wheel rotation speed. During frost control the mixed air temperature sensor shall control the outdoor air and mixed air dampers to maintain 7°C mixed air temperature.

.6 Minimum outdoor air airflow - Outdoor air airflow is measured by the air flow monitoring station and is used to modulate mixing and outdoor air dampers to maintain the minimum outdoor airflow setpoint of 2,060 l/s (adj).

.3 Unoccupied Mode

.1 When the AHU is "off", the supply fan is off, the return fan is off, the cooling coil control valve if closed, the heating coil control modulates to maintain 10°C interior temperature as sensed by the discharge air sensor, the outdoor air dampers are closed, the mixed air dampers are closed, and all terminal units associated with the AHU enter unoccupied mode.

.2 Morning warm-up – The EMCS system shall monitor each zone temperature and outdoor air temperature and automatically start the AHU prior to the occupancy schedule start time based on "optimal start time" to get all the spaces up to occupied setpoint temperature by occupied start time. During this period of operation the outdoor air dampers remain closed. During morning warm-up, the AHU shall discharge 24°C (adj.) supply air, all terminal units shall operate at maximum cooling setpoint, and all terminal units heating hot water control valve shall modulate as required to maintain room temperature setpoint. When a room temperature rises above the occupied heating setpoint, the associated VAV shall enter occupied mode, and all VAV's shall enter occupied mode at occupied period start time.

.3 Morning cool-down - The EMCS system shall monitor each zone temperature and outdoor air temperature and automatically start the AHU prior to the occupancy schedule start time based on "optimal start time" to get all the spaces down to occupied setpoint temperature by occupied start time. During this period of operation the outdoor air dampers remain closed. During morning cool-down, the AHU shall discharge 13°C (adj.) supply air and each terminal unit shall operate in occupied mode. Economizer operation shall be utilized if the outside air temperature is less than the economizer changeover setpoint, see "Economizer Operation" in

Occupied Mode above. When a room temperature reaches the occupied cooling setpoint, the associated VAV shall enter occupied mode, and all VAV's shall enter occupied mode at occupied period start time. Note: this sequence is for future cooling coil installation. Prior to cooling coil installation this sequence shall only be activated in "Economizer Operation".

.4 Alarms

.1 The low temperature cutout sensor shall activate if a temperature of less than 3°C is sensed at any one foot of the sensing element. When the low temperature cutout actives the AHU immediately shuts down, the heating coil control valve fully opens, and the EMCS system provides an alarm that the low temperature cutout stat has activated. The low temperature cutout stat requires a manual reset.

.2 A high static pressure cutout switch measures supply air duct static pressure and shall automatically shut-down the AHU when activated and the EMCS system shall provide an alarm that the unit has shut-down. The high static cutout switch shall require a manual reset and the AHU shall require a manual restart after the high static pressure cutout switch has reset. The high static cutout switch static pressure setpoint shall be 1000 Pa. (adj.).

.5 Gym Air Handler System AHU-2

.1 General Operation

.1 The AHU operates as a constant air volume system and consists of; a supply fan, return fan, carbon dioxide (CO2) sensor, outdoor air intake damper, mixed air damper, exhaust air damper, winter pre-filters, summer pre-filter, final filter, heating glycol coil, and (future) DX cooling coil and (future) steam humidification section.

.2 The AHU is scheduled for automatic operation through the EMCS system on a time of day basis for occupied and unoccupied modes.

.2 Occupied Mode

.1 Supply Fan operation - The supply fan will be energized.

.2 Return fan operation –The return fan is interlocked with the supply fan and shall not operate until supply fan status is proven. The return fan will be energized.

.3 The discharge air temperature set point will be reset as follows: When the outdoor air temperature is above 13°C (adj.), the supply air temperature will be maintained at 13°C (adj.). When the outdoor air temperature is below 13°C (adj.), the supply air temperature shall be reset between 13°C (adj.) and 17°C (adj.) based on the zone cooling demand.

.4 Economizer operation – When the outdoor air temperature is below 18°C (adj.) economizer operation "free cooling" shall be allowed. The outdoor air and mixed air dampers, heating glycol coil control valve and (future) cooling coil control valve in sequence and without overlap to maintain discharge air temperature. The heating glycol coil control valve shall modulate as required to provide additional heat to maintain supply air control point. When the outdoor air temperature is above 18°C (adj.), economizer is disabled. During economizer operation, outdoor air airflow rate shall not fall below minimum outdoor air airflow control point.

.5 Minimum outdoor air airflow – The initial minimum setpoint is 445 l/s (adj) for 3 hours after which CO2 demand ventilation shall occur. If the CO2 sensor is reading CO2 below setpoint, 550 ppm (adj.), then the minimum outdoor air airflow shall be 200 l/s. If the CO2 sensor is reading above setpoint then the minimum outdoor air airflow shall be 445 l/s

.3 Unoccupied Mode

.1 When the AHU is "off", the supply fan is off, the return fan is off, the cooling coil control valve if closed, the heating coil control modulates to maintain 10°C interior temperature as sensed by the discharge air sensor, the outdoor air dampers are closed, the exhaust air dampers are closed.

.2 Unoccupied override – The gym has an override pushbutton which when depressed during unoccupied periods causes the AHU to enter occupied mode for 2 hours (adj.).

.2 Morning warm-up – The EMCS system shall monitor zone temperature and outdoor air temperature and automatically start the AHU prior to the occupancy schedule start time based on "optimal start time" to get all the spaces up to occupied setpoint temperature by occupied start time. During this period of operation the outdoor air dampers and exhaust air dampers remain closed. During morning warm-up, the AHU shall discharge 24°C (adj.) supply air. When a room temperature rises above the occupied heating setpoint, the AHU shall enter occupied mode at occupied period start time.

.3 Morning cool-down - The EMCS system shall monitor zone temperature and outdoor air temperature and automatically start the AHU prior to the occupancy schedule start time based on "optimal start time" to the spaces down to occupied setpoint temperature by occupied start time. During this period of operation the outdoor air dampers and exhaust dampers remain closed. During morning cool-down, the AHU shall discharge 13°C (adj.) supply air. Economizer operation shall be utilized if the outside air temperature is less than the economizer changeover setpoint, see "Economizer Operation" in Occupied Mode above. When the space temperature rises above the occupied heating setpoint, the AHU shall enter occupied mode at occupied period start time. Note: this sequence is for

future cooling coil installation. Prior to cooling coil installation this sequence shall only be activated in "Economizer Operation".

.4 Alarms

.1 The low temperature cutout sensor shall activate if a temperature of less than 3°C is sensed at any one foot of the sensing element. When the low temperature cutout actives the AHU immediately shuts down, the heating coil control valve fully opens, and the EMCS system provides an alarm that the low temperature cutout stat has activated. The low temperature cutout stat requires a manual reset.

.6 Exhaust Fans (EF-1, 3, 5, 6, 7, 8, 10, 11)

.1 Exhaust fans shall energize and de-energize based on the occupied/unoccupied schedule. EMCS system shall monitor status of each exhaust fan.

.7 Exhaust Fans (EF-2, 4, 9, 12)

.1 Exhaust fan is interlocked with space occupancy sensor and operates whenever associated light is energized.

.2 If space does not have an occupancy sensor, the exhaust fan is interlocked with light switch operates whenever associated light is energized.

.8 IT Room Cooling Unit (AC-1, CON-1)

.1 The standalone split system controller controls the system. The system will be energized by the EMCS.

.2 The indoor unit (AC-1) supply fan shall run continuously and the refrigerant compressor shall cycle to maintain a space temperature set point of 23°C degrees (adj.) year round.

.3 The EMCS shall monitor and display temperature within the IT Room

.4 The stand alone controller will provide a general alarm to the EMCS for any local alarms.

.9 Air Terminal Devices, Re-heat coils and Radiant Panels (VAV-1 to VAV-24)

.1 On a call for cooling modulate the VAV box inlet damper from minimum to maximum airflow rate as required to satisfy the space temperature sensor.

.2 On a call for heating the VAV box inlet damper is to maintain its associated minimum airflow rate. Modulate the associated heating control valves for radiant panels and VAV box reheat coils in sequence as required to maintain the space temperature set point.

.3 EMCS to monitor all space temperature sensors, setpoint, VAV box airflow rates, temperature, and damper position.
.5 Air terminal devices are to be energized whenever AHU-1 is energized.

.10 Gym Radiation

.1 On a call for heating the heating control valve shall modulate to maintain temperature setpoint.

.11 Unit and Cabinet Heaters (UH-1, CUH-1/2/3)

.1 On a call for heating the heater's fan will be energized.

.12 Electric Unit Heater (EH-1)

.1 The heater will be energized on a call from the built-in thermostat.

.13 Domestic Water Heaters (DWH-1/2), Recirculating Pump (P-5)

.1 The domestic water heaters are to come with packaged standalone controls.
.2 The EMCS shall energize the heaters, monitor the domestic water supply and return water temperature, and pump status.
.3 Recirculating pump (P-5) shall be energized by the DWH controls.

.14 Mechanical Room Water Sensor

.1 The EMCS shall monitor the mechanical room floor water sensor.

3.7 VERIFICATION OF CUSTOM CONTROL SOFTWARE

.15 Provide copies of trend logs that clearly indicate the:
.1 stability of each control loop under various load conditions including modest step setpoint changes.
.2 adequacy of system startup during summer and winter conditions.
.3 proper operation of the outside air temperature prediction routines.
.4 adequacy of space comfort conditions.

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies equipment which needs to be installed as part of mechanical systems to permit chemical cleaning, chemical treatment and monitoring to be performed.

1.2 RELATED REQUIREMENTS

.1	Spare Parts and Maintenance Materials:	Section 20 00 23.
.2	Mechanical Operations and Maintenance Manuals:	Section 20 01 06.
.3	Chemical Treatment and Cleaning - General Requirements:	Section 23 25 02.
.4	Cleaning and Chemical Treatment of Hydronic Systems:	Section 23 25 13.
.5	Cleaning and Chemical Treatment of Steam Boiler Systems:	Section 23 25 19.
.6	Cleaning and Chemical Treatment of Condenser Water Systems:	Section 23 25 20.
.7	Cleaning and Chemical Treatment of Glycol Systems:	Section 23 25 26.
.8	Cleaning and Chemical Treatment of Spa/Swimming Pools:	Section 25 51 19.

1.3 DETAIL DRAWINGS

.1 Following detail drawings form part of this Section:

.1	23 25 01.01	Chemical Pot Feeder and Corrosion Coupon Rack
.2	23 25 01.02	Installation of Chemical Pot Feeder, By-pass Filter, Corrosion Coupon Rack, and Sample Cooler.

1.4 REFERENCE DOCUMENTS

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

.1	ASTM D2688-05	Standard Test Methods for Corrosivity of Water in the Absence of Heat Transfer (Weight Loss Methods)

1.5 PRODUCT DATA

.1 Comply with requirements of Division 01.

.2 Provide product data for each piece of equipment and control systems. Include sizes and capacity for each system.

1.6 SPARE PARTS AND MAINTENANCE MATERIALS

.1 Provide spare parts and maintenance materials specified in Section 20 00 23 and this Section.

2. Products

2.1 EQUIPMENT AND MATERIALS

.1 Sample Cooler: to ASTM D1192, capable of operating at system working temperature and pressure.

.2 Chemical Pot Feeder: as detailed on Detail 23 25 01.01, capable of operating at system working temperature and pressure.

.3 Corrosion Coupon Holders: fabricated in accordance with ASTM D2688. Two for each system.

.4 Corrosion Coupon Rack: as detailed on Detail 23 25 01.02. One for each system.

.5 Corrosion Coupons: supplied and installed by the Minister.

.6 By-pass Filter: constructed of steel, sized to handle 5% of system circulating rate, and capable of operating at system working temperature and pressure. As detailed on Detail 23 25 01.02

.7 Flow Indicator: constructed of bronze and glass, with ball, sized to handle 5% of system circulation rate, and capable of operating at system working temperature and pressure.

.8 In-line Filter: constructed of steel or fibreglass, sized to handle 100% of system circulating rate, with valve structure to permit backwash, rinse, by-pass & service operation, and capable of operating at system working pressure and temperature.

.9 Chemical Metering System: consisting of:

.1 Chemical Feed Pump: positive displacement type chemical feed pump, with adjustable settings for stroke length and stroke frequency, built-in check and relief valves, foot valves, and PVC suction and discharge tubing, capable of producing a higher pressure than system pressure.

.2 Chemical Mixing Tank Assembly: with 189 L high density free standing moulded polyethylene tank with a split removable cover, a pump shelf mount above or to the side of the tank, and agitator bracket.

.3 Agitator: electrical motor driven agitator, complete with sealed motor, stainless steel shaft and propeller.

3. Execution

3.1 EQUIPMENT INSTALLATION

.1 Install sample cooler for heating systems in accordance with ASTM D1192 and Detail 23 25 01.02

.2 Install chemical pot feeder in accordance with Detail 23 25 01.01 and 23 25 01.02.

.3 Install by-pass filter in accordance with Detail 23 25 01.02. Do not install filter cartridge until system has been cleaned.

.4 Install corrosion coupon rack in accordance with Detail 23 25 01.01 and 23 25 01.02.

.5 Coupons will be installed by the Minister:

.1 After system has been cleaned.
.2 After system(s) are fully operational and treated.

.6 Install in-line filter downstream of circulating pump. Make connections to direct filter backwash and rinse water to drain.

3.2 WASTE WATER AND MATERIAL DISPOSAL

.1 Dispose of waste water and materials in accordance with the "Alberta Infrastructure Water Treatment Program Manual, Section I - Environmental Guideline".

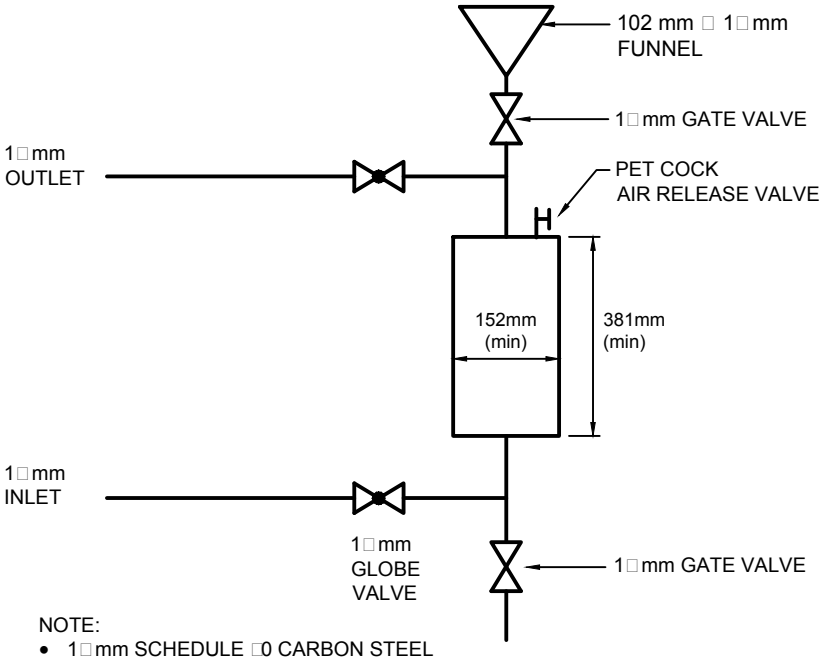
3.3 CHEMICAL TREATMENT AND CLEANING EQUIPMENT SCHEDULE

.1 Supply and install chemical treatment and cleaning equipment for systems as follows:

System	Equipment
Hydronic Systems Section 23 25 13	Sample Cooler (for heating systems only) Chemical Pot Feeder Corrosion Coupon Holders Corrosion Coupon Rack By-pass Filter By-pass Filter Cartridge Flow Indicator
Glycol System Section 23 25 26	Sample Cooler (for heating systems only) Corrosion Coupon Holders Corrosion Coupon Rack By-pass Filter By-pass Filter Cartridge Flow Indicator

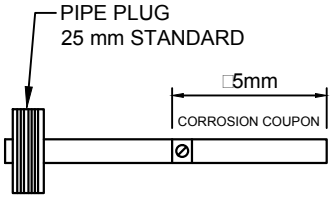
Notes:

END OF SECTION

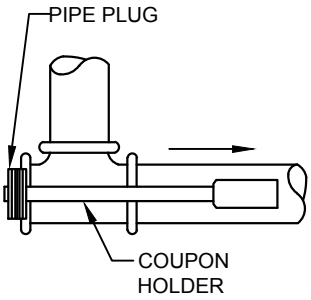


NOTE:
- 1 mm SCHEDULE 0 CARBON STEEL PIPING THROUGHOUT
- PRESSURE RATING OF 1035 KPa(g)

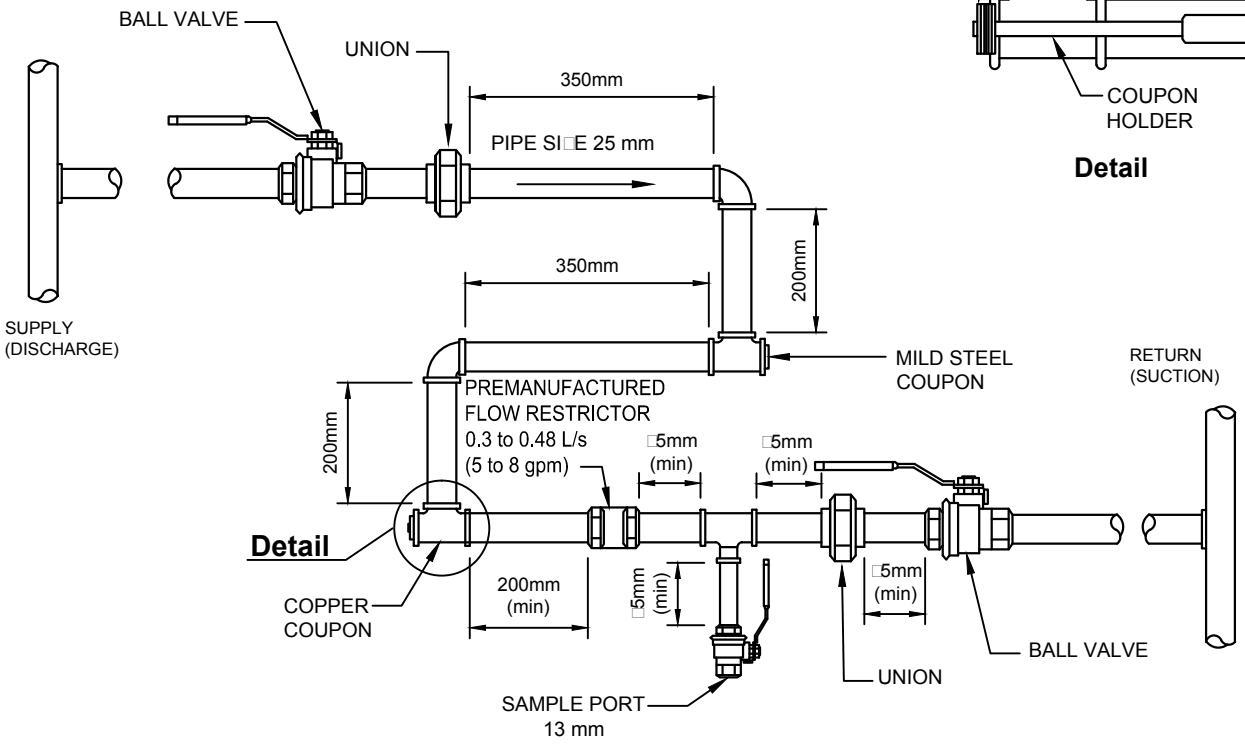
CHEMICAL POT FEEDER



316 Stainless Steel Corrosion Coupon Holder

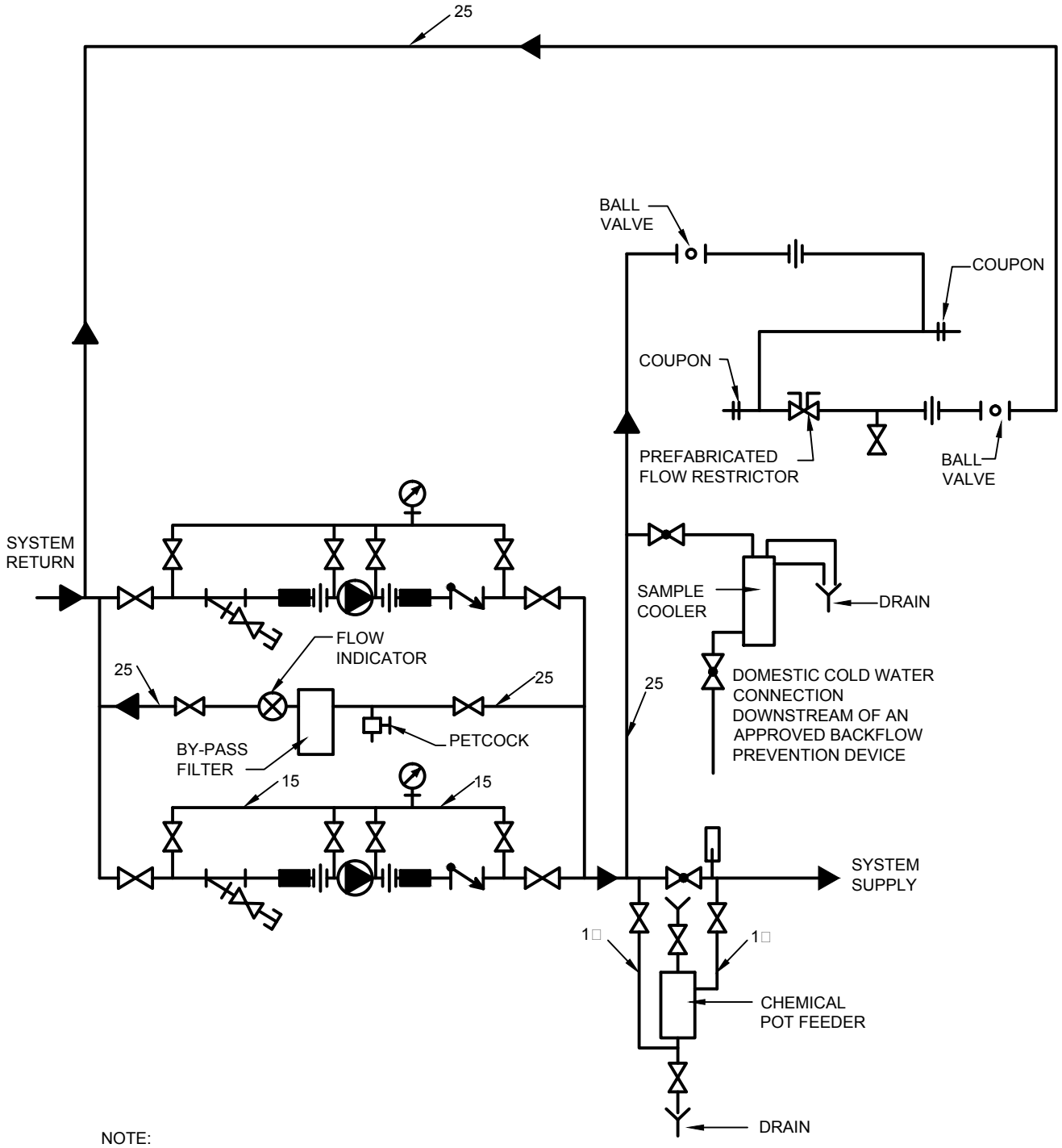


Detail



CORROSION COUPON RACK

Chemical Pot Feeder Corrosion Coupon Rack	2012 - 0 - 20
	Detail 23 25 01 01



NOTE:

- CORROSION COUPON RACK, CHEMICAL POT FEEDER, BY-PASS FILTER, AND SAMPLE COOLER MUST BE LOCATED AT OPERATOR LEVEL AWAY FROM ANY ELECTRICAL EQUIPMENT
- ENSURE DRAIN VALVES ARE INSTALLED IN ALL SYSTEM LOW POINTS

Installation of Chemical Pot Feeder, By-Pass Filter, Corrosion Coupon Rack, & Sample Cooler	2012 - 0 - 20
	Detail 23 25 01 02

1. General

1.1 INTENT

.1 This Section specifies general requirements for onsite, cleaning and chemical treatment of mechanical systems.

1.2 RELATED REQUIREMENTS

.1	Spare Parts and Maintenance Materials:	Section 20 00 23.
.2	Cleaning and Chemical Treatment Equipment:	Section 23 25 01.
.3	Cleaning and Chemical Treatment of Hydronic Systems:	Section 23 25 13.
.4	Cleaning and Chemical Treatment of Glycol Systems:	Section 23 25 26.

1.3 REFERENCE DOCUMENTS

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

.1	ASTM D2688-05	Standard Test Methods for Corrosivity of Water in the Absence of Heat Transfer (Weight Loss Methods)

.2 Alberta Infrastructure Water Treatment Program Manual

1.4 SUBMITTALS

.1 Comply with requirements of Section 20 00 13.

.2 Submit the following information and documents for approval by the Minister:

.1 Proposed cleaning procedure.

.2 Material and safety data sheets for [chemical treatment], [cleaning products], [corrosion inhibitor], [water test reagents], and [glycol].

.3 A permit from the appropriate regulatory body to dispose of spent cleaning solutions to sanitary sewer system, or a statement of intention to dispose of spent cleaning solutions at an approved off-site location.

.4 Recommended control limits and control charts.

.5 Submit additional information specified in related sections.

1.5 QUALITY ASSURANCE

.1 Use a qualified water treatment specialist, who has a demonstrated record of expertise in water systems cleaning and chemical treatment, to supply chemicals, equipment, and consulting services to perform cleaning and chemical treatment work specified, in accordance with the Alberta Infrastructure Water Treatment Program.

1.6 INSTRUCTION

.1 Provide operation and maintenance instructions for water treatment systems including following:

.1 Chemical requirements for water treatment.
.2 Water test procedures.
.3 Operation and maintenance of water treatment equipment.

1.7 SEQUENCING

.1 Perform cleaning and chemical treatment activities as one continuous process without interruption.

2. Products

2.1 WATER TEST EQUIPMENT

.1 Water test equipment shall meet the following minimum requirements. Quantitites for each system are specified in related requirements sections.

.1 pH Test Kit: capable of measuring pH levels of water system, boiler water, and condensate to an accuracy of ±0.1 pH unit.

.2 Sulphite Test Kit: capable of measuring sulphite concentration of boiler water to an accuracy of ±10 mg/L.

.3 P&M Alkalinity Test Kit: one alkalinity test kit capable of measuring the P&M alkalinity concentrations of boiler water to an accuracy of ±10 mg/L.

.4 Chlorine Test Kit: capable of measuring free residual and combined residual chlorine concentrations in system to an accuracy of ±1.5%.

.5 Ortho-Phosphate Test Kit: capable of measuring ortho-phosphate concentration of system water to an accuracy of ±2 mg/L.

.6 Phosphonate/Poly Phosphate Test Kit: capable of measuring phosphonate or poly phosphate concentration of system water to an accuracy of ±2 mg/L.

.7 Hydronic Corrosion Inhibitor Test Kit: sulphite or an organic based corrosion inhibitor test kit capable of measuring concentration of corrosion inhibitor in system to an accuracy of ±10 mg/L.

.8 TDS (Total Dissolved Solids) or Conductivity Meter: capable of measuring TDS concentration or conductivity of water system and boiler water and condensate to an accuracy of ±10 mg/L.

.2 Supply each test kit with a corrosion proof plastic carrying case, complete set of reagents, and complete step-by-step instructions for test procedures.

3. Execution

3.1 DISPOSAL OF SPENT CLEANING SOLUTION

.1 Dispose of spent cleaning solution in an environmentally responsible manner. Following methods are acceptable:

.1 Disposal through sanitary sewer if regulatory body will accept spent cleaning solutions and issue a disposal permit.

.2 Disposal at an off-site disposal facility which meet Alberta Environment requirements.

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies services and material required for onsite, cleaning and chemical treatment of a multi-metal, closed loop [hot water heating system] [and] [chilled water system].

1.2 RELATED REQUIREMENTS

.1	Mechanical Spare Parts and Maintenance Materials:	Section 20 00 23.
.2	Chemical Cleaning and Treatment Equipment:	Section 23 25 01.
.3	Chemical Cleaning and Treatment - General Requirements:	Section 23 25 02.

1.3 REFERENCE DOCUMENTS

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

.1 ASTM D2688-05 Standard Test Methods for Corrosivity of Water in the Absence of Heat Transfer (Weight Loss Methods)

.2 Alberta Infrastructure Water Treatment Program Manual

1.4 PERFORMANCE REQUIREMENTS

.1 Clean hydronic system to remove oil, grease, silt, and rust and leave metal surfaces well passivated.

.2 Chemically treat and maintain hydronic system water to meet following standards:

Parameter	Control Limits
Suspended solids:	Nil.
Iron Corrosion Rate:	stable rate, 0.5 mils per year maximum, no pitting.
Copper Corrosion Rate:	stable rate, 0.2 mils per year maximum, no pitting.
Total Iron Concentration:	0.5 mg/L Fe maximum.
Total Copper Concentration:	0.2 mg/L Cu maximum.
Total Plate Count	10^3 organisms/mL maximum.

PH	8.5 – 9.5, accuracy ±0.1
Conductivity	<2500 μS/cm (micro siemens/cm)

1.5 SUBMITTALS

.1 In addition to submittal requirements specified in Section 23 25 02, submit a written report of actual cleaning activities including:

.1 Times.
.2 System status.
.3 Problems encountered.
.4 Actions taken.
.5 Composition of cleaning & spent cleaning solutions.
.6 Inspection results.
.7 Final concentration of corrosion inhibitor in system.
.8 Corrosion coupon weights.
.9 Corrosion rates.
.10 Final suspended solids concentration in system.
.11 Final iron concentration in system.
.12 Final copper concentration in system.
.13 Final pH.
.14 Final conductivity.

2. Products

2.1 CLEANING CHEMICALS

.1 Cleaning Solution: neutral pH cleaning solution which is capable of removing oil, grease, and rust from metal surfaces of system and passivating cleaned metal surfaces of system. Cleaning solution shall include:

.1 Low foaming non-ionic surfactant for penetrating oily and greasy deposit surfaces.
.2 Solvent for dissolving oil and grease.
.3 Dispersant for dissolving rust.
.4 Reducing agent for corrosion control.
.5 Ferrous and non-ferrous metal corrosion inhibitors.

2.2 CHEMICAL TREATMENT MATERIALS

.1 Corrosion Inhibitor: containing following:

.1 Sulphite based materials for corrosion protection of ferrous material in system.
.2 Corrosion inhibitor of non-ferrous material.
.3 Buffer for pH level control.

2.3 MISCELLANEOUS MATERIALS

.1 Corrosion Coupons: supplied by the Minister.

.2 By-pass Filter Cartridge: sized between 5 and 20 microns for retention of particles greater than 20 microns in diameter.

2.4 WATER TEST EQUIPMENT

.1 Supply one of each of the following water test kits specified in Section 23 25 02:

.1 pH test kit.
.2 Corrosion inhibitor test kit.
.3 TDS (Total Dissolved Solids) or Conductivity Meter.

3. Execution

3.1 EQUIPMENT INSTALLATION

.1 Prior to performing chemical treatment work ensure following work specified in Section 23 25 01 has been completed:

.1 Sample cooler - for hot water heating systems only.
.2 Chemical pot feeder.
.3 By-pass filter and flow indicator.
.4 Corrosion coupon rack as per detail drawing 23 25 01.

3.2 CLEANING - GENERAL

.1 Maintain following conditions during cleaning process:

.1 Manual and automatic valves are in full open position.

.2 By-pass valves are operated to ensure full flow through entire system.

.3 Safety devices, including pressure relief valves, flow switches, and pressure switches are functioning.

.4 System is operated with a minimum pressure of 35 kPa(g) at highest point and expansion tank level is maintained at 1/3 to 1/2 full of water.

.5 Temporary fine mesh strainers for system pump and control valve strainer baskets are installed and cleaned as required.

3.3 CLEANING PROCEDURE

.1 Step 1: Fill system with domestic water, establish circulation, and heat system contents to a temperature of 60°C.

.2 Step 2: After two hours of circulation, collect water samples from at least three different locations in system. If these samples contain suspended solids, clean out strainer baskets, drain system, and repeat steps 1 & 2.

.3 Step 3: Blend in prepared concentrated cleaning solution, establish circulation, and maintain system temperature at 60°C for at least three days.

.4 Step 4: Dump spent cleaning solution to disposal, fill system with domestic water, circulate system contents for at least two hours, and dump spent rinse water to disposal.

.5 Step 5: Fill system with domestic water and repeat step 4 until water samples collected from system are free of oil, grease, and suspended solids.

.6 Step 6: Drain system completely, including all system low points and perform visual inspections of metal surfaces at three different locations.

.7 Complete steps 4, 5 & 6 within a 24 hour period.

.8 If metal surfaces contain oil/grease or silt, fill the system with domestic water and repeat steps 3, 4, 5 & 6.

.9 Immediately after inspection is completed, install filter cartridge, operating pump and control valve strainers fill system with domestic water, blend in concentrated corrosion inhibitor solution until its concentration in system is at an acceptable level for film formation, and pass system water through by-pass filter and corrosion coupon rack.

3.5 CHEMICAL TREATMENT - CONTROL LIMITS

.1 For first month after chemical treatment maintain primary control limits at upper limits.

.2 Maintain following control limits for inhibitor used in system until Interim Acceptance of the Work:

Inhibitor	Primary Control Limits	Secondary Control Limits
Sulphite	50-100 mg/L SO_3 80-160 mg/L Na_2SO_3	8.5-9.5 pH 2000 mg/L TDS max or 2500 μS/cm (micro siemens/cm)

3.6 OPERATION MAINTENANCE UNTIL INTERIM ACCEPTANCE

.1 Perform following minimum routine maintenance until Interim Acceptance of the Work:

.1 Maintain control limits specified under "Performance Requirements" and "Chemical Treatment - Control Limits". Add chemicals as required.

.2 Replace fouled filter cartridges in by-pass filter with new filter cartridges as required to maintain continuous flow through filter.

.3 Test water samples of system monthly for following :

.1 Visual appearance.
.2 pH levels.
.3 TDS concentration.
.4 Corrosion inhibitor concentration.
.5 Total plate count.

.2 Document water analyses results, quantities, dates chemicals added and make-up water used on chemical treatment report form.

3.7 WASTE WATER DISPOSAL

.1 Wastewater discharged into a municipal sanitary sewer system from existing or new systems shall be within the limits established by local authorities. Where no local limits have been established, stay within limits specified in "Alberta Infrastructure Water Treatment Program Manual, Section I - Environmental Guideline".

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies services and material required for onsite, cleaning and chemical treatment of a multi-metal, closed loop [glycol heating system] glycol water system].

1.2 RELATED REQUIREMENTS

.1	Mechanical Spare Parts and Maintenance Materials:	Section 20 00 23.
.2	Chemical Treatment and Cleaning Equipment:	Section 23 25 01.
.3	Chemical Treatment and Cleaning - General Requirements:	Section 23 25 02.

1.3 REFERENCE DOCUMENTS

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

.1	ASTM D1121-07	Standard Test Method for Reserve Alkalinity of Engine Coolants and Anti-rusts
.2	ASTM D2688-05	Standard Test Method for Corrosivity of Water in the Absence of Heat Transfer (Weight Loss Methods)

.2 Alberta Infrastructure Documents:

.1 Alberta Infrastructure Water Treatment Program Manual

1.4 PERFORMANCE REQUIREMENTS

.1 Cleaning activities shall remove oil, grease, silt, and rust from system. Cleaned metal surfaces shall be well passivated.

.2 Ensure that chemical treatment is capable of maintaining operation performance standards as follows:

Parameter	Control Limits
Suspended solids:	Nil.
Iron Corrosion Rate:	Stable rate, 0.5 mils per year maximum, no pitting.
Copper Corrosion Rate:	Stable rate, 0.2 mils per year maximum, no pitting.
Total Iron Concentration:	0.5 mg/L Fe maximum.
Total Copper Concentration:	0.2 mg/L Cu maximum.

1.5 SUBMITTALS

.1 In addition to submittal requirements specified in Section 23 25 02, submit a written report of actual cleaning activities including:

.1 Times.
.2 System status.
.3 Problems encountered.
.4 Actions taken.
.5 Composition of cleaning & spent cleaning solutions.
.6 Type of glycol or manufacturer's brand name of glycol added to system.
.7 Inspection results.
.8 Final glycol concentration.
.9 Final pH level.
.10 Final reserve alkalinity based on 100% glycol.
.11 Final suspended solids concentration.
.12 Final iron concentration.
.13 Corrosion coupon weights.
.14 Corrosion rates.
.15 Final Iron and Copper concentration.

2. Products

2.1 CLEANING CHEMICALS

.1 Cleaning Solution: neutral pH cleaning solution which is capable of removing oil, grease, and rust from metal surfaces of system and passivating cleaned metal surfaces of system. Cleaning solution shall include:

.1 Low foaming non-ionic surfactant for penetrating oily and greasy deposit surfaces.
.2 Solvent for dissolving oil and grease.
.3 Dispersant for dissolving rust.
.4 Reducing agent for corrosion control.
.5 Ferrous and non-ferrous metal corrosion inhibitors.

2.2 CHEMICAL TREATMENT MATERIALS

.1 Glycol: pre-mixed inhibited industrial grade 50% volume ethylene glycol.

.1 Ethylene glycol used must be available with a separate corrosion inhibitor component to restore corrosion inhibitor properties.

2.3 MISCELLANEOUS MATERIALS

.1 Corrosion Coupons: Will be supplied and installed by the Minister.

.2 By-pass Filter Cartridge: sized between 5 and 20 microns, for retention of particles greater than 20 microns in diameter.

2.4 WATER TEST EQUIPMENT

.1 Supply one of each of the following water test kits specified in Section 23 25 02:

.1 pH test kit.

3. Execution

3.1 EQUIPMENT INSTALLATION

.1 Prior to performing chemical treatment work ensure following work specified in Section 23 25 02 has been completed:

.1 Sample cooler - for heating systems only.
.2 By-pass filter and flow indicator device.
.3 Corrosion coupon rack as per detail drawing 23 25 01 01.

3.2 CLEANING - GENERAL

.1 Maintain following conditions during cleaning process:

.1 Manual and automatic valves are in full open position.

.2 By-pass valves are operated to ensure full flow through entire system.

.3 Safety devices, including pressure relief valves, flow switches, and pressure switches are functioning.

.4 System is operated with a minimum pressure of 35 kPa(g) at highest point and expansion tank level is maintained at 1/3 to 1/2 full of water.

.5 Fine mesh strainers for system pump and control valve strainer baskets are cleaned as required.

3.3 CLEANING PROCEDURE

.1 Step 1: Fill system with domestic water, establish circulation, and heat system contents to a temperature of 60°C.

.2 Step 2: After two hours of circulation, collect water samples from at least three different locations in system. If these samples contain suspended solids, clean out strainer baskets, drain system, and repeat steps 1 & 2.

.3 Step 3: Blend in prepared concentration cleaning solution, established circulation, and maintain system temperature at 60°C for at least three days.

.4 Step 4: Dump spent cleaning solution to disposal, fill system with domestic water, circulate system contents for at least two hours, and dump spent rinse water to disposal.

.5 Step 5: Fill system with domestic water and repeat step 4 until water samples collected from system are free of oil, grease, and suspended solids.

.6 Step 6: Drain system completely, including all system low points and perform visual inspections of metal surfaces at three different locations.

.7 Complete steps 4, 5 & 6 with in a 24 hour period.

.8 If metal surfaces contain oil, grease or silt, fill system with domestic water and repeat steps 3, 4, 5 & 6.

.9 Immediately after inspection is completed, install filter cartridge and fill system with pre-mixed glycol, and pass system glycol through by-pass filter and corrosion coupon rack.

3.5 CHEMICAL TREATMENT - CONTROL LIMITS

.1 Maintain control limits specified in following schedule:

Type or Glycol	Heating System and Cooling Systems (Exposed to Outside Temperatures)	Cooling System (Not Exposed to Outside Temperatures)
Ethylene Glycol		
glycol concentration, % vol:	50 ±2	30-35
pH at 25°C:	8.5 minimum	8.5 minimum
reserve alkalinity based on 100% glycol:	9.0 minimum	9.0 minimum

.2 Test for reserve alkalinity in accordance with ASTM D1121. 100% glycol reserve alkalinity value is equal to reserve alkalinity value times 100 divided by glycol concentration.

3.6 OPERATION MAINTENANCE UNTIL INTERIM ACCEPTANCE

.1 Perform following minimum routine maintenance until Interim Acceptance of the Work:

.1 Maintain control limits specified under "Performance Requirements" and "Chemical Treatment - Control Limits".

.2 Replacing fouled filter cartridges in by-pass filter with new filter cartridges as required to maintain continuous flow through filter.

.3 Test glycol samples of system monthly for following:

.1 Visual appearance.
.2 pH level.
.3 Glycol concentration.
.4 Reserve alkalinity concentration based on 100% glycol.
.5 Suspended solids concentration.
.6 Iron and copper concentration.

.4 Document glycol analyses results on a chemical treatment report form.

.2 Document glycol analyses results and any corrosion inhibitor added on a chemical treatment report form.

3.7 WASTE WATER DISPOSAL

.1 Wastewater discharged into a municipal sanitary sewer system from existing or new systems shall be within the limits established by local authorities. Where no local limits have been established, stay within limits specified in “Alberta Infrastructure Water Treatment Program Manual, Section I - Environmental Guideline”.

END OF SECTION

1. General

1.1 REFERENCE DOCUMENTS

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

.1	ASTM A653/A653M-09	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

.2 National Fire Protection Association (NFPA):

.1	NFPA 90A-2009	Standard for the Installation of Air Conditioning and Ventilation Systems
.2	NFPA 90B-2009	Standard for the Installation of Warm Air Heating and Air Conditioning Systems

.3 National Energy Code of Canada for Buildings, 2011

1.2 ALTERNATIVES

.1 Size round ducts installed in place of rectangular ducts indicated from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration of sizes permitted except by written permission.

1.3 DEFINITIONS

.1 Low Pressure: Static pressure in duct less than 0.5 kPa and velocities less than 10 m/s.

.2 Medium Pressure: Static pressure in duct less than 1.5 kPa and velocities greater than 10 m/s.

.3 High Pressure: Static pressure over 1.5 kPa and less than 2.5 kPa and velocities greater than 10 m/s.

.4 Duct Sizes: Inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.4 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Submit shop drawings and samples of duct fittings for approval, including particulars such as thicknesses, welds and configurations prior to start of work.

.2 Submit shop drawings for fibrous glass ducts including manufacturers fabrication and installation manual.

.2 Submit written inspection report of manufacturers acceptance of fabrication and installation of fibrous glass ductwork. Confirm ductwork has been fabricated and installed in accordance with recommendations and SMACNA standards. Inspection shall occur at beginning of installation.

1.5 QUALITY ASSURANCE

.1 Ductwork shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems, and NFPA No. 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for [reuse] [and] [recycling] in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 MATERIALS

.1 Ducts: Galvanized steel lock forming quality, having galvanized coating to ASTM A653M, G90 designation for both sides.

.2 Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

.3 Sealant: Water resistant, fire resistive, compatible with mating materials.

.4 Flexible Ducts: Corrugated aluminum or fabric supported by helically wound steel wire or flat steel strips.

2.2 FABRICATION

.1 Complete metal ducts with themselves with no single partition between ducts. Where width of duct exceeds 450 mm cross break for rigidity. Open corners are not acceptable.

.2 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.3 Construct tees, bends, and elbows with radius of not less than 1 1/2 times width of duct on centre line. Where not possible and where rectangular elbows used, provide approved type air foil turning vanes. Where acoustical lining is provided, provide turning vanes of perforated metal type with fibreglass inside.

.4 Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible. Maximum divergence upstream of equipment to be 30 degree and 45 degree convergence downstream.

.5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

.6 Provide easements where low pressure ductwork conflicts with piping and structure where easements exceed 10% duct area, split into two ducts maintaining original duct area.

.7 Provide necessary baffling in mixed air plenums to ensure good mixed air temperature with variations of not more than ± 15°C under all operating conditions.

.8 Fabricate continuously welded medium and high pressure round and oval duct fittings of one gauge heavier than gauges indicated for duct size. Joints shall be 100 mm cemented slip joint, brazed or electric welded. Prime coat welded joints. Fabricate elbows of five piece construction. Provide standard 45° take-offs unless otherwise indicated where conical 90° tee take-off connections may be used. Adequately brace with truss couplings or comparison angle flanges with asbestos gaskets bolted at 150 mm centers.

.9 Fabricate plenums and casings to configurations shown on drawings. Construct plenums of galvanized panels joined standing seams on outside of casing riveted or bolted on approximately 300 mm centers. Reinforce with suitable angles and provide diagonal bracing as required. Tightly fit at apparatus and caulk with sealant.

.10 Provide 75 mm reinforced concrete curb for plenum walls and floor mounted casings. At floor, rivet panels on 200 mm centers to angles. Where floors are acoustically insulated, provide liner at 1.2 mm galvanized expanded metal mesh, turned up 300 mm at sides with sheet metal shields.

.11 Reinforce door frames with angle iron tied to horizontal and vertical plenum supporting angles. Install hinged access doors where shown, specified or where required for access to equipment for cleaning and inspection.

.12 Fabricate acoustic plenums of galvanized steel. Provide 1.6 mm back facing and 0.8 mm perforated front facing with 3 mm diameter holes on 4 mm centers. Construct panels 75 mm thick packed with 72 kg/m^3 minimum fibrous glass media, on inverted channels of 1.6 mm [on 75 mm reinforced concrete curb].

3. Execution

3.1 INSTALLATION

.1 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pivot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.2 Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

.3 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.4 Provide floor drains in fresh air and humidifier sections with deep seal traps.

.5 Set plenum doors 150 mm to 300 mm above floor. Arrange door swings so that fan static holds door in closed position.

.6 Connect terminal units to medium or high pressure ducts with 300 mm maximum length of flexible duct. Do not use flexible duct to change direction.

.7 Connect diffusers or troffer boots to low pressure ducts with 1.5 m maximum length of flexible duct. Hold in place with caulking compound and strap or clamp.

3.2 LOW PRESSURE DUCT THICKNESSES (MINIMUM)

.1 Rectangular Ducts

Maximum Width	mm
Up to 300 mm	0.6
330 mm to 760 mm	0.8
790 mm to 1370 mm	0.8
1400 mm to 2130 mm	1.0
2160 mm and Over	1.2

.2 Round Ducts

Duct Diameter	mm
Up to 330 mm	0.6
350 mm to 550 mm	0.8
580 mm to 1270 mm	0.8
890 mm to 910 mm	1.0
1300 mm to 1520 mm	1.2
1550 mm to 2130 mm	1.6

3.3 MEDIUM PRESSURE DUCT THICKNESS

.1 Rectangular Ductwork

Maximum	mm
Up to 460 mm	0.8
480 mm to 1220 mm	0.8
1250 mm to 1830 mm	1.0
1850 mm to 2440 mm	1.2
2460 mm and Over	1.6

3.4 HIGH PRESSURE DUCT THICKNESSES

.1 Rectangular Ductwork

Maximum Width	mm
Up to 460 mm	0.8
480 mm to 1220 mm	1.0
1250 mm to 1830 mm	1.2
1850 mm to 2440 mm	1.6
2460 mm to 3660 mm	2.0

3.5 MEDIUM & HIGH PRESSURE DUCT THICKNESSES

.1 Round Ducts	Spiral Lock Seam mm	Longitudinal Seam mm
Up to 200 mm	0.6	0.8
230 to 560 mm	0.8	0.8
580 to 910 mm	0.8	1.0
940 to 1270 mm	1.0	1.0
1300 to 1520 mm	1.2	1.2
1550 mm and Over	1.6	0.6

3.7 PLENUM GAUGES

.1 Fabricate fan plenums and plenums downstream of fan in accordance with duct gauges.

.2 Fabricate plenums upstream of fan between apparatus of 1.6 mm.

.3 Fabricate plenums upstream of filters of 1.2 mm

END OF SECTION

1. General

1.1 REFERENCE DOCUMENTS

.1 National Fire Protection Association (NFPA):

.1	NFPA 90A-2009	Standard for the Installation of Air Conditioning and Ventilation Systems

.2 Underwriter Laboratories of Canada (ULC):

.1	CAN/ULC-S112-M90 (R2001)	Standard Methods of Fire Test of Fire Damper Assemblies
.2	ULC S505-1974	Fusible Links for Fire Protection Service

1.2 SUBMITTALS

.1 Samples:

.1 Submit samples in accordance with Section 20 00 13 – Mechanical General Requirements. Samples to include:

.1 Shop fabricated assemblies as requested.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements. Shop drawing to include:

.1 Factory fabricated assemblies.

1.3 QUALITY ASSURANCE

.1 Fire dampers shall be UL listed and constructed in accordance with CAN/ULC-S112, Fire Test of Fire Damper Assemblies.

.2 Fusible links on fire dampers shall be constructed to ULC S505.

.3 Demonstrate resetting of fire dampers to authorities having jurisdiction and Minister's representative.

.4 Access doors shall be UL labelled.

.5 Accessories shall meet the requirements of NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.6 Fabricate in accordance with ASHRAE handbooks and SMACNA duct manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for [reuse] [and] [recycling] in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 ACCESS DOORS

.1 Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices. Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricate with two butt hinges and two sash locks for sizes up to 450 mm, two hinges and two compression latches with outside and inside handles for sizes up to 600 x 1200 mm and an additional hinge for larger sizes.

2.2 FIRE DAMPERS

.1 Fabricate of galvanized steel or prime coated black steel weighted to close and lock in closed position when released by fusible link.

.2 Fire dampers [in low pressure ductwork] may be [multi-blade,] offset butterfly or curtain type.

.3 Fabricate combination fire and balancing dampers with linkage readily adjustable in open position.

.4 Fire dampers in medium and high pressure ductwork shall be curtain type.

.5 Curtain type fire dampers shall have blades retained in a recess so free area of connecting ductwork is not reduced.

.6 Fusible links shall be set for 72°C.

2.3 DAMPERS

.1 Fabricate of galvanized steel, minimum 1.6 mm, and provide with quadrants or adjustment rod and lock screw.

.2 Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration. Size on basis of straight air volume proportioning.

.3 Fabricate single blade dampers for duct sizes to 300 x 1200 mm.

.4 Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 300 x 1800 mm. Assemble center and edge crimped blade in prime coated or galvanized channel frame with approved type hardware.

.5 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles.

.6 Fabricate multi-blade, parallel action gravity balanced backdraft dampers with blades a maximum of 150 mm width having felt or flexible vinyl sealing edges, linked together in rattle-free manner and with adjustment device to permit setting for varying differential static pressure.

2.4 FLEXIBLE CONNECTIONS

.1 Fabricate of approved neoprene coated flameproof fabric approximately 50 mm wide tightly crimped into metal edging strip and attach to ducting and equipment by screws or bolts at 150 mm intervals.

3. Execution

3.1 INSTALLATION

.1 Provide adequately sized access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Review locations prior to fabrication.

.2 Provide 100 x 100 mm quick opening access doors for inspection at balancing dampers.

.3 Provide fire dampers at locations indicated on drawings. Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings, and hinges.

.4 At each point where ducts pass through partitions, the joints around the duct shall be sealed with non-combustible material.

.5 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger duct as required for proper air balancing.

.6 Provide balancing dampers on high pressure systems where indicated. Splitter dampers shall only be used where indicated on the drawings.

.7 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and where indicated on the drawings.

.8 For connections to medium and high pressure fans, install 12 mm thick neoprene pad over fabric and hold in place with additional metal straps.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 General Mechanical Starting and Testing Requirements: Section 23 08 13.
.2 Mechanical Equipment Starting and Testing: Section 23 08 23.

1.2 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01.

.2 Substitute products shall not decrease motor wattage, increase noise level, increase tip speed by more than 10%, or increase inlet air velocity by more than 20%, from that specified.

1.3 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.2 Submit with shop drawings acoustical data and fan curves showing fan performance with fan and system operating point plotted on curves.

1.4 QUALITY ASSURANCE

.1 Conform to AMCA Bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for [reuse] [and] [recycling] in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 GENERAL

.1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.2 Provide balanced variable sheaves for motors 10 kW and under and fixed sheave to 15 kW and over.

.3 Fans shall be capable of accommodating static pressure variations of ±10% with no objectionable operating characteristics.

2.2 CENTRIFUGAL FANS

.1 Fabricate with multi-blade wheels in heavy gauge steel housing reinforced for service encountered.

.2 Provide V-belt drives with fan and motor mounted on reinforced, rigid steel base with adjustable motor mount.

.3 Provide heavy duty, self-aligning, anti-friction bearings with external lubrication.

.4 Provide where indicated variable inlet vanes.

.5 Provide access door and drain connection to scroll.

.6 Except for packaged air units, belted vent sets and as otherwise noted, centrifugal fans over 430 mm diameter shall have die formed air foil blades welded to side and back plate.

2.3 ROOF MOUNTED FANS

.1 Provide V-belt drives with fan and motor mounted to main housing through neoprene anti-vibration pads.

.2 Heavy aluminum dome type housings shall be reinforced as necessary on sizes with 500 mm wheel and larger.

.3 Provide with multi-blade, rattle free, backdraft damper with felt lined blade edges, birdscreen, disconnect switch and curb caps.

2.4 BELTED VENT SETS

.1 Comply generally with requirements of centrifugal fans suitable for pressures to 1 kPa

.2 Provide with multi-blade rattle free backdraft damper with felt lined blades edges.

2.5 KITCHEN RANGE HOODS

.1 Resiliently mount multi-blade direct driven fan and motor. Motor shall be two-speed plug-in type with permanently lubricated bearings.

.2 Finish hood in white baked on enamel, with rocker type switches for light and two-speed fan. Provide washable type filter of aluminum mesh.

3. Execution

3.1 PERFORMANCE

.1 Fan performance based on site conditions.

.2 Refer to Fan Schedule.

3.2 INSTALLATION

.1 Where inlet or outlet is exposed, provide safety screen.

.2 Provide belt guards on belt driven fans.

.3 Supply and install sheaves as necessary for final air balancing.

.4 Set roof mounted fans on curbs 200 mm minimum above roof. Provide acoustic insulation on duct to below roof line and on fan inlet plenum, and drip pan for collecting condensation.

3.3 PRIMING

.1 Prime coat fan wheels and housing factory inside and outside. Prime coating on aluminum parts is not required.

.2 Provide two additional coats of paint on fans handling air downstream of humidifiers.

3.4 STARTING AND TESTING

.1 Start and test fans as specified in Section 23 08 13 and 23 08 23.

END OF SECTION

1. General

1.1 REFERENCE DOCUMENTS

.1 Sheet Metal and Air Conditioning National Contractors Association (SMACNA):

.1 SMACNA IAQ Guideline for Occupied Building Under Construction

1.2 LABELLING

.1 Label units with capacities as factory adjusted including minimum maximum range of volume regulators.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 00 13 – Mechanical General Requirements

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Submit shop drawings stamped and signed by a professional engineer registered or licensed in the Province of Alberta, Canada.

.2 Shop drawings to indicate the following information:

.1 Capacity.
.2 Pressure drop.
.3 Noise rating.
.4 Leakage.

.3 Include discharge and radiated sound power level schedules with shop drawings, for each of second through sixth octave bands and inlet pressures of 0.25 to 1 kPa.

.3 Closeout Submittals:

.1 Provide instructions for resetting constant volume regulators for incorporation into manuals specified in Section 20 01 06 – Mechanical Operation and Maintenance Manual.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for [reuse] [and] [recycling] in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 FABRICATION

.1 Fabricate casing from 1.0 mm galvanized steel for units 570 L/s and less, and 1.6 mm and over 570 L/s. Line casing with 12 mm thick minimum, neoprene or vinyl coated fibrous glass insulation and provide interior sound attenuator baffle. Casing leakage shall not exceed 2% design flow at rated internal pressure.

.2 Fabricate variable volume regulator sub-assembly of extruded aluminum and coated steel frame with extruded aluminum blades and stainless steel springs. Factory set regulator for specified air quantity, capable of maintaining flow + 5% regardless of inlet static pressure from minimum specified to 1.5 kPa.

.3 Reset volume with damper operator attached to assembly allowing flow range modulation from 100% specified to 0% full flow. Units with heating coils shall have minimum 50% full flow.

.4 Fabricate dual duct 3-way proportioning valve with operator proportioning hot and cold air. Leakage across either valve port shall not exceed 2% design flow. Valves shall fail with the hot normally open and cold normally closed.

.5 Provide water coils mounted integral with casings as indicated.

.6 Provide access doors integral with casing suitable for providing access to regulators, proportioning valves and coils.

.7 Operators and control devices shall be factory mounted within unit and control lines to brought to outside of unit.

3. Execution

3.1 INSTALLATION

.1 Arrange for suitable ceiling access to units. Provide access doors or locate above easily removable ceiling components.

.2 Install units individually from the structure. Do not support from adjacent ductwork.

3.2 PERFORMANCE

.1 Units shall be configuration and capacity as shown on drawings or indicated in the Schedules.

.2 Unit coils, where indicated, shall be 1-row minimum, with minimum capacity indicated with 90.5°C entering water, 74°C leaving water and 50% total air volume.

END OF SECTION

1. General

1.1 QUALITY ASSURANCE

.1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes and ASHRAE standards.

.2 Unit ratings shall be approved by ADC.

.3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Submit copies of manufacturer's product literature, specifications and datasheets.

.2 Indicate the following information:

.1 Capacity.
.2 Throw and terminal velocity.
.3 Noise criteria.
.4 Pressure drop.
.5 Neck velocity.

.2 Closeout Submittals:

.1 Submit maintenance materials in accordance with Section 20 01 06 – Mechanical Operation and Maintenance Manual.

.1 Include keys for volume control adjustment and air flow pattern adjustment.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for [reuse] [and] [recycling] in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 GENERAL

.1 Base air outlet application on space noise level of NC 35 maximum.

.2 Provide supply outlets with sponge rubber seal around the edge.

.3 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.4 Provide plaster frame for diffusers located in plaster surfaces.

.5 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

2.2 SUPPLY GRILLES

.1 Sidewall supply grilles shall have streamlined and individually adjustable blades, depth of which exceeds 20 mm maximum spacing. Provide spring tension or other device to set blades. Provide units with horizontal face, double deflection bar style grilles.

.2 Provide 32 mm margin frame with countersunk screw holes.

.3 Fabricate of steel with 1.0 mm minimum frames and 0.8 mm minimum blades, steel and aluminum with 1.0 mm minimum frame, or heavy aluminum extrusions.

.4 Provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face.

.5 In gymnasiums, front blades shall be front pivoted, welded in place or securely fastened to be immobile.

.6 Finish in factory baked enamel finish.

2.3 LOUVERED SUPPLY GRILLES

.1 Ceiling supply grilles shall have streamlined and individually adjustable curved blades to discharge air along face of grille. Units shall have two-way deflection.

.2 Provide 32 mm margin frame with countersunk screw holes.

.3 Fabricate of heavy aluminum extrusions.

.4 Provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face.

.5 Finish in factory clear lacquer finish.

2.4 RETURN AND EXHAUST GRILLES

.1 Sidewall and ceiling exhaust grilles shall have streamlined blades, depth of which exceeds 20 mm spacing. Provide spring tension or other device to set blades. Provide units with horizontal face.

.2 Provide 32 mm margin frame with countersunk screw holes.

.3 Fabricate of steel with 1.0 mm minimum frames and 0.8 mm minimum blades, steel and aluminum with 1.0 mm minimum frame, or heavy aluminum extrusions.

.4 Provide exhaust grilles, where not individually connected to exhaust fans, with integral, gang-operated opposed blade dampers with removable key operator, operable from face.

.5 In gymnasiums, blades shall be front pivoted, welded in place or securely fastened to be immobile.

.6 Finish in factory baked enamel finish.

2.7 GRID CORE RETURN AND EXHAUST GRILLE

.1 Fabricate fixed grilles of 12 x 12 x 12 mm louvres.

.2 Provide 32 mm margin frame with countersunk screw holes or lay-in frame for suspended grid ceilings].

.3 Fabricate of aluminum.

.4 Provide exhaust grilles, where not individually connected to exhaust fans, with integral, gang-operated opposed bladedampers with removable key operator, operable from face.

2.8 LINEAR RETURN OR EXHAUST GRILLES

.1 Linear return or exhaust grilles shall have streamlined blades with 0° deflection, 3 x 20 mm on 12 mm centers.

.2 Provide 32 mm margin frame with countersunk screw holes.

.3 Fabricate of steel with 1.0 mm minimum frames and 0.8 mm minimum blades, steel and aluminum with 1.0 mm minimum frame, or heavy aluminum extrusions.

.4 Provide exhaust grilles, where not individually connected to exhaust fans, with integral, gang-operated opposed blade dampers with removable key operator, operable from face.

.5 Provide mounting frame suitable for casting in concrete floor.

2.9 ROUND SUPPLY DIFFUSER

.1 Provide round, adjustable pattern, stamped or spun, multi-core type diffuser to discharge air in 360 deg pattern, with sectorized baffles where indicated or required.

.2 Project diffuser collar not more than 25 mm above ceiling face and connect to duct with duct ring.

.3 Fabricate of steel with baked enamel finish.

.4 Provide radial opposed blade damper and multi-louvred equalizing grid with damper adjustable from diffuser face.

2.10 RECTANGULAR SUPPLY DIFFUSER

.1 Provide rectangular, adjustable pattern, stamped, multi-core type diffuser to discharge air in 360° pattern with sectorizing baffles where indicated or required.

.2 Diffusers shall have surface mount or inverted T-bar type frame to suit location.

.3 Fabricate of steel with baked enamel off white finish.

.4 Provide combination splitter damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.11 PERFORATED FACE DIFFUSER

.1 Provide perforated face diffuser with fully adjustable pattern and removable face.

.2 Diffuser shall have surface mount or inverted T-bar type frame to suit location.

.3 Fabricate of steel with steel or aluminum frame and baked enamel off white finish.

.4 Provide combination splitter damper and multi-louvred equalizing grid with damper adjustable from diffuser face.

2.12 DOOR GRILLES

.1 Fabricate of V-shaped louvers of 1.0 mm steel, 25 mm deep on 12 mm centers.

.2 Provide 1.0 mm steel frame with auxiliary frame to give finished appearance on both sides of door.

.3 Factory finish in prime coating.

2.13 OUTSIDE LOUVERS

.1 Louvres 150 mm deep with blades on 45 deg slope with center baffle and return bend heavy channel frame, birdscreen with 12 mm square mesh for exhaust and 20 mm for intake.

.2 Fabricate of 1.6 mm galvanized steel or 3.0 mm extruded aluminum and provide welded assembly.

.3 Finish in factory baked enamel finish.

.4 Fabricate louvered penthouses with mitered corners and sheet roof reinforced with structural angles.

2.14 GOOSENECKS

.1 Fabricate goosenecks of minimum 1.2 mm galvanized steel.

.2 Mount on minimum 300 mm high curb base where size exceeds 230 x 230 mm.

3. Execution

3.1 INSTALLATION

.1 Positions indicated on drawings are approximate only. Check location of outlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement.

3.2 SIZING

.1 Size outside air openings as indicated on drawings.

.2 Size air outlets as indicated on drawings.

END OF SECTION

1. General

1.1 REFERENCE DOCUMENTS

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

.1 ASHRAE 52.2-2007 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

1.2 QUALITY ASSURANCE

.1 Filters shall be product of and supplied by one manufacturer.

.2 Filter media shall be UL listed, Class I or Class II, as approved by local authorities.

.3 Filter components assembled to form filter banks shall be products of same manufacturer.

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01.

.2 Size, media face area, NBS test efficiency, initial and final air resistance of substitute products shall be same as types specified.

1.4 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 00 13 – Mechanical General Requirements

.1 Submit copies of manufacturer's product literature, specifications and datasheets.

.2 Closeout Submittals:

.1 Submit operations and maintenance data for incorporation into manuals specified in Section 20 01 06 – Mechanical Operation and Maintenance Manual.

.1 Include list of manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 FRAMES

.1 Fabricate filter frames and supporting structures of galvanized steel or extruded aluminum with necessary gasketting between frames and walls. Provide holding frames 1.6 mm, "T" section construction.

.2 Provide standard size frames to provide interchangeability of filter media of other manufacturers.

2.2 PANEL FILTERS

.1 Media: 50 mm, or 100 mm thick fibrous glass blanket, factory sprayed with flameproof, non-drip, nonvolatile adhesive.

.2 Holding Frames: 1.2 mm minimum galvanized frame with expanded metal grid on leaving air side and steelrod grid on air entering side, hinged with pull and retaining handles.

3. Execution

3.1 INSTALLATION

.1 Construct and install filters to prevent passage of unfiltered air. Provide felt, rubber or neoprene gaskets.

.2 Do not operate fan system connected to filter banks until filters [temporary or permanent] are in place. Provide new filters at take-over by the Minister. Replace filters used during construction.

.3 Provide filter banks in arrangement shown with removal and access indicated.

3.2 PERFORMANCE

.1 Refer to Air Filter Schedule.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Membrane roofing penetrations: Division 07.
.2 Mechanical General Requirements: Section 23 00 13.
.3 Ductwork and Breeching Insulation: Section 23 07 00.

1.2 REFERENCE DOCUMENTS

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

.1 ASTM C401-91 (2005) Standard Classification of Alumina and Alumina-Silicate Castable Refractories

.2 Canadian Standards Association (CSA):

.1 CAN/CSA B149.1-05 Natural Gas and Propane Installation Code

.2 CAN/CSA B149.2-05 Propane Storage and Handling Code

.3 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S604-M91 Standard for Factory Built, Type A Chimneys

.2 CAN/ULC-S605-M91 Standard for Gas Vents

.3 CAN/ULC-S609-M89 Standard for Low Temperature Vents, Type L

.4 CAN/ULC-S629-M87 Standard for 650°C Factory Built Chimneys

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 DEFINITIONS

.1 Vent: an enclosed passageway for conveying flue gases from the appliances to outdoors.

.2 Breeching: the portion of vent from the appliance to the chimney.

.3 Chimney: a primarily vertical portion of vent.

.4 Draft: the flow of air or combustion products or both, through an appliance and its venting system.

.5 Mechanical Draft: a draft produced by a mechanical device such as a fan, blower, or aspirator which may supplement natural draft.

.6 Forced Draft: a mechanical draft produced by a device upstream of the combustion zone of an appliance.

.7 Induced Draft: a mechanical draft produced by a device downstream from the combustion zone of an appliance.

.8 Natural Draft: a draft other than mechanical draft.

1.5 QUALITY ASSURANCE

.1 Vents and accessories forming part of the venting system shall be ULC labelled.

1.6 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Indicate the following information:
.1 Methods of sealing sections.
.2 Methods of expansion.
.3 Details of thimbles.
.4 Bases/Foundations.
.5 Supports.
.6 Guy details.
.7 Rain caps.

.2 Closeout Submittals:

.1 Submit operations and maintenance data for incorporation into manuals specified in Section 20 01 06 – Mechanical Operation and Maintenance Manual.

1.7 COORDINATION

.1 Coordinate counterflashing work with flashing work detailed on membrane roofing detail drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 VENTS

.1 Type B Vent: to CAN/ULC-S605.

.1 Application: gas fired appliances certified with draft hoods or divertors.

.2 Service Temperature: maximum flue gas temperature of 243°C.

.2 Type BH Vent: to CAN/ULC-S636, AL29-4C.

.1 Application: gas fired appliances certified for use with Category IV appliances.

.2 Service Temperature: maximum flue gas temperature of 110°C.

2.4 ACCESSORIES

.1 Cleanouts: bolted, gasketted type, full size of breeching area.

.2 Appurtenances: raincap, thimbles, support brackets and guys, flashing and counter flashings, fly ash screen, and other materials required to complete the assembly.

3. Execution

3.1 VENT INSTALLATION

.1 Install vents, complete with accessories and appurtances, in accordance with CAN/CGA B149.1 and Alberta amendments, Alberta Building Code, manufacturer's instructions and as follows:

.1 Type B: to CAN/ULC-S605.

.2 Type BH: to CAN/ULC-S636, AL29-4C.

.2 Do not penetrate flue gas chamber of vent with screws or mechanical fasteners.

.3 Install breeching with positive slope upward from appliance.

.4 Suspend breeching using trapeze hangers at 1500 mm centers.

.5 Support chimney at bottom, roof and intermediate levels.

.6 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney.

.7 Install raincap on chimney outlet.

.8 Install counterflashing where chimneys pass through roof.

.9 Provide for expansion and contraction of chimney and breeching.

3.2 VENT SCHEDULE

Tag No.	Appliance	Appliance Input Rating (kW)	Flue Temp (°C)	Draft Type	Fuel Type	Vent Type	Breeching Type
B-1/2		293	110	Direct	NG	BH	N/A
DHW-1/2		35.2	110	Direct	NG	BH	N/A

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 General Mechanical Starting and Testing Requirements — Section 23 08 13

.2 Mechanical Equipment Starting and Testing: — Section 23 08 23

1.2 REFERENCE DOCUMENTS

.1 National Research Council of Canada (NRC):

.1 National Energy Code for Buildings

.2 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code Section IV – Heating Boilers

.3 Canadian Standards Association (CSA)

.1 CSA B149.1 — Natural Gas and Propane Installation Code

.2 CSA B51 — Boiler, Pressure Vessel and Pressure Piping Code

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 01 33 23 – Shop Drawings, Product Data and Samples.

.1 Submit copies of manufacturer's product literature, specifications and datasheets.

.2 Submit factory quality control and performance test reports.

.3 Submit field installation and testing reports.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 23– Shop Drawings, Product Data and Samples.

.1 Indicate the following information:

.1 General arrangement showing terminal points, instrumentation test connections.

.2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.3 Foundations with loadings, anchor bolt arrangements.
.4 Piping hook-ups.
.5 Equipment electrical drawings.
.6 Burners and controls.
.7 All miscellaneous equipment.
.8 Flame safety control system.
.9 Breeching and stack configuration.

.2 Indicate the following engineering information:

.1 Boiler efficiency at 25%, 50%, 75% and 100% of design capacity.
.2 Radiant heat loss at 100% design capacity.

.3 Closeout Submittals:

.1 Submit operations and maintenance data for incorporation into manuals specified in Section 01 78 23 – Operation and Maintenance Data and Manuals.

1.4 QUALITY ASSURANCE

.1 Comply with Provincial Regulations and have CSA and CGA approval.

.2 Units shall be approved by Underwriter's Laboratories and bear CSA label.

.3 Boilers shall be constructed in accordance with ASME Section IV. Units shall bear ASME stamp and be registered.

.4 Comply with NFPA 70 for electrical components and installation.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

1.6 WARRANTY

.1 Pressure Vessel / Heat Exchanger: Warrant the pressure vessel and heat exchanger against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship for a period of ten (10) years from initial start-up.

.2 Warranty for other boiler components shall be one (1) year from Substantial Performance by the Minister.

2. Products

2.1 TYPE

.1 Provide high efficiency condensing hot water boiler suitable for forced draft with insulated jacket, heat exchanger, natural gas burning system, controls and boiler trim.

.2 Must have a minimum steady state efficiency of 91% verified by ANSI Z 21.13 based on a return water temperature of 43°C.

2.2 COMPONENTS

.1 Combustion Chamber: Minimum 16 gauge stainless steel with access for service and inspection, integral combustion air blower and vent connection.

.2 Pressure Vessel: Carbon steel construction, insulated with minimum 50 mm insulation, maximum working pressure of 1100 kPa and factory fitted relief valve at 345 kPa.

.3 Heat Exchanger: 316 stainless steel fire tube and tube sheets, one pass, ASME stamped for a maximum working pressure of 1100 kPa.

.4 Burner: Premix full modulation with minimum 5:1 turndown ratio at continuous CO_2, capable of 99% efficiency without exceeding NO_x above 20 ppm.

.5 Ignition Components: Intermittent spark ignition and UV sensing.

.6 Safety Controls: Pilot flame proven before main gas valve opens, stop gas flow on ignition failure, digital flame safeguard with pre-purge cycle.

.7 Gas Trim: Manual gas valves, motorized main gas valve, pilot gas pressure regulator, automatic pilot gas valve and manual gas pilot valve, all factory mounted and FM labeled.

.8 Safety Devices: High/low gas pressure switches, air flow proving switch, blocked flue detection switch, safety valve, low flow/low level switch and high temperature limit, all factory mounted.

.9 Operating Temperature Controls: Digital P.I.D. controller, adjustable from 4°C to 115°C with provision for outdoor air temperature reset, factory mounted water inlet and discharge temperature sensors. Control panel shall have a screen display for boiler set-up, temperatures, status and boiler diagnostic.

.10 BMS Interface: Provide BACnet interface with the following objects:

- .1 Boiler enable (write)
- .2 Supply water temperature setpoint (read/write/override)
- .3 Supply water temperature (read)
- .4 Gas valve position (read)
- .5 Boiler status (read) i.e. On/Off
- .6 Local manual override (read) i.e. Auto/Manual
- .7 Fault condition (read)

.11 Jacket: 18 gauge brushed stainless steel or equivalent.

.12 Accessories: Condensate treatment kit; one per boiler.

3. Execution

3.1 PERFORMANCE

.1 Refer to schedule on mechanical drawings.

3.2 INSTALLATION

.1 Install in accordance with manufacturer's written recommendations.

.2 Integrate boiler controls and alarms with BMS.

.3 Provide single wall Category IV vent system for each boiler separately. Double wall where exposed on roof.

.4 Install boilers on a 100 mm concrete housekeeping pad, level and plumb.

.5 Install furnished loose boiler components. Provide required service and maintenance clearances as recommended by the manufacturer.

.6 Provide piping, electrical and control wiring connections to boiler control panel and all accessories.

.7 Pipe relief valves and air vents on hot water boilers to floor drain. Provide separate discharge from each valve.

.8 Pipe condensate from boilers and flue to condensate treatment system and drain.

.9 Natural gas fired installation to CAN1-B149.1.

.10 Ensure manufacturer's representative:

- .1 certifies installation, completes and submits signed-off check list prior to start-up,
- .2 witnesses boil-out procedures to manufacturer's requirements,
- .3 provides start-up and burner adjustment services,
- .4 carries out on-site performance verification tests,
- .5 provides maintenance and operating instructions, and
- .6 confirms boiler flue temperature and requirements with Mechanical Trade prior to tender submission.

3.3 STARTING AND TESTING

.1 Start and test boilers as specified in Section 23 08 13 and 23 08 23.

END OF SECTION

1. General

1.1 QUALITY ASSURANCE

.1 Design and construction shall meet requirements of ASME code for unfired pressure vessels and provincial codes.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Submit printed product literature, specifications and datasheet for heat exchangers.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Shop drawings shall include dimensions, locations and size of tapping, and performance data to compare with specification.

.3 Closeout Submittals:

.1 Submit operations and maintenance data for incorporation into manuals specified in Section 20 01 06 – Mechanical Operation and Maintenance Manual.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 PLATE AND FRAME HEAT EXCHANGER

.1 Frames: Carbon steel with baked epoxy enamel paint, stainless steel side bolts, and shroud.

.2 Plates: Stainless steel Type 316 Stainless steel

.3 Gaskets: Nitrile rubber

.4 Performance: to be AHRI certified

2.2 WATER TO WATER HEAT EXCHANGE TRIM

.1 Provide for temperature regulator sensor at heated water outlet.

.2 Provide ASME rated pressure and temperature relief valve on heated water discharge.

.3 Provide thermometers and pressure gauge tappings in water inlets and outlets.

.4 Provide ASME rated pressure relief valve on water inlet on downstream side of control valve.

.5 Provide valved drain piped to floor drain.

3. Execution

3.1 INSTALLATION

.1 Ensure installation permits removal of plates without disturbing installed equipment or piping.

.2 Refer to drawings for details of installation and piping connections.

END OF SECTION

1. General

1.1 SCOPE

.1 Custom designed and built Air Handling Units (AHU) to meet the specific physical and performance criteria defined in this section, related sections and in the contract documents.

.2 Factory installed fabrication with components defined in the Contract Documents, including supplementary items necessary for installation.

.3 Ensure that all internal components are accessible for maintenance and/or replacement purposes.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Refer to and comply with the following sections:

.1	Product Delivery Requirements	Section 01 65 00
.2	Systems Demonstration and Owner's Instruction	Section 01 79 00
.3	Shop Drawings, Product Data, and Samples	Section 01 33 23
.4	General Mechanical Requirements	Section 20 00 13
.5	Vibration Isolation	Section 20 05 48
.6	Pipe and Pipe Fittings	Section 20 20 10
.7	Piping and Equipment Insulation	Section 20 20 30
.8	Ductwork and Breeching Insulation	Section 23 07 00
.9	Equipment Testing and Startup	Section 23 08 23
.10	Balancing and Adjusting of Mechanical Equipment and Systems	Section 23 08 83
.11	Coils	Section 23 82 10
.12	Steam Grid Humidifier	Section 23 84 14
.13	Variable Frequency Drives	Section 26 29 23

.2	Controls	Section 23 09 Series
.3	Electrical	Division 26

1.3 REFERENCE STANDARDS

.1 ANSI/AMCA 210 – ANSI/ASHRAE 51 Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

.2 AHRI 410 – Forced Circulation Air Cooling and Air Heating Coils

.3 ANSI/AHRI – Central Station Air Handling Units

.4 ANSI/AHRI 610 – Performance Rating of Central System Humidifiers

.5 ANSI/AHRI 640 – Performance Rating of Commercial and Industrial Humidifiers

.6 ANSI/AHRI 1060 – Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment

.7 CSA or ETL Certification and labeling

.8 NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilation Systems

.9 SMACNA – HVAC Duct Construction Standards – Metal and Flexible

.10 ANSI/ASHRAE/ESNA Standard 90.1 – Energy Standard for Buildings Except Low Rise and Residential Buildings

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store, protect and handle products as defined in Section 01 65 00, Product Delivery Requirements.

.2 Prior to shipment, comply with the following procedures to ensure equipment delivered to site is clean and protected.

.1 Thoroughly clean interior and exterior of the unit and/or split sections.

.2 Vacuum interior of unit to remove all dust, metal shavings and debris.

.3 Wipe down all surfaces with isopropyl alcohol, and remove excess caulking.

.4 Clean and repaint scratched surfaces, interior and exterior.

.5 Place a 500 g “Cargo-Drypak” desiccant by Dessicaire Inc. onto a 304 stainless steel tray into each section.

.6 Protect unit and materials from rain and other sources of moisture during shipping and on-site storage with 0.254 (10 mil) clear fire retardant polyethylene shrink wrap.

.7 Identify each section with permanent marker to indicate project, work order number and section identification for staging and installation.

.3 As a minimum, ship product in factory fabricated protective containers with factory installed structural base and lifting lugs.

.4 Store components in a clean, dry space until site construction is ready for installation. Protect from weather . Handle with care to protect from damage to components, enclosure and finish.

1.5 QUALITY ASSURANCE

.1 Supply Air Handling Units designed and manufactured specifically to the requirements of this project.

.2 Comply with overall dimensions, and configuration defined in the Contract Documents.

.3 Construct Air Handling Units by a manufacturer who maintains a local parts and service agency.

.4 Electrical installation shall comply with the requirements of Division 26, and the Canadian Electrical Code.

.5 Air flow rates, external static pressures, water flow rates, coil face velocities, filter face velocities, water and air side pressure drops shall be the same or better than specified, for equivalent selections.

.6 Fans shall be AMCA certified.

.7 Coils shall be ARI certified.

.8 Provide all motors with thermal overload protection.

.9 Construction shall comply with the Alberta Building Code.

.10 Unit shall be listed by CSA or ETL and have the listing agency labels affixed to the unit.

.11 Manufacturer's personnel or representative shall participate at the equipment start-up by the Contractor. A complete manufacturer's check list of field start-up tests must be submitted with operations and maintenance instructions and shall be signed by start-up technician and mechanical trade, field supervisor as certified satisfactory for operation.

.12 All components, paints, and lining shall have a flame spread rating of not over 25 with no evidence of continued progressive combustion and a smoke developed rating no higher than 50 as tested according to CAN/ULC – S102.2 Standard

Method of Test for Surface Burning Characteristics of Building Materials and assemblies.

.13 Supply replacement pulleys and sheaves for fans as required to properly balance the systems to design flows at actual job site static pressure conditions. Obtain requirements from balancing agency (Refer to Section 23 08 83, Balancing and Adjusting of Mechanical Equipment and Systems.)

.14 Seal all unit casing penetrations made on site such as for piping, conduit, hanger rods, etc. to the satisfaction of the Air Handling unit manufacturer. Sealing method and components shall be suitable to withstand 1.5 times the working pressure of the unit.

.15 Use the following as selection criteria and supply as specified:

.1 air flow rate
.2 external static pressure
.3 water flow rate

.16 The following are to be equalled or lowered:

.1 coil face velocities
.2 filter face velocities
.3 sound power levels
.4 outlet velocities
.5 water pressure drops
.6 water flows
.7 internal static pressure
.8 fan motor power

1.6 FACTORY TESTING

.1 All Air Handling Units shall have the following tests completed at the manufacturer's plant prior to authorization for shipment to the site.

.2 All Air Handling Units shall be factory Airflow tested to ensure it meets the specified airflow and external static pressure requirements. Tests shall be carried out in accordance with ASHRAE 51 / AMCA 210 Laboratory Methods of Testing Fans for Certified aerodynamic Performance rating. Tests shall be with all filters in location, as specified. Manufacturing company shall certify test results and forward to the consultant. Test set-up shall be as per AMCA 210 Figure 7. Outlet duct setup – Pitot traverse in outlet duct.

.3 Measure motor amperage and confirm on a fan curve that the unit is capable of delivering the specified air volume and static pressure losses with dirty filters.

.4 All Air Handling Units shall be factory leak tested to ensure that the unit meets a SMACNA Seal Class "A". The leakage test shall be carried out at 150% of the total operating supply fan static pressure and the total sum of leakage rates for all sections shall not exceed 1% of the unit rated air flow. Tests shall be carried out in accordance SMACNA HVAC Air Duct Leakage Test Manual. Tests shall be carried out with unit completely assembled and with duct connection locations sealed with temporary metal covers. Units shall be tested under positive for sections that are positive under normal operating conditions and negative pressure for sections that are negative under normal operating conditions. Positive and negative sections will be separated by a temporary blanking plate. The total sum of leakage rate is the summation of the leakage from the positive sections plus the leakage rate from the negative sections. Manufacturing company shall certify test results and forward to the consultant within 24 hours of the test. **[**The leakage test shall be witnessed by the Minister's representative, Consultant and manufacturer's representative**.]**

.5 In the event of a unit failing to meet the specified requirements, take corrective action to ensure that the units meet the specified requirements. Once corrective action has been taken, all tests described above shall be redone. The Minister's representative shall witness the retesting. The manufacturing company shall include all travel costs for the Minister's representative to return to the plant for the retest. The unit will not be authorized for shipment to site until such time as all testing listed above is proven to meet the specified requirements.

1.7 FIELD TESTING

.1 All Air Handling Units, shipped in sections, shall have the following tests completed on site prior to duct connection to the units. The Minister's representative and the representative of the manufacturer shall witness all testing. A minimum 5 working days' notice will be required prior to each site visit.

.2 All Air Handling Units, shipped in sections, shall be field leak tested by the Contractor to ensure that the unit meets a SMACNA Seal Class "A". The leakage test shall be carried out at 150% of the total operating supply fan static pressure and the total sum of leakage rates for all sections shall not exceed 1% of the unit rated air flow. Tests shall be carried out in accordance SMACNA HVAC Air Duct Leakage Test Manual. Tests shall be carried out with unit completely assembled and with duct connection locations sealed with temporary metal covers. Units shall be tested under positive for sections that are positive under normal operating conditions and negative pressure for sections that are negative under normal

operating conditions. Positive and negative sections will be separated by a temporary blanking plate. The total sum of leakage rate is the summation of the leakage from the positive sections plus the leakage rate from the negative sections. Manufacturing company shall certify test results and forward to the consultant within 24 hours of the test. The leakage test shall be witnessed by the Minister's representative, Consultant and manufacturer's representative.

1.8 ACOUSTIC TESTING AND PERFORMANCE CRITERIA

.1 Conduct sound tests at the unit manufacturer's test facility under AMCA 320, Laboratory Methods of Sound Testing of Fans Using Sound Intensity.

.2 Conduct sound power level test for each unit under scheduled operating pressures and air delivery. Measure sound power level at the AHU supply outlet, return inlet, exhaust outlet and outside air inlet, as well as casing radiated sound.

.3 The Air Handling Unit sound power levels must not exceed the following criteria for sound power levels in decibels (dB).

Location	Average	63 HZ	125 HZ	250 HZ	500 HZ	1K HZ	2K HZ	4K HZ	8K HZ
Units from 10,000-15,000 cfm (Where specifically applicable)									
Inlet	84	83	81	81	79	78	77	75	73
Outlet	91	91	84	92	88	86	80	76	72
Casing	71	85	77	77	66	60	54	51	48
Units from 15,001-25,000 cfm (Where specifically applicable)									
Inlet	85	84	86	80	80	81	78	74	67
Outlet	93	94	90	92	92	89	82	79	74
Casing	72	84	81	78	68	62	56	53	48

1.9 SUBMITTALS

.1 Shop drawings to include all general information defined by Section 01 33 23, Shop Drawings, Product Data and Samples. Omission of any of the requirements identified in the above referenced section(s) and as specified herein will cause shop drawings to be immediately returned without review.

.2 Submit shop drawing which shall include the following minimum information.

.1 Overall outside dimensional drawing including service clearances.

.2 Dimensional and construction details. Submit unit construction drawings for the following components:

.1 Side panels, including connection details

.2 Top panel, including connection details
.3 Floor, including connection details
.4 Doors, hinges, latch, viewing port
.5 Fan, motor and drive, mounting and isolation
.6 Coil section
.7 Pipe and conduit penetration through casing or floor
.8 Drain pan
.9 Damper, linkage and drive construction and mounting
.10 Air blender

.3 Material and gauge of all construction components.

.4 Unit splits, point loads, and recommended methods of unit installation and lifting.

.5 AMCA certified fan performance curves for the entire bank of fans in a fan array system, as well as fan performance curves for a single fan unit.

.6 Electrical voltages, phase and power requirements.

.7 Make, model, selection criteria and pressure drop curves of air blenders.

.8 Selection criteria for coils, indicating air side and fluid side capacities, in and out conditions, velocities, pressure drops and fouling factors. Submit a drawing showing headers, circuiting, arrangement, connection sizes, and materials of construction.

.9 Air filters media, efficiency rating, velocity, pressure drop charts and capacities. Indicate mounting method and arrangement.

.10 Vibration isolation on fans.

.11 Humidifier shop drawings and capacities. Refer to Section 23 84 14.

.12 Table indicating pressure drops through all components of the unit, including backdraft damper and dispersion screen on fan discharge as applicable.

.13 Damper Shop Drawings.

.14 Detailed composite wiring diagrams showing factory installed wiring, including wiring of the control components.

.15 Sound power levels generated by the air handling unit and casing radiated noise levels outside the fan section as outlined in Article 1.9, Acoustic Testing and Performance Criteria.

.16 Neoprene lining specification including erosion resistance data.

.17 Variable Frequency Drive assemblies and motor shop drawings and data. Refer to Section 26 29 23, Variable Frequency Drives.

.18 Manufacturer performance information for humidifiers.

.19 Manufacturer performance information for heat recovery wheel.

.3 Submit all factory test data outlined in this section.

.4 Submit detailed test data on internal component pressure drops, fan pressure allowance for dirty filters and available external static pressure at unit discharge and unit air inlet.

2. Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Haakon, Engineered Air, Trane Custom, Scott Springfield, Silent Air, Hunt Air.

2.2 TYPE

.1 Provide factory assembled air handling unit in configuration as indicated on the drawings. Unit shall include all specified components installed and tested at the factory. Field fabrication of units and their components will not be accepted. All units shall be completely assembled and inspected. Components

.2 Air Handling Units may consist of but not be limited to the following components:

.1 AHU-1 Classrooms:

.1 Supply fan
.2 Return fan
.3 Heat recovery wheel
.4 Reheat coil
.5 Cooling coil (for future installation)
.6 Summer prefilter
.7 Winter prefilter frame
.8 Final filter

.9 Steam grid humidifier (for future installation)
.10 Motorized outdoor air damper
.11 Motorized mixed air damper
.12 Motorized exhaust air damper
.13 Outdoor air flow station
.14 Access sections
.15 Discharge air damper

.2 AHU-2 Gym:

.1 Supply fan
.2 Return fan
.3 Reheat coil
.4 Cooling coil (for future installation)
.5 Summer prefilter
.6 Winter prefilter frame
.7 Final filter
.8 Steam grid humidifier (for future installation)
.9 Motorized outdoor air section
.10 Motorized mixed air section
.11 Return air carbon monoxide sensor
.12 Access sections
.13 Discharge air damper

2.3 CABINET

.1 Walls and Ceilings:

.1 Double wall panel construction with at least two breaks at each joint. Wall and ceiling joints to be broken inward seal all panel joints. Casing depth to match the specified insulation thickness. Inside surfaces shall be clean and flush, free of exposed flanges.

.2 Stiffeners of angle steel shall be supplied as required to maintain casing deflection criteria of 1/200 at 1.5 times the working pressure. If panels cannot meet this deflection, add addition internal reinforcing.

.3 Minimum 1.6 mm G90 galvanized steel exterior panels with air dried enamel finish. Colour by Architect.

.4 Insulate all exterior walls and roof with 50 mm thick rigid fibrous glass acoustic insulation, minimum 68 kg/m³ density.

.5 Minimum 0.9 mm solid G90 galvanized steel inner panels.

.6 Provide an airtight seal barrier between exterior panels and frame.

.2 Base and Floor:

.1 Construct a structural steel base, complete with a minimum 150 mm deep; epoxy coated perimeter C-channel iron frame and intermediate structural channels at 300mm on centres.

.2 Fabricate base using electric welding procedures on structural components to AWS D1.1. Galvanize assembly to G120 galvanized steel.

.3 Construct floor assembly with minimum 3.25 mm tread plate. Insulate underside with polyurethane closed cell foam or rigid fibrous glass to provide R-12 insulating performance or greater. Secure floor to structural members below with no penetrations through the floor skin. All seams shall be continuously welded.

.4 Provide a 38 mm perimeter collar around the entire unit, and around each floor opening to ensure the unit is internally watertight. The entire base shall act as a drain pan and hold up to 38 mm of water.

.5 Enclose the insulation on the bottom of the floor plate with 1.0 mm galvanized sheet metal.

.6 Thermally isolate all points of contact between the floor, vapour barrier, and structure.

2.4 ACCESS DOORS

.1 Provide insulated hinged man sized access doors.

.1 Construct access doors to be the same as casing each complete with 250 mm x 250 mm or 300 mm diameter round double glazed tempered glass hermetically sealed viewing window.

.2 Provide minimum two (2) Ventlock latches per door, operable from both sides.

.3 Hinges shall be continuous stainless steel piano hinges.

.4 Doors to be sealed with automotive type 13 mm closed cell hollow round black gasket with a metal encapsulated reinforced backing that mechanically fastens to the door frame (foam gaskets are not acceptable).

.5 Door sizes to be minimum 600 mm x 1800 mm or larger as required to facilitate component removal.

.6 All access doors must swing against the air pressure.

.2 Provide access doors for the following sections:

.1 Fan Section
.2 Humidifier Section
.3 Preheat Coil Section
.4 Reheat Coil Section
.5 Cooling Coil Section
.6 Final Filter Section
.7 Summer Prefilter Section
.8 Winter Prefilter Section
.9 Mixing Section
.10 Access Sections
.11 Heat Wheel Section

2.5 FINISH

.1 All unit panels, base structure and liners shall be finished with a suitable coating that will meet ASTM B-117 requirements for 1200 h salt spray resistance.

2.6 MARINE LIGHTS AND DUPLEX OUTLETS AND WIRING

.1 Provide marine type lights in all sections having an access door on all units. Lights shall be factory installed and wired to a single pilot lighted switch located outside the supply fan access door. Marine lights shall have protective metal cage and glass globes.

.2 Provide duplex receptacle beside the switch adjacent to the fan access door.

.3 Wire power connection in metal conduit to all lights and duplex outlet to one location for connection by Division 16. All wiring to be copper, minimum size #12 RW90.

.4 Light and duplex outlet power to be fed from a separate source so that the lights can operate when the unit is off.

.5 For split units, the equipment vendor shall retain and coordinate electrical contractor to provide labour for wiring between sections.

2.7 DRAIN PANS

.1 On units without stacked coils, provide a single fabricated 1.6 mm Type 304 stainless steel recessed drain pan under cooling coils and humidifier in compliance with ASHRAE Standard 62. On units with stacked coils, provide a separate stainless steel drain pan under each stacked coil with a 25mm stainless steel interconnecting drain line. On all units, provide a secondary stainless steel drain pan extending under the entire access section downstream of the cooling coil, and the humidifier section. Provide a drain pan to drain the fresh air intake or mixing plenum. Double slope all drain pans to the drain connection and pipe all drains to exterior side of unit.

.2 Insulate the underside of the entire recessed drain pan with two part sprayed on polyurethane closed cell foam or rigid fibrous glass insulation to match the bottom of the C-channel base.

2.8 CENTRIFUGAL FANS

.1 Acceptable Fan Manufacturers:

Trane, Chicago, Northern, Loren Cook, Twin City, Barry Blower, CES Group.

.2 Fans to be double width, backward inclined airfoil, centrifugal type. Fan to be both statically and dynamically balanced.

.3 Provide a complete airflow measuring station in each fan inlet cone, with static pressure taps and total pressure tubes. The entire air flow monitoring probe must be located outside the inlet throat as to not obstruct the air flow. Flow measuring station to provide an analog to digital CFM readout using a 4-20 mA output control signal for BAS interface.

.4 Fan selection shall be based on actual air conditions at the geographical location of the unit. Select fans in the midrange of their performance capabilities such that increasing the RPM of the fan to achieve an additional 15% air flow delivery through the specified unit will not change the fan Class or require an increase in motor horsepower.

.5 Fan shafts are to be solid, ground and polished, carbon steel, SAE 1045 material, machined to close tolerances, keyed to the fan wheel. Coat the fan shaft with rust inhibitor after machining. Hollow shafts will not be acceptable.

.6 Fan bearings shall be in self aligning pillow block, grease lubricated, and extra heavy duty spherical roller type, selected for an L_{10} life of 200,000 hours at design operating conditions. Bearings are to be mounted on the fan structural bracing.

Provide extended lubrication lines to permit lubrication for both bearings to be performed at the access door side.

.7 Provide variable sheaves for motors 11 kW and under and fixed sheaves for motors 15 kW and over. Exchange sheaves as necessary during balancing.

.8 Mechanical trade to supply variable frequency drives and wiring interface. Comply with Section 26 29 23, Variable Frequency Drives.

.9 Entire fan assembly including fan scroll, wheel and motor to be integrally mounted on an spring vibration isolation base and to be separated from unit casing with flexible connections and spring isolators. Concrete may be poured into steel base on site but fan and base must be factory mounted.

.10 Belt guards shall have sides of galvanized steel and faces of expanded metal. Provide a face on both the outside and the inside of the drive assembly. Provide openings in the faces for fan and motor tachometer readings. Belt guard shall be sized to allow either sheave to be increased by two sizes. Belt guards shall be OSHA approved fully enclosed metal bolt guard.

.11 Fan drives shall be of a multiple V-belt banded configuration. The drive system combination shall be of one manufacturer and shall be suitable for a centrifugal fan application and shall be rated by the drive manufacturer for the motor horsepowers and fan and motor RPMs provided by the Air Handling Unit manufacturer. Selection of the drive system shall be made by a synchronous drive system manufacturer regularly engaged in the manufacturer of these drive components. The internally mounted motors shall be provided on a slide rail base to allow proper adjustment of belt tension.

2.9 MOTORS

.1 Motors shall be premium efficiency type, suitable for VFD interface. All motors to be by the same manufacturer.

.2 Factory mount motors and wire to an external disconnect switch,. Disconnect switch by air handling unit manufacturer. Run wiring in EMT liquid-tight conduit/raceways.

2.10 VFD

.1 Provide, install and wire requied VFDs packaged with unit, refer to Section 26 29 23 Variable Speed Drives for requirements.

2.11 VIBRATION ISOLATION

.1 Each fan and motor are to mounted on an all welded, structural steel, prime coated, internal isolation base, completed with open spring isolators with an internal isolation efficiency of at least 98% from the building structure. Isolators shall be free standing with sound deadening pads and levelling bolts. Spring diameter to compressed operating height ratio shall be 1 to 1. Spring deflection shall be 50 mm. The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible fabric connection.

.2 Manufacturer to provide independent data for internal isolation bases. If 98% efficiency cannot be met, cost of inertia bases shall be the responsibility of supplier.

2.12 FILTERS

.1 Filters containing urea formaldehyde or fiberglass are not acceptable.

.2 50 mm, pleated summer prefilter, average efficiency MERV 8 on ASHRAE Test Standard 52.2-2007, Addendum B, Appendix J. Comply with Section 23 42 00, Particulate Air Filters, for detailed filter specifications.

.3 Frame only for winter prefilter, same as summer filter frame.

.4 100 mm, deep pleated final filter, average efficiency MERV 13 on ASHRAE Test Standard 52.2-2007, Addendum B, and Appendix J. Comply with Section 23 42 00B, Particulate Air Filters.

.5 Galvanized mounting racks to suit specified filter type.

.6 Limit filter velocity based on face area to less than 2.5 m/s.

.7 Provide one Dwyer 2000 magnehelic filter gauge for each bank of filters, including for each position of prefilter. Flush mount gauge on the exterior of the unit.

2.13 COIL SECTIONS

.1 Enclose coils in coil sections with headers and U-bends fully contained within the casing. Comply with Section 23 82 10, Coils.

.2 Extend coil supply and return header connections, drain and vent fittings through casing. Coil connections shall be of same material as the coil headers.

.3 Coil racks to be galvanized steel angle, providing completely independent support for each coil. Each coil is to be separately removable without disturbing the other coils. Provide removable coil access panels in the unit casing.

.4 Construct cooling coil racks using 304 stainless steel. Section 2.8 on drain pans. Maximum cooling coil face velocity to 2.5 m/s.

.5 Provide adequate plenum space downstream of the cooling coil to contain all moisture from the cooling coil before the air stream impinges onto the next component.

.6 Maximum heating coil face velocity to 2.5 m/s.

2.14 HUMIDIFIERS

.1 Provide for future installed steam grid humidifier.

2.15 MIXING SECTION

.1 Configure to ensure complete mix of air. Arrange dampers to direct the air flow from one set of blades into the other. Set return dampers to direct air at minimum outdoor air damper when fully open.

.2 Utilize damper sections which extend across unit width plane with maximum width not exceeding 1200 mm per section.

2.16 DAMPERS

.1 Outside air dampers shall be low leakage type dampers with hollow blades filled with extruded polyurethane insulation; Tamco 9000 or equal. Outside air dampers shall be insulated and "R" value of the total damper as a unit of not less than R 0.35 °C m^2/W.

.2 Return air dampers shall be non-insulated; Tamco 1000 or equal.

.3 Damper blades shall be minimum 2.75 mm extruded aluminum. Blades shall be of air foil design, 150 mm wide, maximum blade length 1200 mm.

.4 Damper seals shall be designed for minimum air leakage by means of overlapping seals.

.5 Frames shall be minimum 2.75 mm extruded aluminum channel with grooved inserts for seal.

.6 Install blade linkage hardware in frame out of air stream.

.7 Arrange linkage and provide an adequate number of damper operators to ensure that the interconnected damper sections operate in unison without binding.

.8 The outdoor, return and exhaust dampers shall be integral part of the Air Handling Units and shall be factory supplied and installed.

.9 Select outdoor and exhaust dampers at 5 M/s face velocity. Select return air damper for pressure drop similar to exhaust damper, ductwork and louvre.

.10 Controls contractor shall supply and field install damper operators. Extend drive and provide mounting bracket to place outdoor air actuators outside air stream. Check unit and room height to ensure adequate space if extended through top of cabinet.

2.17 DIRECT EXPANSION COOLING

.1 Provide for future installed DX cooling coil.

2.18 ENTHALPY HEAT RECOVERY WHEEL

.1 Provide an enthalpy heat recovery wheel sized per the ventilation requirement of the unit. Construct the module with internal bypass dampers to relieve the pressure drop across the wheel when the wheel is not operating.

.2 The enthalpy heat recovery wheel shall be ARI 1060 certified. The air-handling unit nameplate shall bear the ARI 1060 certification label. The energy recovery cassette shall be an Underwriters Laboratories (UL) Recognized Component certified for mechanical, electrical and fire safety in accordance with UL Standard 1812. The calculated total net effectiveness of the recovery device shall be not less than 70% when the specified ventilation flow rate equals the exhaust flow rate.

.3 The enthalpy heat recovery module shall incorporate a rotary wheel with all necessary seals, drive motor, and drive belts. The enthalpy heat recovery wheel shall incorporate a desiccant without the use of binders or adhesives. Coated segments shall be washable using standard detergent or alkaline-based coil cleaners. The desiccant shall not dissolve in the presence of water or high humidity.

.4 Flame and Smoke Test and Rating: Enthalpy Recovery Wheels shall have a flame-spread rating of 25 or less and smoke-developed rating of 50 or less as tested in accordance with ASTM E84.

.5 The energy recovery wheel shall be assembled from corrugated sheets of coated aluminum interleaved with a coated smooth liner in a winding to form the wheel

which creates a large number of axial air flow passages or flutes. Flutes must pass 800 micron sized particles. A smooth flange shall be attached to the outer diameter of the wheel where the peripheral seat is to be installed. Energy recovery wheels shall be manufactured of aluminum treated for corrosion resistance and shall include a high water vapor capacity ion desiccant media with low co-adsorption characteristics to absorb and transfer humidity in the vapor phase. The substrate and desiccant shall be coated with a permeable bacteria-static treatment. Wheels shall be capable of cleaning by vacuum, with a water and detergent wash or, low-pressure compressed air. Wheel surfaces shall be smooth to provide consistent+ seal gap for the labyrinth seal.

.6 The cassette of the rotary heat exchanger shall have a built-in purge section providing a minimum cross contamination of exhaust air to the supply air. The purge angle and purge air volume shall be determined by the manufacturer considering the air face velocity, the wheel rotational speed and the differential air pressure between the entering outside air and the entering exhaust air streams. Purge: Cassette shall be complete with a built-in purge section to limit carry-over of exhaust air to the supply air stream to 0.04% when operated under design conditions.

.7 The motor shall be supplied with labyrinth face seal, which at no time are required to make contact with any rotating surface of the exchanger rotor. For optimum performance, these multipass seals shall utilize four labyrinth stages.

.8 Wheels of more than 1.73 m in diameter shall be of segmented construction, with a minimum of four sections. Wheels of more than 2.9 m in diameter shall be of segmented construction, with a minimum of six and a maximum of 12 sections. The manufacturer shall provide the rotor media in a segmented fashion to allow for field erection or replacement of one section at a time without requiring side access. The media shall be rigidly held by a structural spoke system made of extruded aluminum. The spokes shall not require tuning or threaded tie-rods to compensate for out of roundness of the wheel. The encased pie segments shall be bolted to the hub, to each other and to the periphery flange/rim. Each media to spoke and media to rim joint shall be sealed with high grade weather resistant low vapor emitting caulking to prevent air from bypassing the media.

.9 Construct the cassette of heavy wall welded tube to ensure rigidity and stability. Galvanized block off and casing side panels shall be removable to provide easy access to internal parts. Cassettes less than 1.73 m wheel diameter shall be factory assembled mechanically tested and shipped as one piece. Larger cassettes with wheel diameters greater than 1.73 m shall be shipped in sections after factory assembly and mechanical testing. The cassette casing shall include blank turned-in flanges to permit field attachment to AHU bulkheads.

.10 Isolate the supply and exhaust air stream from each other by means of adjustable seals secured to the cassettes panels and duct dividers/air partitions.

.11 The rotor shall be a structural framework, which limits the deflection of the rotor due to air pressure loss to less than 0.80 mm. The housing sheet metal shall be made of galvanized steel to prevent corrosion. The housing structural framework shall be of tubular construction painted with epoxy paint.

.12 The rotor shall be supported by two pillow block bearings, which can be maintained or replaced without the removal of the rotor from its casing or the media from its spoke system.

.13 The rotor shall be driven by a self-adjusting belt system. The manufacturer shall provide an A/C motor with internal overload protection for variable speed applications.

.14 Variable speed control shall be accomplished by the use of an A/C inverter. The motor and drive system must allow for a turndown ratio of 80:1 (20 rpm to ¼ rpm; 60 Hz to 1 Hz). Variable speed drive shall be supplied and installed by the wheel manufacturer.

.15 Wheel Drive System: The wheel shall be driven by a V-belt installed around the outside of the wheel. A gear motor shall be installed and sized to drive the wheel through its complete speed range for all seasons and speed control scenarios. The gear-motor shall be VFD-rated for variable speed operation. The gear-motor is to be rated for 575/3/60 power supply. The gear-motor shall be factory mounted.

.16 Controls: The control of wheel rotational speed is to be by the use of a variable frequency drive (VFD) rated for the full rpm range of the wheel and the full load amps of the gear-motor. The wheel speed shall be modulated in response to a signal from air stream temperature sensors mounted in the air ducts. The temperature sensors shall be supplied by the wheel manufacturer for field mounting. The manufacturer shall supply the speed controller which shall process the temperature signals, output a signal to the VFD and relay alarms to the building control system. The speed controller shall be energized by a remote signal from the Owner's BMS or an interlock with the supply air fan contacts. The controller shall include local manual set point adjustment. The speed controller shall include an internal transformer/power supply from an input of 115/1/60 power supply.

.17 Wheel bearings shall be permanently sealed and lubricated and have a minimum L-10 life of 400,000 hours.

.18 Mount the wheel drive motor in the cassette frame. The wheel drive motor shall be thermally protected and UL Component Recognized. Drive belts shall not require belt tensioners.

.19 Provide access doors immediately upstream and downstream of the energy recovery wheel cassette. Provide adequate space for cleaning, service and maintenance of the wheel, motor, bearings and belt.

.20 Provide frost control prevention by air preheat. Winter design supply and exhaust air conditions leaving the energy wheel provided by the unit manufacturer shall include any derate in performance due to frost protection measures.

2.19 TEST PORTS

.1 Provide 25 mm diameter test ports for air stream testing in each plenum section between each component within the Air Handling Unit.

.2 The test ports shall have a 25 mm stainless steel tube that extends between the inside and outside of the unit and screwed cap on the exterior to allow access.

.3 The test ports shall be flanged on the exterior to allow air seal and flanged on the interior to cover the penetration of the casing.

3. Execution

3.1 ASSEMBLY

.1 Do not operate unit for any purpose, temporary or permanent, until duct cleaning has been completed, filters are in place, bearings have been lubricated and system tested under the manufacturer's direct supervision.

.2 Contractor shall verify opening dimensions and installation methods to ensure unit sections and components can be physically installed into the designated space.

.1 The contractor has the responsibility to transport sections to the Project Site and manufacturer's representative shall help supervise reassembling the sections together for all air handlers. Contractor shall unload and hoist the sections onto the designated floor space.

.2 Reassemble the sections together for all air handlers in their footprint under the direction of the manufacturer.

.3 Additional unit section or component splits required for installation during construction shall be the responsibility of the contractor without additional cost to the Owner.

.4 Units must be bolted together for reassembly. Drive screw construction at unit splits is unacceptable.
.5 Extend all internal coil piping to casing walls.
.6 Submit a written acceptance letter stating the unit was assembled and complies with manufacturer's assembly requirements.

.3 Units are to be one-piece construction unless shipped in splits.

.4 Split units are to be site assembled in accordance with manufacturer's recommended method of installation and sealing.

.5 Pipe units to permit coil removal.

.6 Any piping or conduit passing through the unit casings must be sealed with rubber grommets and retaining plates to prevent air or water leakage.

.7 Insulate all piping as per Section 20 20 30, Piping and Equipment Insulation.

.8 Rig and set the unit in place. Ensure that spreader bars are used and the unit is protected from the lifting cables.

.9 Entire air handling unit is to be levelled.

.10 Set unit onto a neoprene sheet between the unit and housekeeping pad.

.11 Each drain connection shall be provided with a deep seal trap, and all connections piped to drain.

.12 Remove all internal hold-down bolts and shipping fasteners; install any parts that were shipped loose and level spring isolators.

.13 Check and re-align all access doors and dampers to ensure smooth operation through the entire range of travel.

.14 Upon start-up, check each fan motor for fan rotations and amp draw for each phase.

.15 All belt drives are to be re-adjusted for tension and alignment.

.16 Provide a drain valve on each coil drain fitting, and a vent valve on each coil vent.

.17 Any floor penetrations of the unit are to be thoroughly sealed to ensure the watertightness and integrity of the entire floor of the unit.

.18 Air filter supplier shall conduct a field review to confirm filter installation is in accordance with manufacturer's recommendations. Submit report of findings.

.19 The Contractor shall review all component sections for damage upon arrival to site, prior to acceptance for unpacking and reassembly. Any damages after unpacking are the responsibility of the Contractor.

.20 Contractor shall rotate fans, motors, and heat wheels bi-weekly from arrival to site until units are started.

.21 Gaskets and/or sealing components are to be supplied by the unit supplier. The reassembly of units shall be reviewed and instructed by supplier, to ensure factory quality reassembly.

3.2 ON SITE ALIGNMENT

.1 A qualified millwright shall confirm alignment of the fans and motors and submit a report for each. A vibration specialist shall perform vibration measurements on each fan/motor assembly at full air volume delivery. Adjustments in the fan balancing and alignment shall be conducted until the vibration measurements fall within the specified tolerances. Submit a report of the findings.

3.3 AIR HANDLING UNIT SCHEDULE

.1 Refer to Schedules on drawings for performance.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 General Mechanical Starting and Testing Requirements: Section 23 08 13.
.2 Mechanical Equipment Starting and Testing: Section 23 08 23.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Submit type of refrigerant used.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Show on shop drawings equipment, piping and connections, valves, strainers, thermostatic valves required for complete system.

.3 Closeout Submittals:

.1 Submit operations and maintenance data for incorporation into manuals specified in Section 20 01 06 – Mechanical Operation and Maintenance Manual.

1.3 QUALITY ASSURANCE

.1 Provide factory assembled, package type unitary air conditioning unit[s], product of manufacturer regularly engaged in production of unit of type and size specified, who issues complete catalogue data on such products.

.2 Manufacturer shall be responsible for selection and operation of components furnished by him. Provide written certification that components not furnished by him have been selected in accordance with his requirements.

2. Products

2.1 TYPE

.1 Provide split, packaged, factory assembled, prewired unit, consisting of cabinet, compressor, condensing coil, evaporator fan, evaporator coil, filters and controls.

2.2 CABINET

.1 Fabricate of heavy gauge galvanized steel with baked enamel finish, easily removed access doors or panels with quick fasteners. Provide drain pan with bituminous coating.

2.3 COMPRESSOR

.1 Provide hermetic compressor, 3600 r/min maximum, resiliently mounted with positive lubrication and inherent motor protection.

.2 Unit capable of operating down to -18^{O}C ambient temperature.

2.4 CONDENSER

.1 Provide coaxial, tube within a shell, refrigerant air cooled condenser with finned copper inner tube and steel outer shell.

2.5 EVAPORATOR FAN(S)

.1 Provide double width, double inlet, belt driven, forward curved centrifugal fan(s), statically and dynamically balanced, with permanently lubricated ball bearings.

.2 Provide variable pitch belt drive.

2.6 EVAPORATOR COIL

.1 Provide direct expansion type cooling coil with seamless copper tubes and aluminum fins.

.2 Refrigerant circuit shall incorporate thermal expansion valve, filter-drier, and charging valves.

2.8 CONTROLS

.1 Factory wired controls shall include contactor, high low pressure cutouts, internal winding thermostat for compressor, control circuit transformer, non-cycling reset relay, temperature controller, fan-off-cool switch.

3. Execution

3.1 INSTALLATION

.1 Provide initial charge of refrigerant (R-410A) and oil.

3.2 STARTING AND TESTING

.1 Start and test air conditioners as specified in Section 23 08 13 and 23 08 23.

END OF SECTION

1. General

1.1 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.1 Submit, in addition to shop drawings, schedules of radiation heating elements and enclosure indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers and a comparison of specified heat required to actual heat output provided.

1.1 QUALITY ASSURANCE

.1 Terminal heat transfer units shall be product of manufacturer regularly engaged in production of such units who issues complete catalogue data on such products.

2. Products

2.1 GENERAL

.1 Factory apply baked primer coat on metal surfaces of enclosure or cabinet.

2.1 HYDRONIC RADIANT PANELS

.1 Ceiling Panels: Constructed of modular 600 mm wide aluminum extrusions with interlocking edges; aluminum pans with silkscreened pattern matching ceiling tile; manufactured and assembled to sizes and configurations indicated.

.2 Pipe Coil: 600 mm module to incorporate extruded void into which continuous 12 mm copper pipe is rolled and thermally bonded. Provide return bends for two water connections to each panel.

.3 For exposed panels located in areas without ceilings provide panels with edge frame.

.4 Cross brace entire assembly with structural members and insulate top with 25 mm thick single sided foil backed fibreglass insulation. Configure panels within T-bar ceiling module and run wall to wall.

2.2 WALL FIN RADIATION

.1 Heating Elements: 30 mm seamless copper tubing, 1 mm minimum wall thickness, mechanically expanded into evenly spaced aluminum fins, suitable for sweat fittings.

.2 Heat Elements: 30 mm condenser tube, 3 mm minimum wall thickness mechanically expanded into evenly spaced steel fins.

.3 Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure bracket.

.4 Enclosures: 1.2 mm steel up to 450 mm in height, 1.6 mm steel over 450 mm in height c/w easily jointed components for wall to wall installation. Support rigidly, top and bottom, on wall mounted brackets at 900 mm centres maximum.

2.3 UNIT HEATERS

.1 Casing: 1.2 mm steel with threaded connections for hanger rods.

.2 Coils: Seamless copper tubing, 0.6 mm minimum wall thickness, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

.3 Fan: Direct drive propeller type, statically and dynamically balanced. Horizontal models complete with sleeve bearings and fan guard. Vertical model complete with grease lubricated ball bearings.

.4 Air Outlet: Adjustable pattern diffuser on projection models and four-way louvers on horizontal throw models.

3. Execution

3.1 INSTALLATION

.1 Provide each unit with shut-off valve on supply and lockshield balancing valve on return piping.

.2 Provide each unit at high points with easily accessible manual air vent. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For fan coil units and unit heaters provide float operated automatic air vents with stop valve.

.3 For inaccessible valves, provide factory-made permanently hinged access doors, 150 x 180 mm minimum size, integral with cabinet.

3.2 PERFORMANCE

.1 Refer to schedules.

.2 Radiation and convector capacities are based on 18°C entering air temperature, 82°C entering water temperature.

.3 Unit heater capacities are based on 16°C entering air temperature, 82°C entering water temperature.

END OF SECTION

1. General

1.1 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

.2 Number of tube rows, air and water pressures drops, and such features as drainability, same or opposite end connections, support and venting, same as type specified.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's product data in accordance with Section 20 00 13 – Mechanical General Requirements.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 20 00 13 – Mechanical General Requirements.

.3 Closeout Submittals:

.1 Submit operations and maintenance data for incorporation into manuals specified in Section 20 01 06 – Mechanical Operation and Maintenance Manual.

1.3 QUALITY ASSURANCE

.1 Coils shall be the product of manufacturer regularly engaged in production of coils who issues complete catalogue data on such products.

2. Products

2.1 GENERAL

.1 Provide extended surface type coils with tubes of copper or brass, and plate or helical type fins of copper or aluminum.

.2 Space fins 5 per 10 mm maximum. Helical fins may be crimped.

.3 Mount coil section in galvanized steel casing designed for bolting to other sections or ductwork.

2.2 WATER AND GLYCOL HEATING COILS

.1 Design for maximum operating limits of 1380 kPa and 104 °C.

.2 Face length shall not exceed 3 m per section.

.3 Coil headers shall be cast iron, copper tube or steel pipe.

3. Execution

3.1 INSTALLATION

.1 Support coil sections on steel channel or double angle frames and secure to casings. Arrange supports for cooling coils so they do not pierce or short circuit drip pans. Level serpentine coils and install drainable coils with pitch within casings. Arrange galvanized steel casings for bolting to other section, ductwork or unit casings. Provide airtight seal between coil and duct or unit cabinets.

.2 Make necessary connections to coils, including valves, air vents, unions and connections from drip pans. Provide gate valve on supply line and lockshield globe valve on return line to each water coil.

.3 Locate water supply at bottom of supply header and return water connection at top to provide self-venting and reverse return arrangement. Provide float operated automatic air vents at high points complete with stop valve. Ensure water coils are drainable and provide drain connection at low points.

.4 Protect coils so fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins unless required to be replaced.

.5 Install coils with 20 mm per m pitch.

.6 Install vacuum breaker in steam line at header, or in header.

END OF SECTION

1. RELATED REQUIREMENTS

.1	Summary of Work:	Division 01.
.2	Coordination:	Division 01.
.3	Regulatory Requirements:	Division 01.
.4	Submittals:	Division 01.
.5	Quality Control:	Division 01.
.6	Temporary Power:	Division 01.
.7	Product Options and Substitutions:	Division 01.

2. RELATED WORK

.1	Trench Excavating and Backfilling:	Section 31 23 10.

3. SERVICE CONNECTIONS

.1 Contractor shall be responsible for connection of project service lines to Utility's lines and sources, regardless of whether the required work is performed by Contractor's own forces, Subcontractors, or Sub-Subcontractors, or by a Utility.

.2 Coordinate service connections work. Make all necessary arrangements with, comply with requirements of, and cooperate fully with each Utility.

.3 Cut, fit and patch work of this Contract as required to fit or be received by work of each Utility.

4. CONNECTION OF WORK PROVIDED UNDER OTHER DIVISIONS

.1 Coordinate with other disciplines, for requirements pertaining to electrical connection of equipment supplied and installed under other Divisions.

5. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

.1 Comply with requirements of Division 01.

.2 Submit shop drawings, product data and samples as specified, indicating details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment and materials. Include data on manufacturer's recommended environmental conditions for equipment affected by temperature and humidity.

.3 Provide wiring, single line and schematic diagrams for electrical control systems and where otherwise applicable. Include wiring drawings or diagrams showing interconnection among work of different Sections.

.4 Shop drawings shall be submitted in pdf format.

.5 Cross or block out from manufacturer's standard product data sheets all data inapplicable or irrelevant to project. Where multiple models are shown on the shop drawings, clearly indicated which model(s) are proposed.

.6 All component identification numbers for communications equipment shall be generic.

.7 Provide shop drawing cover page(s), including the following:

.1 Indicate the project name, and the document types.
.2 Indicate product name(s) and reference the associated specification section and item number. For example, for a product ABC by manufacturer XYZ:
"XYZ ABC - Section 26 12 34 item 2.1."
.3 Provide a minimum of half a page (4 inches) of blank space for affixing of shop drawing review stamps.

.8 Coordinate with other trades for exact equipment requirements where sizing of electrical equipment such as breakers or starters are concerned. Shop drawings submitted to the consultant that have not been coordinated are subject to rejection and resubmittal. This contractor shall ensure that shop drawings that entail coordination with other trades such as, but not limited to, MCCs, electric panels, wire, disconnect switches, motor starters shall be done prior to submission of shop drawings to ensure that actual ratings of the equipment matches those in the shop drawing submittals. Otherwise, these shop drawings shall be rejected & returned outright.

.9 A maximum of two (2) shop drawing reviews will be provided by the Consultant. Beyond this, the Contractor shall be responsible for the Consultant fees for additional shop drawing reviews due to deficiencies found in the shop drawings.

6. SUBSTITUTIONS

.1 Substitute Products: Where substitute products are permitted, unnamed products will be accepted by the Minister, subject to the following:

.1 Substitute products shall be the same type as, be capable of performing the same functions as, and meet or exceed the standards of quality and performance of the named product(s). Substitutions shall not require revisions to Contract Documents nor to work of Other Contractors.

.2 Substitute Manufacturers: Where substitute manufacturers are permitted, unnamed manufacturers will be accepted by the Minister, subject to the following:

.1 Substitute manufacturers shall have capabilities comparable to those of the named manufacturer(s). Substitutions shall not require revisions to Contract Documents nor to work of Other Contractors.

.3 In making a substitution Contractor represents that:

.1 he has investigated substitute product or manufacturer, or both, and has determined that it meets the criteria specified in Substitute Products or Substitute Manufacturers, or both, and
.2 he will make any changes to the Work necessitated by the substitution as required for the Work to be complete in all respects, and
.3 he waives claims for additional costs and time caused by substitution which may subsequently become apparent.

.4 Substitutions shall not be ordered nor installed without Minister's acceptance.

.5 If in Minister's opinion, a substitution does not meet requirements of Contract Documents, Contractor shall, at no extra cost to Minister, provide a product which, in Minister's opinion, does meet requirements of Contract Documents.

.6 If providing alternative products or materials, then assume full responsibility for ensuring that all coordination factors are considered including but not limited to power & wiring, weight, space and connections requirements. The contractor shall bare any and all costs incurred for additional space requirements, structural, components, or changes to services that may be necessary. Supply to the Engineer proof of equality, difference in delivery dates and price (if any) in the form of certified quotations from suppliers of both specified items and proposed substitutions.

7. PROJECT RECORD DRAWINGS

.1 Comply with requirements of Division 01.

.2 Record actual locations of all pull boxes, feeders, electrical equipment.

.3 Record any changes to branch circuit designations.

.4 Record all changes made during the construction process.

.5 Obtain, at own expense, electronically generated drawings which include all changes to the original tender drawings and clearly marked as "AS BUILT" drawings.

8. REGULATORY REQUIREMENTS

.1 Comply with Safety Codes Act and rules and regulations made pursuant thereto, including Canadian Electrical Code.

.2 Unless otherwise indicated, all references in the Contract Documents to "Canadian Electrical Code" or "CEC" shall mean the edition of the Canadian Electrical Code, Part I, CSA C22.1 and the variations made thereto by Alberta regulation, which are in force on the date of bid closing for the Contract.

.3 All electrical products shall be tested, certified and labelled in accordance with a certification program accredited by the Standards Council of Canada. Where a product is not so labelled, provide written approval by the authority having jurisdiction.

.4 Submit to authority having jurisdiction and utility company, necessary number of drawings and specifications for examination and approval prior to commencement of electrical work. Pay associated fees.

.5 Submit to Minister, copy of electrical permit obtained from authority having jurisdiction.

9. DELIVERY, STORAGE & HANDLING

.1 Deliver, store and handle materials in accordance with Division 01 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

10. WASTE MANAGEMENT & DISPOSAL

.1 Follow Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 50 00.

.2 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 50 00.

.3 Divert unused metal materials from landfill to metal recycling facility.

11. CERTIFICATES & REPORTS

.1 If authority having jurisdiction, electrical inspector and/or safety codes officer conducts an electrical inspection, submit to the consultant a copy of the inspection report.

.2 If authority having jurisdiction conducts an electrical inspection, submit copy of certificate of acceptance provided by authority having jurisdiction.

12. REFERENCE DOCUMENTS

.1 Comply with applicable standards of following organizations:

.1 Electrical and Electronic Manufacturers Association of Canada (EEMAC).

.2 National Electrical Manufacturers Association. (NEMA).

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

.4 Insulated Power Cable Engineers Association (IPCEA).

13. CLEANING

.1 Do the following prior to Interim Acceptance of the Work, as required to remove all construction dust and debris:

.1 Clean out all cabinets and enclosures with vacuum or compressed air.

.2 Wipe all insulators with clean, dry rags.

.3 Clean all luminaires, with vacuum or clean dry rags.

END OF SECTION

1. INTENT

.1 Contractor shall obtain all specified operation and maintenance data. Using this data, Contractor shall prepare and submit operation and maintenance manuals as specified.

2. RELATED REQUIREMENTS

.1 Comply with requirements of Operation and Maintenance Data and Manual requirements specified in Division 01.

3. FORMS

.1 Obtain a current list of Alberta Infrastructure Equipment Identification Forms from the Minister. Use these forms in presenting Operation and Maintenance Data.

4. MANUAL SYSTEM CATEGORIES

.1 Organize manual into the following major system categories:

- .1 PDS - Power Distribution System
- .2 CAS - Communication and Security Systems
- .3 LTG - Lighting Systems
- .4 FSS - Fire Safety Systems

.2 Provide master divider tabs and index for each major system category, with white tabs, 75 mm in length.

5. SUB-SYSTEM DIVISIONS

.1 Divide major system categories into subsystems as follows:

- .1 PDS - Power Distribution System:
  - .1 Low Voltage Systems (Below 750 Volts)
  - .2 Emergency Systems
  - .3 Motor Control Systems
- .2 CAS - Communication and Security Systems:
  - .1 Public Address System
  - .2 Closed Circuit Television System
  - .3 Intercom System
  - .4 Programmable Clock System
  - .5 Telephone System

.3 LTG - Lighting Systems:

.1 Interior Lighting
.2 Exterior Lighting
.3 Lighting Control

.4 FSS - Fire Safety Systems:

.1 Fire Alarm System

.2 Organize each sub-system into the following sections:

.1 Operations Section
.2 Maintenance Section
.3 Contract Documentation & Standards Section

.3 Provide an index and divider for each subsystem and section, colour coded as follows:

.1 PDS Subsystems - Blue
.2 CAS Subsystems - Green
.3 LTG Subsystems - Yellow
.4 FSS Subsystems - Red

.4 Use 45 mm tabs for each subsystem and 40 mm tabs for sections, use same colour for section tabs as for subsystem tabs.

6. OPERATIONS SECTION

.1 In each system or category and/or subsystem, include an operations section which includes:

.1 System Description
.2 System Operating Instructions
.3 Schematic Diagrams
.4 Equipment Data Sheets

.2 System Descriptions: prepare descriptions which, at least, includes the following:

.1 Power Distribution System - PDS:

.1 Calculated demand in kVA of entire system and on each transformer 150 kVA and above.
.2 Short Circuit analysis of entire system, including incoming fault level.
.3 Protective Device Coordination study for entire system.
.4 Description of protection, transfer and metering scheme.

.5 Calculated system operating power factor together with method of improvement and anticipated improvement.

.6 Single line diagram of entire power system indicating all breaker, switches, protective devices and instrumentation.

.2 Communication and Security Systems - CAS:

.1 Public Address:

.1 System Installer.
.2 Integral Transient and memory protection.
.3 Nature and quantity of preamplifications inputs and space capacity on mixer preamplifier.
.4 Order of pertinence of inputs.
.5 Zoning and zone control.
.6 Power requirements of speaker zones.
.7 Power amplifier sizes.
.8 Speaker types, sizes and spacing.
.9 Horn types.
.10 Other pressing equipment eg compressors, equalizers
.11 Microphones
.12 Interfaces: telephone, security system, etc.

.2 CCTV Systems:

.1 System installer.
.2 Integral transient and memory protection.
.3 Areas covered.
.4 Camera and lens types.
.5 Switcher types.
.6 Control equipment.
.7 Monitors.
.8 Fibre optic equipment and cable.
.9 Pan, tilt equipment.
.10 Environmental equipment eg enclosures, heaters, fans etc.

.3 Programmable Clock System:

.1 System installer.
.2 Integral transient and memory protection.

.3 Master Clock:

.1 Location.
.2 Supervisor and connection periods.
.3 Manual control.
.4 Daylight savings feature.
.5 Program control points (ie control of lighting, bells, mechanical equipment, etc.).

.4 Clocks:

.1 Digital or analog.
.2 12 or 24 hour system.
.3 Mounting.

.5 Interval Timer Clock:

.1 Stop, start, reset buttons.
.2 Pilot lights.
.3 Clock descriptions.

.4 Telephone System:

.1 System installer.
.2 Integral transient and memory protection.
.3 Required feature and function.
.4 Connections to paging, intercom, security, pocket pager, mobile radio, etc.

.3 Lighting Systems - LTG:

.1 Interior Lighting:

.1 Include following in description of interior lighting system:

.1 Calculate and include energy consumption in Watts per square metre.
.2 Include any areas where ambient lighting has been supplemented with task lighting.

.2 Exterior Lighting:

.1 Include following in description of exterior lighting:

.1 Include anticipated lighting levels for parking lots, roadways, etc.

.3 Lighting Control System:

.1 Interior Lighting:

.1 Describe method of switching. Include switching of corridors, large general use areas and any lighting connected to emergency or standby power.

.2 For low-voltage switching systems, include following:

.1 Time clock/computer controlled and zone(s) of control.
.2 Location of any master switches and area they control.

.2 Exterior Lighting:

.1 Describe method of controlling exterior lighting (ie photocell, timelock, override switch, master switch, etc.)

.2 Include location of all control equipment.

.4 Fire Safety Systems - FSS:

.1 Fire Alarm System:

.1 General description ie single or two stage, zoned, non-coded, etc.
.2 Interconnection to other system ie, security system, building management system in Division 23 etc.

.3 System Operating Instructions:

.1 Prepare system operating instructions, with the Manufacturers' and Suppliers bulletins as backup. Provide the following:

.1 Power Distribution System - PDS:

.1 Provide an overall description of operation of power system in both normal and emergency mode.

.2 Protective schemes such as overcurrent, short circuit, undervoltage, ground fault, including lock out and restraint as applicable.
.3 Transfer schemes both normal and emergency.

.2 Communication and Security Systems - CAS:

.1 Public Address System:

.1 Inputs and their precedence and volume controls.
.2 Zoning and its control.
.3 Main volume control.
.4 Settings of processing and power equipment.
.5 Termination, sublimation locations, schedules.
.6 Connections to other systems; settings.
.7 Component's names.
.8 Features/option not used.

.2 CCTV System:

.1 Camera number vs area covered.
.2 Camera - monitor assignments.
.3 Camera - switcher assignments.
.4 Switcher - monitor assignments.
.5 Dwell line, other controls.
.6 Microprocessor control equipment, reprogramming.
.7 Environmental enclosures; pan/tilt drives.
.8 Labeling of cables.

.3 Programmable Clock System:

.1 Monitor Clock:
.1 Manual/automatic control.
.2 Programming instructions.
.3 List features used/not used.
.2 Clocks.
.3 Interval timer clock.
.1 Control panel.

.3 Lighting Systems - LTG:

.1 Time clock.
.2 Photocell.

.3 Low Voltage Setting:

.1 Details of systems type and composition.
.2 Location in the building.
.3 Function of each component.
.4 Provisions for future expansion.

.4 Fire Safety Systems - FSS:

.1 Fire Alarm System:

.1 Fire alarm control unit.
.2 Wiring class.
.3 Zoning.
.4 Programming instructions if microprocessor / addressable.
.5 Supervisory zone operation.
.6 Systems trouble.
.7 System reset.
.8 Alarm stage:
.1 System operation.
.2 Auxiliary relay operation:
.1 Door release.
.2 Smoke damper operation.
.3 Fan shutdown.
.4 Sprinkler system.
.5 Security system.
.6 Fire department "alarm".

.4 System Schematics:

.1 Include all schematics that are applicable, which will assist in operation and maintenance of system.

.5 Equipment Identification:

.1 Provide data for each component of the system on Alberta Infrastructure Equipment Identification forms.

.2 The Minister will supply one reproducible copy of forms requested by the Contractor for use on the project.

.3 The Contractor shall produce all necessary equipment identification forms not included.

.4 New forms shall contain information similar in nature to that contained in the Alberta Infrastructure forms.

.5 The Minister will transform Consultant produced forms in the Department format and will provide one reproducible copy to the Contractor.

.6 Equipment Identification forms are only required for Power Distribution System equipment.

7. MAINTENANCE SECTION

.1 General:

.1 Summarize data for this section from Contractor supplied maintenance submissions, supplemented by any additional appropriate data.

.2 Include maintenance as a section of each system.

.3 Organize data into sections, with divider tabs as follows:

.1 Maintenance Tasks and Schedules
.2 Spare Parts
.3 Suppliers and Contractors
.4 Tags and Directories
.5 Maintenance Brochures

.2 Maintenance Tasks and Schedules:

.1 Organize data according to system category, with further breakdown into individual systems as used in operations division of the manual. Provide section index and divider tabs for each system category. Summarize maintenance tasks from maintenance manufacturer's brochures, for each component of system in following format:

.1 Daily
.2 Weekly
.3 Monthly
.4 Semiannually
.5 Annually
.6 When required

.3 Spare Parts List:

.1 Organize data according to system category, with further breakdown into individual systems as used in operations division of manual. Provide section index and divider tabs for each system category. Summarize maintenance tasks from maintenance manufacturer's brochures, for each component of system.

.4 Suppliers and Contractors List:

.1 Provide summary of suppliers and contractors for each component of the system. List name, address and telephone number of each.

.5 Tags and Directories:

.1 Provide a copy of tags and directories as specified in Contract Documents.

.6 Maintenance Brochures:

.1 Include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment or system. Provide section index and divider tabs. Maximum of twenty-five sheets or one brochure per tab.

8. CONTRACT DOCUMENTATION AND STANDARDS SECTION

.1 Coordinate collection of data required for this section.

.2 Organize all data required by Construction Contract into sections, with divider tabs, as follows:

.1 Drawing List
.2 Shop Drawings and Product Data
.3 Certificates
.4 Warranties and Bonds
.5 Reports
.6 Standards Division

.3 Drawing List: provide a list of all drawings required for performance of construction contract.

.4 Shop Drawings and Product Data: provide final copies of all shop drawings and product data required by the Contract Documents. Include section index and divider tabs. Maximum of twenty-five sheets or one shop drawings per tab.

.5 Certifications: provide copies of contractor certifications for the performance of the product and systems, and test reports verifying performance of products and systems. Include section index and divider tabs with maximum of twenty-five sheets or one report per tab. This should include, but not be limited to the following:

.1 Electrical systems inspection.
.2 Utility company inspection.
.3 Occupational Health and Safety inspection.
.4 Fire Alarm Verification certificate.

.6 Warranties and Bonds: include one copy each of the Contractor's warranty, manufacturers' warranties longer than one year, bond, and any service contract provided by Contractor. Provide section index.

.7 Reports: include copies of all reports relating to the testing, adjusting and balancing of equipment and systems, as required by the contract specification Sections 26 08 10. Include section index and divider tab for each report.

.8 Standards Division: allow 25 mm binder space for standards.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1 Spare Parts and Maintenance Materials: Division 01.

1.2 INVENTORY LIST

.1 Submit a complete inventory list of electrical spare parts and maintenance materials delivered to the Minister.

2. Products

2.1 SPARE PARTS AND MAINTENANCE MATERIALS SCHEDULE

Item			Quantity
.1	Lighting Control System:		
	.1	Low voltage relays:	Six
	.2	Low voltage switches:	Six
.2	Fire Alarm System:		
	.1	Products of combustion detectors:	3
	.2	Thermal detectors:	Two of each type
	.3	Manual pull stations:	2

2.2 TOOLS AND CABINETS

.1 Provide all special tools required for normal maintenance in a heavy gauge, corrosion resistant metal box complete with lock and keys.

.2 Provide wall mounted metal cabinet with adjustable shelving and hinged locking door to house all spare parts associated with power system.

3. Execution

3.1 DELIVERY

.1 Deliver spare parts and maintenance materials to project site or other location designated by Minister and obtain receipt for materials delivered.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Wire and Cable:	Section 26 05 13.
.2	Conduit:	Section 26 05 34.
.3	Utility Metering:	Section 27 27 13.
.4	Fill Materials:	Section 31 05 13.
.5	Trench Excavating and Backfilling:	Section 31 23 10.

1.2 DETAIL DRAWING

.1 Following detail drawing is appended hereto and forms part of this Section:

.1 26 04 10.01: Underground Service Entrance Drain Assembly

1.3 COORDINATION

.1 Coordinate work of this Section with Utility.

.2 Coordinate work of this Section with work specified in Section 31 23 10.

2. Products

2.1 DRAIN ASSEMBLY

.1 Provide 25 mm drain holes in bottom of each conduit.

.2 Provide fabricated 50 mm PVC drainage assembly with saddle cutouts for each conduit as shown in detail 26 04 10.01.

2.2 CABLE LUGS

.1 Cable lugs: suitable for application and acceptable to Utility.

2.3 PROTECTIVE MATERIAL FOR CONDUIT AND DUCTS

.1 Sand: as specified in Section 31 05 13.

.2 Planking: 38 x 140 mm pressure treated fir.

2.4 MARKER TAPE

.1 Underground detectable warning tape indicating buried electrical lines below.

.2 Type: Polyester, metal detectable.

.3 Colour: red.

3. Execution

3.1 TRENCH EXCAVATING

.1 Excavate trenches for underground service as specified in Section 31 23 10 and as follows:

.1 Excavate along service routing indicated on drawings.

.2 Excavate to depth required to ensure minimum 900 mm cover between conduit and finish grade.

.3 Slope trench 150 mm per 30 m length to low point indicated on drawings.

3.2 CABLE IN CONDUIT OR DUCT INSTALLATION

.1 Level bottom of trench with minimum 75 mm layer of sand prior to conduit or duct installation.

.2 Use Conduit to duct adapters when connecting to threaded galvanized rigid steel conduit.

.3 Backfill with sand to 100 mm over cable.

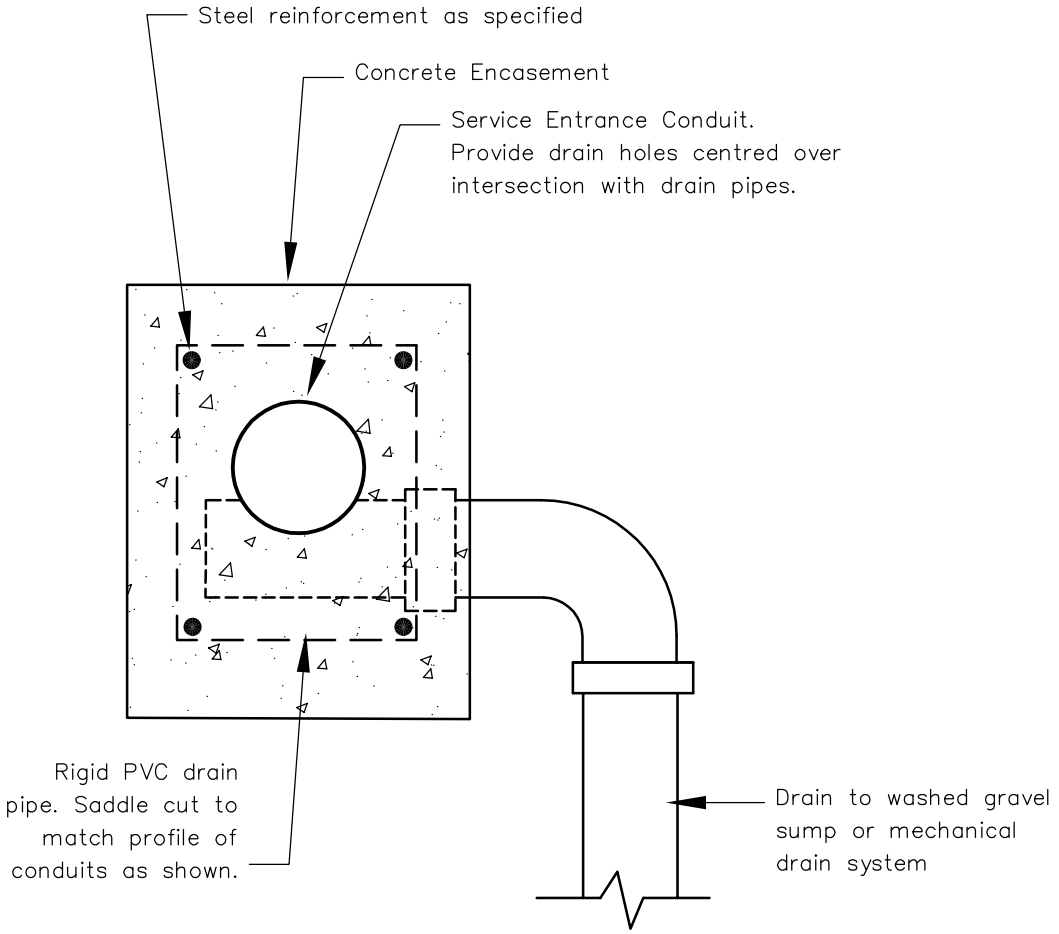
.4 Install drainage assembly. Band drainage assembly with 12 mm stainless steel straps to conduit assembly to prevent mechanical displacement. Extend drain pipe into 1000 mm round and 3000 mm deep washed gravel sump.

.5 Encase with 50 mm thick concrete envelope.

3.3 MARKER TAPE

.1 Install underground warning tape along the entire length cable/conduit run.

END OF SECTION



NOTES:
Provide backwater preventor where drain is connected to mechanical drain system

Underground Service Entrance Drain Assembly Detail	2008 - 06 - 02
	Detail 26 04 10 01

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Colour coding and identification of wires: Section 26 05 53.

1.2 COORDINATION

.1 Coordinate installation of cables which pass through fire rated walls, floors or ceilings with firestopping work specified in Division 07.

2. Products

2.1 GENERAL

.1 Where hazardous locations are indicated on the drawings, select proper types and fittings to comply with Canadian Electrical Code (CEC).

2.2 BUILDING WIRING

.1 Building Wiring: to CSA C22.2 No. 75-08 and as follows:

.1 Conductors: solid copper for No. 10 AWG and smaller, stranded copper for No. 8 AWG and larger.
.2 Insulation: RW90 X-link.
.3 Insulation Rating: 600 V.
.4 Sizes: as indicated in Wire Size Schedule.

2.3 CABLES

.1 Armoured Cable: to CSA C22.2 No. 51-09, and as follows:

.1 Conductor: copper.
.2 Insulation: RW90 X-link.
.3 Rating: 600 V.
.4 Size: 12 AWG gauge.
.5 Configuration: as indicated on drawings.
.6 Armour: aluminum interlocking.

.2 Type TECK 90 Cable: to CSA C22.2 No. 131-07 (R2012) and as follows:

.1 Conductor: copper.
.2 Insulation: cross linked polyethylene (XLP).
.3 Rating: 600 V.
.4 Size: as indicated in schedules.
.5 Configuration: as indicated in schedules.

.6 Inner Jacket: PVC -40°C.
.7 Armour: aluminum.
.8 Outer Jacket: PVC -40°C.

.3 Service Entrance Cable: to CSA C22.2 No. 52-09 and as follows:

.1 Conductor: copper.
.2 Insulation: XHHW cross linked polyethylene (XLP) and PVC jacket.
.3 Rating: 600 V AC.
.4 Configuration: three conductors, two insulated, one uninsulated concentric neutral 100 %.
.5 Size: as specified in Wire Size Schedule.

.4 Control Cable for Class 2 Remote Control and Signal Circuits:

.1 Conductor: copper.
.2 Insulation: 300 V insulation, rated 90°C.
.3 Configuration: individual conductors twisted together, and covered with a PVC jacket.

.5 Variable Frequency Drive Cable: to CSA C22.2 No. 123, CSA C22.2 No. 174 and as follows:

.1 Conductor: copper.
.2 Insulation: 1000 V insulation, rated 90°C.
.3 Configuration: individual conductors twisted together, shielded, and three bonding conductors.
.4 Sheath: corrugated continuous aluminum and covered with a PVC jacket.
.5 Manufacturers: Nexans DriveRx VFD Cable or consultant approved equal.

.6 Fire Alarm Horizontal Cable:

.1 Conductor: copper complete with bonding coductor.
.2 Insulation: 105°C, Fire Alarm & Signals Cable (FAS), FT4 rated.
.3 Rating: 300 V.
.4 Armour: unarmoured in conduit.
.5 Provide all wiring according to manufacturer's recommendations.

2.4 CONNECTORS

.1 Provide factory fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated.

3. Execution

3.1 WIRING, GENERAL

.1 Splice only in junction or outlet boxes.

.2 Conductor length for parallel circuits shall be identical.

.3 Neatly train and lace conductors inside cabinets, equipment and panelboards.

3.2 WIRING INSTALLATION IN RACEWAYS

.1 Swab raceway system before installing wiring.

.2 Use pulling lubricant for conductors No. 4 AWG and larger.

3.3 WIRE CONNECTIONS AND TERMINATIONS

.1 Use solderless pressure connectors with insulated covers for copper wire splices and taps, No. 8 AWG and smaller.

.2 Use insulated spring wire connectors with plastic caps for conductors No. 10 AWG and smaller.

.3 Use split bolt connectors for copper wire splices and taps, No. 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150% of insulation value of conductor.

3.4 TECK 90 CABLE INSTALLATION

.1 Provide protection for exposed cables where subject to damage.

.2 Support horizontal runs on cable tray complete with spacers and clamps.

.3 Support vertical runs on channels complete with spacers and clamps.

.4 Support cables minimum one diameter apart. Maintain equal spacing across supports.

.5 Install single conductor cables in 3 phase circuits as follows:

.1 Arrange cables in delta formation supported on hardwood spacer blocks providing one cable diameter space between cables. Install spacers at 900 mm centres around horizontal and vertical runs of cable.

.2 Install non-magnetic and insulating plates at cable termination points. Fit connectors at supply points with grounding style bushing and No. 6 AWG copper conductor to connect supply end of cable sheath to ground. Ground cable sheath at supply end only.

.3 Install non-metallic plate at load end of cable to terminate cable.

.4 Provide non-magnetic plates, minimum 12 mm aluminum, securely bolted over openings cut in enclosure.

3.5 VARIABLE FREQUENCY DRIVE CABLE INSTALLATION

.1 According to manufacturer's recommendations.

3.6 WIRE SIZE SCHEDULE

.1 All Circuits: all wire sizes shown are minimum sizes, verify exact sizing based on code requirements for voltage drop and routing on site.

.2 Lighting Circuits: No. 12 AWG minimum.

.3 Power Circuits: No. 12 AWG minimum, except as follows:

.1 No. 10 AWG for 15 A, 120 V circuits longer than 23 m.
.2 No. 8 AWG for 15 A, 120 V circuits longer than 37 m.
.3 No. 10 AWG for 20 A, 120 V circuits longer than 17 m.
.4 No. 8 AWG for 20 A, 120 V circuits longer than 27 m.

.4 Motor Circuits: No. 12 AWG minimum, except as otherwise indicated on drawings or in schedules.

.5 Feeder Circuits: as indicated on drawings or in schedules.

.6 Fire Alarm System Circuits:

.1 Initiating Data Communication Link (DCL): No. 18 AWG and in accordance with manufacturer's recommendations.
.2 Audible Signaling: No. 14 AWG and in accordance with manufacturer's recommendations.

.3 Visual Signaling: No. 14 AWG and in accordance with manufacturer's recommendations.

.4 Auxiliary: No. 14 AWG and in accordance with manufacturer's recommendations.

.5 Ground: No. 14 AWG green insulated ground conductors to bond all devices to ground.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Testing of Ground Resistance: Section 26 08 10.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Medium-Voltage Cable: Section 26 05 13.

1.3 COORDINATION

.1 Coordinate installation of ground rods and cables with ground level concrete work specified in Division 03, to provide a complete integrated system.

2. Products

2.1 MATERIALS

.1 Grounding and bonding equipment: to CSA C22.2 No. 41-M1987 and as follows:

.1 Ground Rods: 20 mm x 3 m copper clad steel.

.2 Ground Conductors: as specified in Section 26 05 13.

.3 Ground Grid:

.1 No of ground rods: 3.
.2 Interconnect conductors: 3/0 bare copper.
.3 Ground conductors: 3/0 bare copper to system neutral point.

.4 Ground Bars: solid copper, pre-drilled from two-hole lug connections with a minimum thickness of ¼ inch for wall mounting using standard insulators.

3. Execution

3.1 INSTALLATION

.1 Comply with requirements of CSA C22.2 No. 0.4-M1982 and Canadian Electrical Code.

.2 Install complete permanent grounding system including electrodes, conductors, connectors and accessories.

.3 Protect exposed ground conductors from mechanical injury.

.4 Make buried connections, and connections to electrodes using compression connections shall be approved for direct burial, meet IEEE Standard 837 requirements, and be irreversible, cast copper, high conductivity as manufactured by Thomas and Betts, or equal.

.5 Use mechanical connectors for ground connection to equipment provided with lugs.

.6 Do not solder joints.

.7 Install separate insulated ground conductor in conduit runs, the conduit is not to be used as the grounding means.

.8 Install bonding wire in flexible metal conduit connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw.

.9 Install separate insulated ground conductor in conduit runs installed in concrete which is subject to moisture penetration and underground.

3.2 SYSTEM GROUNDING

.1 Provide ground conductor to water main ahead of water meter.

.2 Provide flexible copper bonding jumper around water meter, associated unions and valves to ground building side of water system.

.3 Provide ground grid with one ground conductor from grid to system neutral point.

3.3 TESTING

.1 Test ground resistance as specified in Section 26 08 10.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Cable: Section 26 05 13.
.2 Conduit: Section 26 05 34.
.3 Cable Trays, Wireways, and Surface Raceways: Section 26 05 36.
.4 Interior Lighting Fixtures: Section 26 51 13.

1.3 COORDINATION

.1 Coordinate installation of inserts with:

.1 Concrete work specified in Division 03.
.2 Suspended ceiling work specified in Division 09.
.3 Mechanical work specified in Divisions 20 to 23.

2. Products

2.1 SUPPORTING DEVICES

.1 Provide metal brackets, frames, hinges, clamps and related types of supporting devices and support systems adequate for weight of equipment and raceways, including wiring which they carry.

.2 Straps: steel.

.3 Channels:

.1 Normal single-sided configuration: 42 x 42 mm galvanized steel or 54 x 54 mm stainless steel.
.2 Normal double-sided configuration: 54 x 54 mm stainless steel. Two full-size single-sided configuration channels mounted back-to-back are not allowed. Eaton B-Line 4D22 series or approved equal.
.3 Shallow configuration: 27 x 54 mm stainless steel. Eaton B-Line 4D21 series or approved equal.

.4 Rod Hangers: 6 mm galvanized steel.

.5 Inserts: preset expansion types.

3. Execution

3.1 INSTALLATION

.1 Install supporting devices to maintain headroom, neat mechanical appearance and to support equipment loads required.

.2 Except where otherwise indicated, support equipment, conduit and cables using clips, spring loaded bolts, or cable clamps designed as accessories to base channel members.

.3 Support exposed conduit and conduit installed in space above suspended ceilings and in crawl spaces using hangers, clamps or clips. Support conduit on each side of bends and on spacing in accordance with Canadian Electrical Code.

.4 Where three or more conduits run parallel, install conduit on conduit racks. Size conduit racks to provide 25% spare capacity.

.5 Support riser conduit at each floor level with clamp hangers.

.6 Do not fasten supports to piping, ductwork, mechanical equipment or conduit.

.7 Do not use shot driven pins.

.8 Provide 19 mm plywood backing supports within the wall construction and install surface mounted cabinets and panelboards with minimum of four anchors.

.9 Bridge studs top and bottom with channels to support flush mounted cabinets and panel boards in stud walls.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Electrical Identification: Section 26 05 53.

1.2 RELATED SECTIONS

.1 Wiring Devices: Section 26 27 26.

1.3 COORDINATION

.1 Coordinate box locations with work specified in:

.1 Division 04, for installation of boxes in masonry.
.2 Division 09, for installation of boxes in locations where access panels are required.

2. Products

2.1 METAL OUTLET BOXES

.1 Outlet boxes: to CAN/CSA-C22.2 No. 18.2-06 (R2016) and as follows:

.1 Sheet Steel Boxes: pressed sheet steel, galvanized, blanked for conduit, integral locating lugs.

.2 Cast Boxes: corrosion resistant steel, factory threaded hubs, weatherproof.

2.2 NON-METALLIC OUTLET BOXES

.1 Outlet boxes: to CAN/CSA-C22.2 No. 85-M89 (R2010) and as follows:

.1 Same as sheet steel boxes, except of rigid PVC material.

2.3 PULL AND JUNCTION BOXES

.1 Pull and junction boxes: to CSA C22.2 No. 40-M1989 (R2009) and as follows:

.1 Material: sheet steel.
.2 Covers: screw-on, key-lock.
.3 Barriers: where indicated.

2.4 BUSHINGS, KNOCKOUT CLOSURES, AND LOCKNUTS

.1 Bushings, Knockout Closures and Locknuts: to CAN/CSA-C22.2 18.2-06 (R2011), corrosion resistant.

2.5 AIR/VAPOUR HATS

.1 Air/vapour Hats: polyethylene, minimum 0.40 mm thick, with minimum 25 mm wide flanges, designed to be installed over electrical boxes and provide an effective air/vapour seal.

3. Execution

3.1 OUTLET BOX INSTALLATION

.1 Provide boxes where indicated and as required for:

- .1 Splices.
- .2 Taps.
- .3 Wire pulling.
- .4 Equipment.
- .5 Device location.

.2 Install boxes flush mounted, except in following locations where boxes shall be surface mounted:

- .1 Electrical rooms.
- .2 Mechanical rooms.
- .3 Other locations where surface mounting is indicated on drawings.

.3 Except where otherwise indicated, install boxes for vertical mounting of devices.

.4 Support boxes independent from conduit.

3.2 LOCATION OF WALL OUTLET BOXES

.1 Outlets are indicated on drawings schematically. Consider locations indicated as approximate. Verify locations prior to rough-in.

.2 Confirm size and location of equipment supplied and installed under other Sections, prior to rough-in.

.3 Do not install boxes back to back. Allow minimum:

.1 150 mm separation in conventional walls.
.2 600 mm separation in acoustic rated walls.

.4 Position boxes in masonry walls to suit masonry course lines.

.5 Except where otherwise indicated, mount boxes at following heights:

.1	Local switches:	1200 mm
.2	Receptacles:	
.1	General:	300 mm
.2	Above counters:	150 mm
.3	Above baseboard heaters:	200 mm
.4	Utility rooms:	1200 mm
.3	Telephone outlets:	
.1	General:	300 mm
.2	Wall mounted telephone:	1400 mm
.4	Clocks:	2100 mm

.6 Measure mounting height from finished floor to centre line of device.

.7 Minister reserves the right to change location of outlets prior to installation with no change in Contract Price, provided that distance does not exceed 3 m from originally indicated location.

3.3 PULL AND JUNCTION BOX INSTALLATION

.1 Locate above accessible ceilings and in unfinished areas.

.2 Locate so as to minimize need for access doors. Provide access doors as required.

.3 Support boxes independent from conduit.

3.4 AIR/VAPOUR HAT INSTALLATION

.1 Install air/vapour hats around electrical boxes located in walls and ceilings where polyethylene vapour retarder is indicated on drawings or schedules.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Identification:	Section 26 05 53.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1	Wire and Cable:	Section 26 05 13.
.2	Hangers and Supports:	Section 26 05 29.
.3	Boxes and Fittings:	Section 26 05 33.
.4	Cable Trays, Wireways and Surface Raceways:	Section 26 05 36.

1.3 COORDINATION

.1 Coordinate with other work including wire and cable, boxes and fittings and panel work, as necessary to interface installation of conduit with other work.

.2 Coordinate installation of conduit in concrete with work specified in Division 03.

.3 Coordinate installation of conduit in masonry with work specified in Division 04.

.4 Coordinate installation of conduit which penetrates roof or waterproofing membranes with work specified in Division 07.

.5 Coordinate installation of conduit which pass through fire rated walls, floors or ceilings with firestopping work specified in Division 07.

2. Products

2.1 CONDUIT, GENERAL

.1 Except where otherwise required by Canadian Electrical Code (CEC), provide conduit of types specified in Conduit Installation Schedule and sizes indicated on drawings or specified.

.2 Conduit embedded in concrete floors shall be maximum 102 mm size.

.3 Where sizes are not indicated, select proper sizes to suit intended use, fulfill wiring requirements, and comply with Canadian Electrical Code (CEC).

2.2 METAL CONDUIT AND TUBING

.1 Rigid Metal Conduit: to CSA C22.2 No. 45-M1981 (R2003), and as follows:

.1 Galvanized Rigid Steel Conduit: zinc coated steel.

.2 Rigid Aluminum Conduit: with factory applied, closed-end thread protectors.

.3 Fittings: same material as conduit.

.2 Electrical Metallic Tubing (EMT): to CSA C22.2 No. 83.1-07 (R2012), with fittings as follows:

.1 Fitting Material for 25 mm size Conduit and Smaller: zinc alloy or zinc coated steel.

.2 Fitting Material for Conduit Larger than 25 mm Size: zinc coated steel.

.3 Type: compression or set screw, liquid tight for wet or damp areas.

.3 Flexible Metal Conduit: to CSA C22.2 No. 56-04 (R2009), and as follows:

.1 Flexible Metal Conduit: spirally wound, interlocked zinc coated strip steel, minimum 10 mm diameter.

.2 Flexible Metal Conduit Fittings: threadless hinged clamp type.

.3 Liquid-Tight Flexible Metal Conduit: continuous interlocked and double-wrapped steel, zinc coated inside and outside, coated with liquid-tight jacket of flexible PVC, minimum 12 mm diameter.

.4 Liquid-Tight Flexible Metal Conduit Fittings: cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings.

.4 Miscellaneous Fittings: locknuts, bushings, reducers, chase nipples, 3 piece unions, split couplings, plugs, and expansion fittings specifically designed for their particular application.

2.3 NON-METALLIC CONDUIT

.1 Rigid Type EB1 PVC Conduit: to CSA C22.2 No. 211.1-06 (R2011).

.2 Rigid PVC (Unplasticized) Conduit: to CSA C22.2 No. 211.2-06 (R2011).

.3 Reinforced Thermosetting Resin Conduit (RTRC) and Fittings: to CSA C22.2 No. 211.3-96 (R2002)

2.4 NON-METALLIC PIPE/DUCTING

.1 Polyethylene Pipe: to CSA B137.1-95, minimum series 75.

.2 Flexible Plastic Underground Power Cable Ducting: to CSA C22.2 No. 211.1-06 (R2011).

3. Execution

3.1 INSTALLATION OF CONDUIT, GENERAL

.1 Install conduit concealed, in walls, floors, ceilings, above suspended ceilings, and underground, except in following rooms:

.1 Mechanical Room.
.2 Electrical Rooms.

.2 Where required to be concealed, install conduit neatly and close to building structure so as to minimize need for furring.

.3 Installed conduit shall be free from dents, bruises and other damage.

.4 Plug conduit ends to prevent entry of dirt and moisture.

.5 Seal conduit with duct seal compound or fibreglass where conduit leaves heated area and enters unheated area.

.6 Provide necessary flashing and pitchpockets, making watertight joints where conduit passes through roof or waterproofing membranes.

.7 Where conduit crosses building expansion joints, install expansion fitting approved by authority having jurisdiction, complete with grounding jumper. Provide bend or offset in conduit adjacent to building expansion joint where conduit is installed above suspended ceilings.

3.2 INSTALLATION OF METAL CONDUIT AND TUBING

.1 Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

.2 Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

3.3 INSTALLATION OF RIGID METAL CONDUIT

.1 Cut conduit straight, properly ream, cut threads and brush threads clean.

.2 Fasten conduit terminations in sheet metal enclosures with two locknuts and terminate with bushing. Install locknuts inside and outside enclosure.

.3 Conduit installed underground shall be painted with two coats of corrosion inhibiting compound before backfilling.

3.4 INSTALLATION OF NON-METALLIC CONDUIT

.1 Make field bends and solvent cemented joints in accordance with manufacturer's instructions.

3.5 INSTALLATION OF EXPOSED AND SEMI-CONCEALED CONDUIT

.1 Comply with the following when installing conduit exposed in service areas, unfinished areas, finished areas, and in accessible spaces behind ceilings, walls and floors:

.1 Install conduit to conserve headroom and cause minimum interference in spaces through which conduit passes.

.2 Install conduit so as not to interfere with ceiling inserts, luminaires or ventilation ducts or outlets.

.3 Alter routing to avoid structural obstructions, keeping crossovers to a minimum.

.4 Install exposed conduit and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls and structural members.

.5 Run conduit for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.

3.6 INSTALLATION OF CONDUIT IN CONCRETE SLABS

.1 Place conduit between bottom reinforcing steel and top reinforcing steel.

.2 Separate conduit by not less than diameter of largest conduit to ensure proper concrete bond.

.3 Ensure minimum 20 mm concrete cover.

.4 Coordinate with structural details and requirements for mounting and supports.

3.7 CONDUIT INSTALLATION SCHEDULE

Conduit Type	Application
Rigid Aluminum	- Heating cables.
Rigid Type DB2/ES2 PVC	- Service entrances. - All other exterior underground conduit runs.
Flexible Metal	- Connections to luminaires. - Connections to control devices. - Connections to gymnasium boxes.
Liquid-tight Flexible Metal	- Connections to motors.
Polyethylene Pipe or Flexible Plastic Underground Power Cable Ducting	- Mechanical protection of direct buried conductors for car plug-ins.
EMT	- All other applications.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Electrical Identification: Section 26 05 53.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Wire and Cable Section 26 05 13.
.2 Hangers and Supports: Section 26 05 29.

1.3 REFERENCED DOCUMENTS

.1 NEMA VE 2 – Cable tray Installation Guidelines.

1.4 COORDINATION

.1 Coordinate with other work, including wire and cable, boxes and fittings and panel work, as necessary to interface installation of electrical raceways and components with other work.

.2 Coordinate installation of cable trays and wireways which pass through fire rated walls, floors or ceilings with firestopping work specified in Division 07.

2. Products

2.1 RACEWAYS, GENERAL

.1 Provide raceways of types and sizes indicated.

.2 Where not indicated, select proper types and sizes to fulfill wiring requirements and comply with Canadian Electrical Code (CEC).

2.2 COMMUNICATIONS CABLE TRAYS

.1 Cable trays and fittings: to CSA C22.2 No. 126-M91 and EEMAC-F5-1, and as follows:

.1 Type: ladder or wire basket.

.2 Material: steel.

.3 Finish: galvanized and prime painted.

.6 Accessories and fittings: Horizontal elbows, end plates, dropouts, vertical risers and drops, tees, wyes, expansion joints and reducers, manufactured for cable tray supplied. Provide barriers where different voltage systems are in the same cable tray.

.7 Radii on Fittings: minimum 300 mm.

2.3 WIREWAYS

.1 Wireways, Auxiliary Gutters and Associated Fittings: to CSA C22.2 No. 26-1952 and as follows:

.1 Material: sheet steel.

.2 Finish: baked enamel.

.3 Cover: hinged.

.4 Accessories: elbows, tees, couplings, and hanger fittings manufactured for wireway supplied. Provide barriers where required.

2.4 SURFACE RACEWAYS

.1 Surface Raceways and Fittings: to CSA C22.2 No. 62-93 and as follows:

.1 Type: two channel, dual cover, aluminum raceway.

.2 Mounting: surface.

.4 Size: 155 mm x 60 mm.

.5 Finish: corrosion resistant and non-abrasive, inside and outside, satin anodized finish.

.6 Accessories: corners, boxes and adapters, manufactured for raceway system supplied, including device plates for wiring & communications devices as shown on drawings.

.7 Legrand Wiremold ALA4800 series or approved equal.

3. Execution

3.1 INSTALLATION OF RACEWAYS, GENERAL

.1 Install raceways where indicated, in accordance with manufacturer's written installation instructions.

.2 Where exposed, install raceways to conserve headroom and cause minimum interference in spaces through which they pass.

3.2 INSTALLATION OF CABLE TRAYS

.1 Support cable trays with trapeze style hangers as specified in Section 26 05 29, at all bends and tee fittings and as per NEMA VE2 and manufacturer's recommendations.

3.3 INSTALLATION OF WIREWAYS

.1 Support wireways with trapeze style hangers as specified in Section 26 05 29, at 900 mm o.c. and at all bends and tee fittings.

3.4 INSTALLATION OF SURFACE RACEWAYS

.1 Support surface raceways at maximum 900 mm o.c.

.2 Punch suitable openings for conduit offset for surface connections.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1 Site painting of electrical work: Section 09 91 30.

1.2 REFERENCE DOCUMENTS

.1 Comply with requirements of latest edition of "APWSS Colour Coding Requirements for Mechanical and Electrical Systems", hereinafter referred to as "APWSS Colour Coding Requirements".

.2 Obtain copy of APWSS Colour Coding Requirements document from Minister prior to starting work.

2. Products

2.1 IDENTIFICATION MATERIALS

.1 Lamicoid Nameplates: 3 mm thick plastic engraving sheet, black face, white core, mechanically attached, sizes as follows:

.1 Size 1: 12 mm high with 5 mm high letters.
.2 Size 2: 20 mm high with 8 mm high letters.
.3 Size 3: 25 mm high with 12 mm high letters.

.2 Wire Identification Materials: Use one of the following:

.1 Heat shrink sleeves, blank.
.2 Clear plastic tape wrap-on strips with white writing section.
.3 Wrap-on strips, pre-numbered.
.4 Slip-on identification bead markers or sleeves, blank or pre-numbered.

.3 Colour Banding Tape: 25 mm wide adhesive backed plastic tape, integrally coloured.

3. Execution

3.1 COLOUR IDENTIFICATION OF EQUIPMENT

.1 Electrical equipment shall be prefinished in coded colours designating voltage or system, as indicated in Equipment Identification Schedule.

.2 Voltage colour identification for line voltage equipment shall be as follows:

	Voltage	Colour
.1	120/208 V or 120/240 V:	Grey

.3 System colour identification for low voltage systems equipment shall be as follows:

	System	Colour
.1	Fire Alarm and Fire Telephone:	Red
.2	Low Voltage Switching:	Black
.3	Telephone Cabinets:	Blue
.4	Phone cables:	Blue
.4	Computer and Data Systems:	Orange
.5	Clock System:	Brown
.6	Security, Card Access and CCTV:	Green
.7	Public Address:	Purple

.4 Refer to APWSS Colour Coding Requirements document for specific paint colour numbers.

.5 Where impracticable to obtain equipment prefinished in coded colours, equipment may be site painted in coded colours. Coordinate with work specified in Section 09 91 30.

3.2 NAMEPLATE IDENTIFICATION OF EQUIPMENT

.1 Identify equipment with lamicoid nameplates, as indicated in Equipment Identification Schedule.

3.3 PANELBOARD DIRECTORIES

.1 Identify loads controlled by each overcurrent protective device in each panelboard, by means of a typewritten panelboard directory.

3.4 COMMUNICATIONS CABLE AND EQUIPMENT LABELING

.1 Label communication outlets, panels and ports with lamicoid nameplates as specified in Equipment Identification Schedule.

.2 Label each of cables with other ends address using Wire Identification Materials.

.3 Label outlets with labels vertically aligned in each row.

.4 Position panel labels in the same position on each panel.

3.5 INTERMITTENT COLOUR CODING OF CONDUIT AND CABLE

.1 Apply colour banding tape in required colours for each voltage or system in accordance with APWSS Colour Coding Requirements in 25 mm wide bands all around conduit or cable as follows:

.1 At least once in each 3 m of conduit or cable run.
.2 Where conduit or cable enters inaccessible ceiling, wall and floor spaces.
.3 At least once in each room or area through which a conduit or cable passes.

.2 Apply colour banding on electrical conduit and cable in the following locations as defined in Section 09 91 30:

.1 Exposed in service areas.
.2 Exposed in unfinished areas.
.3 Semi-concealed spaces.
.4 Exposed to Exterior.

.3 Apply system colour paint on conduit couplings.

3.6 IDENTIFICATION OF PULL AND JUNCTION BOXES

.1 Identify pull and junction boxes over 100 mm size as follows:

.1 Use boxes which are prefinished in coded colours, or spray paint inside and outside of boxes prior to installation, in coded colours designating voltage or system.

.2 Apply size 2 lamicoid nameplate to cover of each box. Identify system name. Where sequence identification is required, identify system name and number.

.2 Identify pull and junction boxes 100 mm or less in size as follows:

.1 Spray paint inside of boxes in coded colours designating voltage or system.

.2 Apply permanent identifying markings directly to box covers designating voltage or system using indelible black ink.

3.7 COLOUR IDENTIFICATION OF WIRING

.1 Identify No. 4/0 AWG wiring and smaller by continuous insulation colour.

.2 Identify wiring larger than No. 4/0 AWG by continuous insulation colour or by colour banding tape applied at each end and at splices.

.3 Colour coding shall be in accordance with Canadian Electrical Code.

.4 Where multi-conductor cables are used, use same colour coding system for identification of wiring throughout each system.

.5 Maintain phase sequence and colour coding throughout each system.

3.8 NAME/NUMBER IDENTIFICATION OF WIRING

.1 Identify No. 8 AWG wiring and smaller using one of the wire identification materials specified in 2.1.

.2 Type or print on blank wire identification materials using indelible black ink.

.3 Identify wiring at all pull boxes, junction boxes, and outlet boxes for all systems.

.4 Identify each conductor as to panel and circuit, terminal, terminal numbers, system number scheme, and polarization, as applicable.

3.9 IDENTIFICATION OF RECEPTACLES AND FIRE ALARM END-OF-LINE RESISTORS AND DUCT DETECTORS

.1 Standard duplex receptacles: provide lamicoid nametag with 6 mm high white lettering on black background (red background for emergency receptacles) indicating circuit and panel designation and locate on wall above receptacle. On all other receptacles provide lamicoid nametag indicating voltage, phase, amps, circuit and panel designations.

.2 Fire alarm end-of line resistors and duct detectors: identify zone number with 6 mm high white lettering on red background on lamicoid nametag located on wall above device. Identify remote LED indicators for duct detectors.

3.10 EQUIPMENT IDENTIFICATION SCHEDULE

Equipment	Colour	Nameplate Identification	Lamicoid Nameplate Size
Main Distribution Centre	Voltage Colour	- Building name, consulting engineer, date installed, amperage, voltage	3
		- Main breaker Metering cabinet	2
		- Instrument transformer enclosure	2
		- Loads controlled by each overcurrent protective device	1
		- Metering devices	1
Distribution Centres	Voltage Colour	- Distribution centre designation, amperage, and voltage	2
		- Loads controlled by each overcurrent protective device	1
Panelboards	Voltage Colour	- Panelboard designation	2
Manual Motor Starters	N/A	- Load controlled and mnemonics	1
Ground Bus	N/A	- System Ground	1
On/Off Switches	N/A	- Load controlled	1
Disconnect Switches, Magnetic Motor Starters and Contactors:	Voltage Colour	- Voltage and equipment controlled and mnemonics	2
Wireways	N/A	- Voltage and system designation	2
Line Voltage Cabinets and Enclosures	Voltage Colour	- Designation and voltage	2

Equipment	Colour	Nameplate Identification		Lamicoid Nameplate Size
Low Voltage Cabinets and Enclosures	System Colour	-	System name; system name and number if more than one cabinet or enclosure	2
		-	Major components within cabinets and enclosures	1
Communication Outlet and Outlet Assemblies	N/A	-	Outlet Designation	1
Communication Panels	N/A	-	Panel Designation	1
Fire Alarm Control Panels	Red	-	Fire Alarm Panel designation	3
Fire Alarm Annunciator Panels	Red	-	Fire Alarm Panel designation	2
Fire Alarm End of Line Device	Red	-	Fire Alarm Zone or Circuit designation	1
Fire Alarm Mechanical Equipment Controls	Red	-	Fire Alarm Control Zone designation	1

END OF SECTION

1. General

1.1 SCOPE

.1 The Contractor shall furnish short-circuit and protective device coordination studies as prepared by an electrical engineer licensed to practice in the project jurisdiction.

.2 Furnish an Arc Flash Hazard Analysis Study. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in the CSA Z462, Annex D.

.3 The scope of the studies shall include all new distribution equipment under this contract.

1.2 REFERENCES

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
.2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
.3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
.4 IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

.2 American National Standards Institute (ANSI):

.1 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
.2 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

.3 Canadian Electrical Code –CSA C22.1 latest version accepted in the jurisdiction.

.4 Canadian Standards Association (CSA) – Z462 – Workplace electrical safety latest version accepted in the jurisdiction.

.5 National Fire Protection Association (NFPA) – NFPA.70E – Standard for Electrical Safety in the Workplace.

1.3 SUBMITTALS FOR REVIEW/APPROVAL

1 The short-circuit and protective device coordination studies shall be submitted to the Consultant prior to receiving final review of the distribution equipment shop drawings and/or prior to release of final distribution equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Consultant may be obtained for preliminary submittal of sufficient study data to ensure that the selection of devices and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

.1 The results of the short-circuit, and protective device coordination studies and arc flash hazard analysis shall be summarized in a final report.

.2 The report shall include the following sections:

.1 Executive Summary.
.2 Descriptions, purpose, basis and scope of the study.
.3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
.4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
.5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
.6 Details of the incident energy and flash protection boundary calculations.
.7 Recommendations for system improvements, where needed.
.8 One-line diagram.
.9 Copies of the Arc Flash Warning Labels for each distribution equipment to be labelled.

1.5 QUALIFICATIONS

.1 The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting power system studies.

.2 The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

.3 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least 2 actual arc flash hazard analysis it has performed in the past year.

1.6 COMPUTER ANALYSIS SOFTWARE

.1 The studies shall be performed using the latest revision of the SKM systems Analysis Power*Tools for Windows (PTW) software program, ETAP, or, engineer approved equivalent software program.

2. Products

2.1 STUDIES

.1 Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.

.2 The Contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462 – Workplace electrical safety, reference Article 4.3.3 and Annex D.

2.2 DATA COLLECTION

.1 Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, and protective device coordination studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

.2 Source combination may include present and future motors.

.3 Load data utilized may include proposed loads obtained from Contract Documents provided by Consultant or Contractor.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

.1 Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

.2 Transformer design impedances shall be used when test impedances are not available.

.3 Provide the following:

.1 Calculation methods and assumptions.
.2 Selected base per unit quantities.
.3 One-line diagram of the system being evaluated.
.4 Source impedance data, including electric utility system and motor fault contribution characteristics.
.5 Tabulations of calculated quantities.
.6 Results, conclusions, and recommendations.

.4 Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

.1 Electric utility supply termination point.
.2 Utility transformer primary and secondary terminals.
.3 Low voltage switchgear.
.4 Branch circuit panelboards.
.5 Other significant locations throughout the system.

.5 For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

.6 Protective Device Evaluation:

.1 Evaluate equipment and protective devices and compare to short circuit ratings.
.2 Adequacy of switchboard, and panelboard bus bars to withstand short-circuit stresses.
.3 Notify Consultant in writing, if circuit protective devices are improperly rated for the calculated available fault currents.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

.1 Proposed protective device coordination time-current curves (TCC) shall be displayed on log-on scale graphs.

.2 Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

.3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

.4 Identify the device associated with each curve by manufacturer type, function, and , if applicable, tap, time delay, and instantaneous settings recommended.

.5 Plot the following characteristics on the TCC graphs, where applicable:

.1 Electric utility's overcurrent protective device.
.2 Low voltage fuses including manufacturer's minimum melting, total clearing, tolerance, and damage bands.
.3 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
.4 Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.

.5 Conductor damage curves.
.6 Pertinent motor starting characteristics and motor damage points, where applicable.
.7 Pertinent circuit breaker in each applicable panelboard.

.6 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH ANALYSIS

.1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in CSA Z462, Annex D.

.2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, panelboards) where work could be performed on energized parts.

.3 The Arc-Flash Hazard Analysis shall include all locations where work could be performed on energized parts.

.4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 5 J /cm^2.

.5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

.6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all operating conditions. The maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.

.7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

.1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
.2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

.8 For each equipment locations with a separately enclosed main device (where there is adequate separations between the line side terminals of the main protective device and the work locations), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

.9 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculations.

.10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

.11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.6 REPORT SECTIONS

.1 Input data shall include, but not be limited to the following:

.1 Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
.2 Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltages ratings, kVA rating, impedance, % taps and phase shift
.3 Reactor data, including voltage rating, and impedance.
.4 Generation contribution data, (synchronous generator and Utility), including short-circuit reactance (X”d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
.5 Motor contribution data, including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

.2 Short-Circuit Output Data shall include, but not be limited to the following reports:

.1 Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

.1 Voltage.
.2 Calculated fault current magnitude and angle.
.3 Fault point X/R ratio.
.4 Equivalent impedance.

.2 Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

.1 Voltage.
.2 Calculated symmetrical fault current magnitude and angle.
.3 Fault point X/R ratio.
.4 Calculated asymmetrical fault currents based on fault point X/R ratio.
.5 Equivalent impedance.

.3 Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

.1 Voltage.
.2 Calculated symmetrical fault current magnitude and angle.
.3 Fault point X/R ratio.
.4 No AC Decrement (NCD) Ratio.
.5 Equivalent impedance.
.6 Multiply factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
.7 Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.

.3 Recommended Protective Device Settings:

.1 Phase and Ground Relays:

.1 Current transformer ratio.
.2 Current setting.
.3 Time setting.
.4 Instantaneous setting.
.5 Recommendations on improved relaying systems, if applicable.

.2 Circuit Breakers:

.1 Adjustable pickups and time delays (long time, short time, ground).
.2 Adjustable time-current characteristic.
.3 Adjustable instantaneous pickup.
.4 Recommendations on improved trip systems, if applicable.

.4 Incident energy and flash protection boundary calculations:

.1 Arcing fault magnitude.
.2 Protective device clearing time.
.3 Duration of arc.
.4 Arc flash boundary.
.5 Working distance.
.6 Incident energy.
.7 Hazard Risk Category.
.8 Recommendations for arc flash energy reduction.

3. Execution

3.1 FIELD ADJUSTMENT

.1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering services division of the equipment manufacturer under the Startup commissioning and Acceptance Testing contract portions.

.2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

.3 Notify Consultant in writing as early as possible of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

.1 Provide a 89 mm 127 mm thermal transfer type label of high adhesion polyester for each work location analyzed.

.2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Consultant and after any system changes, upgrades or modifications have been incorporated in the system.

.3 The label shall include the following information, at a minimum:

.1 Location designation.
.2 Nominal voltage.
.3 Arc flash protection boundary.
.4 At least one of the following:
.1 Available incident energy and the corresponding working distance,
.2 Minimum arc rating of PPE,
.3 Required level of PPE, and/or
.4 Highest Hazard/Risk category for the equipment.
.5 Date of hazard analysis.

.4 Labels shall be machine printed, with no field markings.

.5 Arc flash labels shall be provided in the following manner and all labels shall be provided:

.1 For each 208 volt panelboard, one arc flash label shall be provided.
.2 For each low voltage switchboard, one arc flash label shall be provided.

3.3 ARC FLASH TRAINING

.1 The contactor shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours).

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies general requirements common to all starting and testing of electrical equipment and systems. Read this Section in conjunction with related Sections which specify specific portions of electrical starting and testing work.

.2 Except where otherwise specified, arrange and pay for the testing and related requirements specified in this and related Sections.

.3 If test results do not conform with applicable requirements, repair, replace, or adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

1.2 RELATED SECTIONS

.1	Electrical Operation and Maintenance Manuals:	Section 26 01 11.
.2	Electrical Starting and Testing by Contractor:	Section 26 08 20.
.3	Electrical Starting and Testing by Contractor's Testing Agent:	Section 26 08 30.
.4	Electrical Equipment and Systems Demonstration and Instruction:	Section 26 08 40.

1.3 SUBMITTALS

1 Submit to the Minister a list of equipment and instruments which will be used in starting, testing, balancing and adjusting electrical equipment. The Minister may require changes to the proposed equipment and instruments.

1.4 REPORTS

.1 Submit field reports in accordance with Section 26 01 10.

1.5 STARTING AND TESTING - GENERAL

.1 Prior to testing ensure all electrical equipment is cleaned and free of dust.

.2 After testing, protect equipment subject to dust from construction activities.

.3 Notify Minister when starting and testing of all systems has been completed.

.4 Do not conceal or cover equipment until inspected, tested and approved by Minister.

.5 Assume all liabilities associated with starting, testing and balancing procedures.

.6 Assume all costs associated with starting, testing, adjusting and balancing, including supply of testing equipment and witnessing of factory testing by Contractor and Minister.

1.6 WITNESSING OF STARTING AND TESTING

.1 Prior to starting and testing of electrical equipment or systems, prepare a schedule of all tests specified. Review schedule with Minister.

.2 Provide sufficient notice (minimum three days) prior to commencing tests requiring witnessing by Minister.

.3 Minister or Minister's Performance Testing Agent may witness all or any portion of testing and starting procedures performed by Contractor or Contractor's Testing Agent.

.4 Contractor shall be present for all tests specified in Section 26 08 30.

1.7 MANUFACTURER'S STARTING RECOMMENDATIONS

.1 Prior to starting equipment or systems, obtain and review manufacturer's installation, operation and starting instructions. Read in conjunction with procedures specified in Sections 26 08 20 and 26 08 30.

.2 Use manufacturer's and supplier's starting personnel where required to maintain validity of manufacturer's warranty. Confirm with manufacturer that all testing specified in this Section and Sections 26 08 20 and 26 08 30 will not void any warranties.

.3 Compare installation to manufacturer's published data and record discrepancies. Modify procedures detrimental to equipment performance prior to starting equipment.

1.8 MANUFACTURER'S SERVICE ON SITE

.1 Arrange and pay for qualified manufacturer's representatives to supervise starting and testing of following electrical equipment and systems:

.1 Clock and Program Equipment.
.2 Sound System.
.3 Closed Circuit Television System.
.4 Security System.
.5 Fire Alarm System.
.6 Transfer Switch.
.7 Variable Frequency Drives.

.2 Manufacturer's personnel shall be experienced in design and operation of equipment and systems being started and have ability to interpret results of readings, and tests and report results in a logical fashion.

1.10 REFERENCE DOCUMENTS

.1 Perform tests in accordance with:

.1 These Contract Documents.
.2 Requirements of authorities having jurisdiction.
.3 Manufacturer's published instructions.
.4 Applicable CSA, IEEE, IPCEA, EEMAC, NEMA and ASTM standards.

.2 If requirements of any of the foregoing conflict, notify Minister before proceeding with tests and obtain clarification.

1.11 CONTRACTOR AND MANUFACTURER REPORTS

.1 Log and tabulate test results on appropriate test report forms provided by the Minister.

.2 Submit completed test report forms immediately after tests are performed.

.1 Record all data gathered on site on approved test report forms.
.2 Note any damage, missing parts or incomplete work on test form.
.3 Record date of corrected deficiencies on form.
.4 Arrange for Minister to initial completed test report forms prior to the end of the work day that information is gathered. Provide the Minister with one photo copy of each completed test report form.
.5 Maintain one photocopy on site of all data taken during starting and testing period.
.6 Maintain one copy of all final starting, testing, balancing and adjusting reports on site up to interim acceptance of the work for reference purposes.

.3 Arrange for manufacturer to submit copies of all production test records for production tests required by EEMAC and CSA standards for manufactured electrical equipment to the Minister prior to shipping.

.4 Arrange for manufacturer to submit brief step-by-step description of entire starting procedure to allow Minister to repeat starting at any time.

1.12 CORRECTION OF DEFICIENCIES

.1 Correct all contract deficiencies found during electrical starting and testing of equipment and systems and Minister's performance verification.

1.13 CONTRACTOR'S TESTING AGENT(S)

.1 Arrange and pay for services of testing agent(s) to perform tests and verifications specified in Section 26 08 30 - Electrical Starting and Testing by Contractor's Testing Agent.

.2 Contractor's Testing Agent(s) Qualifications:

.1 Registered testing firm whose normal day to day business is electrical testing.

.2 Testing agent shall be independent of any Supplier, Contractor or Subcontractor who's work is tested and shall not have any financial or other interests in or with the Contractor.

.3 Employ at least one electrician holding a current journeyman's certificate in the Province of Alberta.

.3 Contractor's Testing Agent(s) Report:

.1 Arrange for Contractor's Testing Agent(s) to submit three bound copies of all test results, together with deficiency lists, and summary of tests, and include recommendations for any corrective action required directly to the Minister.

1.14 COORDINATION

.1 Coordinate starting of electrical equipment and systems with testing and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 26.
.2 Mechanical equipment and systems specified in Division 20 to 23.
.3 Other equipment and system specified in other Divisions.

.2 Where any equipment or systems requires testing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

1.15 IMPLEMENTATION

.1 Except where otherwise specified, perform all testing and related requirements specified herein prior to Interim Acceptance of the Work.

.2 Perform load balance, power factor and voltage testing three months after Practical Completion of facility.

1.16 SCHEDULING

.1 Provide a contractor start-up schedule as specified in Division 01.

2. Products

2.1 TEST EQUIPMENT

.1 Provide all equipment and tools necessary to perform testing specified and as otherwise required.

3. Execution

Not Used

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with 26 08 10 - Electrical Starting and Testing - General Requirements and other related electrical starting and testing Sections.

2. Products

Not Used

3. Execution

3.1 BASIC ELECTRICAL START-UP AND TESTING

.1 Energizing Main Electrical System:

.1 Prior to energizing main electrical system:

.1 Verify supply authority voltage and phase rotation.
.2 Ensure all testing as specified in Section 26 08 30 has been completed and deficiencies have been corrected.
.3 Megger all feeders and record results on approved test report forms.

.2 Testing of Wiring and Wiring Devices:

.1 Test conductors at distribution centres and panelboards for insulation resistance to ground (megger test).
.2 Test service grounding conductors for ground resistance.
.3 Test all wiring devices for correct operation and circuitry.

.3 Ground Resistance Testing:

.1 Measure ground resistance of ground grids with earth test megger to verify compliance with CSA C22.2 No. 0.4 (R2013) and Canadian Electrical Code.

.4 Load Balance Testing:

.1 Perform load tests with as many building loads on as possible prior to Interim Acceptance and three months after Practical Completion.

.2 Test load balance on all feeders at distribution centres and lighting panelboards.

.3 If load unbalance exceeds 15%, reconnect circuits to balance loads. Revise panelboard directories and wiring identification accordingly.

.5 Starting Motors:

.1 Prior to starting motors:

.1 Confirm motor nameplate data with motor starter heater overloads, setting of MCP's and sizing of fuses.
.2 Verify rotation.
.3 Ensure disconnects are installed.
.4 Confirm labeling of motors, disconnects and starters.

.2 Measure and record operating load amp readings for all three phase motors.

3.2 LIGHTING

.1 Function test all light switches, luminaires, dimmers and lighting control equipment such as photo-cells and time clock settings, low voltage relay panels, and controllers.

.2 Check operation of all battery operated emergency lighting units, exit lights and connection of exit lights to emergency lighting units as specified.

.3 Record all photo-cell and time-clock settings.

3.3 CLOCK AND PROGRAM EQUIPMENT

.1 Prior to function testing of system, perform following in conjunction with manufacturer:

.1 Check installation of master clock and all secondary clocks. Ensure wiring has been properly terminated.

.2 Confirm operation of master clock features and all clocks.

.3 Confirm operation of interval or elapsed time clocks.

.2 Manufacturer shall function test system as follows:

.1 Function test master clock with respect to automatic secondary clock correction, manual clock correction and automatic daylight savings corrections.

.2 Check secondary clock correction.

.3 Check start, stop, reset operations of interval timer clocks.

.3 Record results on approved test report forms.

3.4 SOUND SYSTEM

.1 Prior to function testing of system, perform following in conjunction with manufacturer:

.1 Manufacturer shall install all head-end equipment and terminate all wiring.

.2 Test system for proper operation and sound level readings taken. Adjust equipment and speaker settings to meet levels specified and documented.

.3 Verify correct operation of all paging zones, all page and other system functions.

.2 Manufacturer shall function test system in presence of the Minister as follows:

.1 Confirm operation of all sound equipment including amplifiers, pre-amplifiers, tuner, tape deck, microphone, speakers and any other auxiliary equipment.

.2 At various settings of amplifier, record sound pressure levels (SPL) under each speaker and half-way between each speaker.

.3 Check all interconnections with other systems.

.3 Record results on approved test report forms.

3.5 CLOSED CIRCUIT TELEVISION SYSTEM

.1 Prior to function testing system, perform following:

.1 Check installation of all cameras, monitors and control units and proper identification.

.2 Check operation of all camera pan/tilt controls and zoom lenses.

.3 Check clarity of pictures on all monitors at minimum and normal light levels.

.2 Manufacturer shall function test system in presence of the Minister as follows:

.1 For each camera, check operation of camera, zoom lens and pan/tilt control. For exterior camera's, check heaters and wipers.

.2 Check clarity of picture at monitor. Check monitors with camera's at minimum light levels.

.3 Check all interconnections with other systems.

.3 Record results on approved test report forms.

3.6 SECURITY SYSTEM

.1 Prior to function testing of system, perform following in conjunction with manufacturer:

.1 Ensure all equipment is properly installed and all terminations completed.

.2 Prior to testing, ensure all programming is complete and software is performing correctly.

.3 Ensure all magnetic locks, door contacts and card readers are operational.

.2 Manufacturer shall function test system in presence of the Minister as follows:

.1 Door Supervision System:

.1 Check installation and operation of all door contacts and control panels, including automatic dialer, if specified.

.2 Confirm proper door labeling on all annunciators and main control.

.3 Record results on approved test forms.

.2 Card Access System

.1 Check installation of all equipment.

.2 Confirm operation of each door. Check door contacts, proper latching of magnetic locks, card operation and exit push buttons.

.3 Confirm correct labeling of doors in programming.

.4 Check remote alarming via automatic dialers.

.3 Check all interconnections with other systems.

.3 Record results on approved test report forms.

3.7 COMMUNICATIONS CABLING

.1 Check installation of all equipment.

.2 Ensure all cables are properly identified at each end and correctly terminated prior to testing as specified in Section 26 08 30.

END OF SECTION

Plan No: 016559
Project ID: B4166A-0001

1. General

1.1 INTENT

.1 Read this Section in conjunction with 26 08 10 - Testing and Starting of Electrical Equipment and Systems - General Requirements and other related Electrical Starting and Testing Sections.

1.2 REFERENCED DOCUMENTS

.1 Alberta Building Code, ABC-2014

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems and Fire Protection Commissioning

2. Products

Not Used

3. Execution

3.1 MAIN DISTRIBUTION CENTRE - LOW VOLTAGE

.1 Enclosure:

.1 Visually inspect.

.2 Torque all bus connections to manufacturers requirements and seal with red lacquer.

.3 Megger test main bus at 1000 V.

.4 Check phasing and continuity of horizontal and vertical bus. This includes phasing and phase rotation of incoming service.

.2 Wiring Checks:

.1 Check all control, relaying and instrumentation wiring against vendor wiring schematics, three line diagrams and project specifications.

.2 Test each circuit for continuity using a buzzer or similar device.

.3 Check polarity and verify phase relationships on all three phase metering circuits.

.4 Where errors are discovered and changes are required, mark up and note required corrective action on vendor prints.

.3 Instrumentation:

.1 Test and calibrate all digital metering units in accordance with manufacturers bulletins.

.2 Check calibration on all ammeters using 5 Amp secondary injection test.

.3 Perform wiring checks as listed above.

.4 Breakers - Air Circuit Breakers:

.1 Visually inspect.

.2 Clean and lubricate.

.3 Contact resistance (ductor) test and adjust contacts.

.4 Insulation resistance (Megger) test.

.5 Mechanical function test.

.6 Electrical function test.

.7 Test and calibrate, to settings provided, all elements of solid state trip unit as follows:

.1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.

.2 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instruction.

.3 If the manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.

.4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.

.5 Check C/T and P/T ratios and compare to coordination data.

.5 Breakers - Molded Case Breakers 150 Amp Frame and Larger:

.1 Visually inspect.

.2 Ductor test.

.3 Megger test.

.4 Mechanical function test.

.5 Set all units with adjustable magnetic trip units.

.6 Where solid state protection is provided with large breakers, test units as follows:

.1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.

.2 Set and test to settings provided in coordination study.

.3 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instruction.

.4 If manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.

.5 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.

.6 Check C/T and P/T ratios and compare to coordination data.

3.2 COMMUNICATION CABLING TESTING

.1 Test all runs upon completion of permanent terminations, using instrumentation acceptable to Minister. Before commencing testing, submit sample test data sheet(s) and information with respect to test instrumentation to be used.

.2 Copper Media:

.1 Test for the following:

.1 Continuity.
.2 Pair placement and polarity.
.3 DC resistance.

.4 Characteristics at Highest contemplated frequency for data and voice cables:
.1 Attenuation.
.2 Return Loss, Reflective Signal Loss
.3 Pair-to-pair NEXT and PS NEXT, measured at both ends
.4 Pair-to-pair ACRF and PS ACRF, measured at both ends
.5 Mutual Capacitance.
.6 Propagation Delay/Delay Skew.
.5 Run length.

.2 Before recording results, compare readings to predicted values based on cable specification and run length, using connector and patch cord losses as part of predicted value. Retest runs with:

.1 Resistance and capacitance readings more than 10% above or below predicted values.
.2 NEXT, PS NEXT, ACRF or PS ACRF values 3dB higher than predicted values.
.3 Attenuation values 2dB higher than predicted values.

.3 Reconnect or re-install and retest as necessary to correct excessive variations.

.3 Fiber Optic Media:

.1 Ensure that test instrument is temperature-stabilized or is temperature-independent or temperature-compensated before commencing test.

.2 Test for following:

.1 Run attenuation at 850 nm and 1300 nm wavelengths.
.2 Run length.

.3 Before recording results, compare readings to predicted values based on cable specification and run length, using connector and patch cord losses as part of predicted value. Retest runs with:

.1 Attenuation values greater than 6.0 dB/km @ 850 nm and 4.0 dB/km @ 1300 nm.

.4 Reconnect or re-install and retest as necessary to correct excessive variations.

.4 Reports:

.1 Record results in tabular form.

.2 Segregate horizontal runs, inter-room runs, and risers by category or run and by type of cable.

.3 Present horizontals' results in ascending order, following sequential numbering.

.4 Report Submission:

.1 Submit report to Consultant for review. Provide report as part of O&M manuals.

.2 Submit report prepared in electronic form using Microsoft Excel or Lotus 1-2-3 on compact disc or dvd.

3.3 COMMISSIONING OF LIFE SAFETY AND FIRE PROTECTION SYSTEMS

1 General:

.1 For the Life Safety and Fire Protection systems, all integrated systems shall be commissioned as a whole to ensure the proper operation and inter-relationship between the systems.

.2 The intent of this section is to describe a commissioning process defined and monitored by a contractor-hired "Commissioning Agent" and implemented by the "Contractor". Morrison Hershfield is capable of performing the Commissioning Agent role, if so desired.

.3 Except where otherwise specified, arrange and pay for the testing and related requirements specified.

.4 The Commissioning Agent shall be responsible for reviewing all drawings and specifications to determine required systems for testing, and testing procedures.

.5 The Commissioning Agent is to prepare testing procedures and appropriate forms for recording testing results, with the CAN/ULC-S1001 referenced as a minimum standard.

.6 The testing procedures and appropriate forms shall be submitted for client review.

.7 Prior to testing of systems, prepare a schedule of all tests specified. Review schedule with client.

.2 Testing:

.1 Testing shall not commence until after the completion of the Fire Alarm Verification.

.2 Provide all equipment and tools necessary to perform testing specified and as otherwise required.

.3 Prior to testing ensure all equipment is cleaned and free of dust.

.4 After testing, protect equipment subject to dust from construction activities.

.5 Notify client when testing of all systems has been completed.

.6 Assume all liabilities associated with testing procedures.

.7 Assume all costs associated with testing and adjusting.

.8 The Commissioning Agent is to witness all of testing procedures performed by Contractor.

.9 The Contractor shall be present for all tests.

.10 If test results do not conform with applicable requirements, repair, replace, or adjust or balance equipment and systems. Repeat testing as necessary until acceptable results are achieved.

.11 Correct all contract deficiencies found during testing of equipment and systems.

.12 The following systems shall be included in the integrated systems testing at a minimum:

.1 Fire Alarm
.2 Mechanical Building Automation System
.3 Security Intrusion Alarm
.4 Security Access Control & Door Hardware
.5 Public Address

.3 Report:

.1 Submit completed test report forms immediately after tests are performed:

.1 Record all data gathered on site on approved test report forms.
.2 Note any damage, missing parts or incomplete work on test form.
.3 Record date of corrected deficiencies on form.

.2 Prepare commissioning report using forms prepared and supplied from the Commissioning Agent.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Identification:	Section 26 05 53.
.3	Main Distribution Centre:	Section 26 18 37.
.4	Distribution Panelboards:	Section 26 24 16.
.5	Branch Circuit Breaker Panelboards:	Section 26 24 17.
.6	Motor Starters:	Section 26 29 13.

1.2 PRODUCT DATA

.1 Comply with requirements of Section 26 00 10.

.2 Provide manufacturer's product data for all devices.

.3 Provide following information:

.1 Time current characteristic curves on full size (280 mm x 432 mm) log-log time/current graph paper.

.2 Fault interrupting capability of each device in symmetrical amperes at applied voltage.

.3 Time current curves for all circuit breaker overload, overcurrent and ground current tripping devices.

.4 Relay current transformer ratios, accuracy class and current sensor tap ranges.

.5 Motor control overcurrent protective device characteristics and curves.

1.3 SOURCE OF SUPPLY

.1 Supply all overcurrent protective devices in each of the following categories by a single manufacturer:

.1 Moulded case circuit breakers.
.2 Air circuit breakers.

2. Products

2.1 MOULDED CASE CIRCUIT BREAKERS - GENERAL

.1 Moulded Case Circuit Breakers: to CAN/CSA-C22.2 No. 5.1-M91.

2.2 BRANCH MOULDED CASE CIRCUIT BREAKERS

.1 Trip Type: thermal/magnetic.

.2 Voltage: as indicated in schedules.

.3 Poles: as indicated in schedules.

.4 Interrupting Capacity: as indicated in schedules.

.5 Mounting: bolt-in any position.

.6 Normal operation: in 40°C ambient.

.7 Features:

.1 Thermal and instantaneous magnetic trip.
.2 Trip free, toggle type operation.
.3 Quick-make, quick-break action.
.4 Positive handle trip indication.
.5 Trip rating visible with panel trim installed.

2.3 FEEDER MOULDED CASE CIRCUIT BREAKERS

.1 Trip Type: thermal/magnetic.

.2 Voltage: as indicated in schedules.

.3 Poles: as indicated in schedules.

.4 Interrupting Capacity: as indicated in schedules.

.5 Mounting: bolt-in any position.

.6 Normal operation: in 40 °C ambient.

.7 Features:

.1 Thermal and instantaneous magnetic trip.
.2 Trip free, toggle type operation.
.3 Quick-make, quick-break action.
.4 Positive handle trip indication.
.5 Trip rating visible with panel trim installed.

2.4 AIR CIRCUIT BREAKERS

.1 Industrial Air Circuit Breakers: to CAN/CSA C22.2 No. 5.1-M91 and IEEE No. 20 1973.

.2 Interrupting Rating: as indicated in schedules.

.3 Frame: non magnetic metal frame, complete with frame ground, 3 or 4 pole. Frame size as per schedule.

.4 Contacts: high pressure segment type with arcing auxiliary.

.5 Arc Chutes: non combustible, removable, blowout design.

.6 Mechanism: stored energy quick make, quick break.

.7 Operation: manual close, trip operator clearly labelled.

.8 Indicator: open/close visual indicator. Dead front design.

.9 Phase isolation with interphase insulated barriers.

.10 Automatic Trip Unit: solid state consisting of current monitors and sensor unit. Self-powered. Operating temperature -40° to +55°C.

.11 Auxiliary Contacts: two Form C.

.12 Current monitors: mounted on breaker frame. Tap setting or monitor rating to be shown on front of breaker.

.13 Sensor Unit:

- .1 Type: solid state electronic sensor powered from current monitor source.
- .2 Calibration: visible identified trip adjustment/calibration from front of breaker.
- .3 Mounting: on breaker frame.
- .4 Trip Actuation: powered by circuitry within the monitor sensor device.
- .5 Trip Indication: visual On/Off.
- .6 Adjustments:
  - .1 Long delay pickup.
  - .2 Long delay time.
  - .3 Short delay pickup.
  - .4 Short delay time.
  - .5 Instantaneous trip.
  - .6 Ground fault pickup.
  - .7 Ground fault delay time.
  - .8 Ground fault restraining signal.

.14 Spring charging circuit.

.15 Drawout circuit breakers equipped with:

.1 Self-storing supporting rails.
.2 Primary multi-segment silverplated contacts. Fixed stationary contacts in switchgear. Segments contacts on breaker frame.
.3 Self-aligning rails and primary contacts.
.4 Safety interlocks to prevent withdrawing or inserting breaker while in closed position.
.5 Secondary auxiliary contacts.
.6 Racking tools and/or devices.
.7 Engaged, test, and withdrawn position indicator.

.16 Accessories:

.1 Remote control terminals.
.2 interlocking terminals.
.3 Alarm contacts.

.17 Compact dimensions to fit into specified distribution centre.

3. Execution

3.1 INSTALLATION

.1 Install overcurrent protective devices as indicated, in accordance with manufacturer's written instructions.

.2 Fasten overcurrent protective devices without causing mechanical stresses, twisting or misalignment of equipment in final position.

.3 Set field-adjustable trip settings as indicated subsequent to installation.

.4 Overcurrent protective device sizes and identification as specified in respective equipment schedules.

3.2 TESTING AND ADJUSTING

.1 Comply with requirements of Section 26 08 10.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Identification:	Section 26 05 53.
.3	Overcurrent Protective Devices:	Section 26 18 16.
.4	Surge Protection Devices:	Section 26 19 46.
.5	Distribution Panelboards:	Section 26 24 16.
.6	Utility Metering:	Section 26 27 13.
.7	Main Distribution Centre Metering:	Section 26 27 14.

1.2 REFERENCE DOCUMENTS

.1 CSA C22.2 No. 29-15 - Panelboards and Enclosed Panelboard.

.2 CAN/CSA-C22.2 No. 76-M92 - Splitters.

1.3 PRODUCT DATA

.1 Comply with requirements of Section 26 00 10.

.2 Provide manufacturer's product data for all systems and components.

.3 Provide data on recommended environmental conditions for equipment affected by temperature.

.4 Dimensions of equipment were sized using Eaton design information. Contractor shall ensure that the physical dimensions of equipment submitted will

1.4 COORDINATION

.1 Coordinate size and location of concrete housekeeping bases with work specified in Section 03 30 00.

2. Products

2.1 PREASSEMBLED TYPE MAIN DISTRIBUTION CENTRE

.1 Main Distribution Centre: to CSA C22.2 No. 29-15 and as follows:

.1 Bus Characteristics:

.1 Capacity: as shown on drawings.
.2 Construction: Rectangular section copper, silver plated joints.
.3 Bracing: as shown on drawings.
.4 Neutral: full capacity, solid neutral design.
.5 Ground bus: copper.

.2 Enclosure:

.1 Prefinished painted sheet steel.
.2 Uniform height, depth and width.
.3 Internal barriers to separate the various components.
.4 Bushed ports or buspads in barriers.
.5 Separate barriered compartment for metering transformers.
.6 Main breaker compartment suitable for mounting drawout breaker.
.7 Component arrangement as indicated on drawings.
.8 Drip cover.
.9 Maximum depth: 610 mm.
.10 Breaker lifting device, cantilever type with continuous rail on top of main distribution centre.

.3 Trim:

.1 Sectionalized.
.2 Screw-on cover over main breaker.
.3 Hinged cover with sealing studs over metering transformer section.
.4 Hinged door on door construction cover dished back to breaker faces with hinged locking door over feeder breaker section.

.4 Overcurrent Protective Devices: As specified in Section 26 18 16 and as follows:

.1 Main breaker: drawout, air circuit breaker case.
.2 Feeder breakers: bolt-in, moulded case.

.5 Coordination Curves: As specified in Section 26 18 16.

3. Execution

3.1 INSTALLATION

.1 Install main distribution centre securely, plumb and square to adjoining surfaces on 100 mm concrete housekeeping base.

.2 Connect main service cable(s) to main breaker.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Main Distribution Centre:	Section 26 18 37.
.2	Distribution Panelboards:	Section 26 24 16.
.3	Branch Circuit Panelboards:	Section 26 24 17.

1.2 PRODUCT OPTIONS AND SUBSTITUTIONS

.1 Refer to Division 01 for requirements pertaining to product options and substitutions.

1.3 REFERENCED DOCUMENTS

.1 ANSI/UL 1449 3rd Edition, Surge Protection Devices

.2 UL 67, Panelboards

.3 UL 96A, Installation Requirements for Lightning Protection Systems

.4 ANSI/IEEE C62.41, Guide for Surge Voltages in Low-Voltage AC Power Circuits

1.4 APPROVALS

.1 The system shall have proper listing and/or approval from the following nationally recognized agencies:

.1 ULC Underwriters Laboratories Canada
.2 CSA Canadian Standards Association

1.5 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

.1 Comply with requirements of Section 26 00 10.

1.6 OPERATION AND MAINTENANCE DATA

.1 Comply with requirements of Section 26 01 11.

1.7 QUALIFICATIONS

.1 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

.2 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

.3 The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.8 WARRANTY

.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least ten (10) years from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this guarantee period shall be included in the submittal bid.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

2. Products

2.1 PRODUCT MANUFACTURERS

.1 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

2.2 VOLTAGE SURGE SUPPRESSION - GENERAL

.1 Electrical Requirements

.1 Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

.2 Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

.3 The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

.4 Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●

Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

.5 Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

.6 ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

.2 SPD Design

.1 Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

.2 Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

.3 Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.

.4 Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

.5 Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

.1 Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

.1 For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode.

.2 For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

.3 The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

.2 Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

.3 Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

.4 Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total:

.1 The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

.6 Overcurrent Protection

.1 The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

.7 Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

.8 Safety Requirements

.1 The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

.2 SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.3 SYSTEM APPLICATION

.1 The SPD applications covered under this section include distribution and branch panel locations, busway, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

.2 Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	**Application**	**Per Phase**	**Per Mode**
C	Service Entrance Locations (Switchboards, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, Busway)	120 kA	60 kA

.3 SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.4 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

.1 The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

.1 The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

.2 SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

.3 The panelboard shall be capable of re-energizing upon removal of the SPD.

.4 The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.

.5 The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.

.6 The complete panelboard including the SPD shall be UL67 listed.

.2 Switchboard and Busway Requirements

.1 The SPD application covered under this section is for switchboard and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

.2 The SPD shall be of the same manufacturer as the switchboard, and busway.

.3 The SPD shall be factory installed inside the switchboard, and/or bus plug at the assembly point by the original equipment manufacturer.

.4 Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

.5 The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

.6 The SPD shall be integral to switchboard, and/or bus plug as a factory standardized design.

.7 All monitoring and diagnostic features shall be visible from the front of the equipment.

3. Execution

3.1 INSTALLATION

.1 Install equipment in accordance with manufacturer's requirements.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Identification:	Section 26 05 53.
.3	Testing, Adjusting and Balancing of Electrical Equipment and Systems:	Section 26 08 10.
.4	Overcurrent Protective Devices:	Section 26 18 16.

1.2 SOURCE OF SUPPLY

.1 All distribution panelboards shall be by a single manufacturer.

1.3 PRODUCT DATA

.1 Comply with requirements of Sections 26 00 10.

.2 Provide manufacturer's product data for all systems and components.

.3 Provide data on manufacturer's recommended environmental conditions for equipment affected by temperature.

2. Products

2.1 DISTRIBUTION PANELBOARDS

.1 Distribution panelboards to CSA C22.2 No.29-M1989 and as follows:

.1 Bus characteristics:

.1 Construction: rectangular section copper silver plated joints.

.2 Bracing: as shown on drawings.

.3 Neutral: full capacity, solid neutral design.

.4 Ground bus: copper.

.2 Enclosure:

.1 Prefinished painted sheet steel.
.2 Uniform height, depth and width.
.3 Drip cover.

.3 Trim:

.1 Hinged door on door construction cover dished back to device face with hinged locking door, 2 keys per unit.

.4 Overcurrent Protective Devices: bolt-in breakers as specified in Section 26 18 16.

3. Execution

3.1 INSTALLATION

.1 Install panelboards securely, plumb and square to adjoining surfaces. Mount panelboards 1800 mm and larger on 100 mm concrete base.

.2 Install panelboards flush or surface as indicated.

.3 Mount panelboards at not less than 1800 mm to top of trim.

.4 Connect loads to feeder breakers as specified in distribution panelboard schedules.

.5 Breaker sizes as specified in distribution panelboard schedules.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Identification:	Section 26 05 53.
.3	Overcurrent Protective Devices:	Section 26 18 16.
.4	Surge Protection Devices:	Section 26 19 46.

1.2 SOURCE OF SUPPLY

.1 All branch circuit panelboards shall be by a single manufacturer.

1.3 REFERENCE DOCUMENTS

.1 CSA C22.2 No 29-M1989, Panelboards and Enclosed Panelboard.

1.4 PRODUCT DATA

.1 Comply with requirements of Section 26 00 10.

.2 Provide manufacturer's product data for all components.

.3 Provide data on manufacturer's recommended environmental conditions for equipment affected by temperature.

2. Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No 29-M1989 and as follows:

.1 Bus Characteristics:

.1 Construction: rectangular section copper silver plated joints.
.2 Bracing: as shown on drawings.
.3 Neutral: full capacity, solid neutral design.
.4 Ground bus: copper

.2 Enclosure:

.1 Flush mounted: galvanized sheet steel.
.2 Surface mounted: prefinished, painted sheet steel.
.3 Drip cover.

.3 Trim:

.1 Door-On-Door Construction, concealed hinges and mounting screws, hinged locking door and flush catch, 2 keys per panel.

.4 Overcurrent Protective Devices: bolt-in breakers as specified in Section 26 18 16, with unused spaces complete with blank coverplates.

.5 Surge Protection Devices: as specified in Section 26 19 46.

3. Execution

3.1 INSTALLATION

.1 Install panelboards securely, plumb and square to adjoining surfaces.

.2 Install panelboards flush or surface as indicated.

.3 Mount panelboards at 1800 mm to top of trim.

.4 Connect loads to circuits as indicated.

.5 Number of breakers, and sizes specified in Schedules.

.6 Install two spare 21 mm conduits stubbed up into ceiling space for flush panelboards only.

.7 Labels and directories as per section 26 05 53.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1 Electrical General Requirements: Section 26 00 10.
.2 Main Distribution Centre: Section 26 18 37.

1.2 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

.1 Install the following materials supplied by Utility:

.1 Current transformers for utility metering.
.2 Potential transformers for utility metering.

1.3 COORDINATION

.1 Coordinate location of meter cabinet with Utility.

2. Products

2.1 METERING TRANSFORMER CABINET

.1 Separate barriered compartment in main distribution centre with hinged door and sealing studs. Confirm size with Utility.

3. Execution

3.1 INSTALLATION

.1 Install metering transformer cabinet at location indicated on drawings.

.2 Provide 35 mm conduit from metering transformer cabinet to meter.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1 Electrical General Requirements: Section 26 00 10.
.2 Electrical Operation and Maintenance Data: Section 26 01 10.
.3 Testing, Adjusting, and Balancing of Electrical Equipment and Systems: Section 26 08 10.
.4 Main Distribution Centre: Section 26 18 37.

2. Products

2.1 DIGITAL AC METERING SYSTEM

.1 Provide a microprocessor based digital AC metering system capable of providing following electrical measurements:

.1 Volts on each phase.
.2 Current on each phase.
.3 Frequency.
.4 Power factor.
.5 Kilo-Volt-Amperes.
.6 Kilowatts.
.7 Total MWH.
.8 Programmable KW set point[s] with dry contact relay output[s].
.9 KW hour storage for 24 hours.
.10 Historic minimum and maximum data for all measured parameters.

.2 Technical Features:

.1 Display: 20 character alphanumeric 10 mm high.

.2 Readout: two fields:

.1 Field 1: Volts and amperes for phases A, B, and C or average selectable by front panel button.

.2 Field 2: Any one of KVA, KW, PF frequency or MWH, or automatic sequence of all selectable by front panel button.

.3 Display update rate: every 3 seconds.

.4 Control: 4 buttons to provide the following operating modes:

.1 Auto sequence.
.2 Non-sequence.
.3 Display maximum.
.4 Display minimum.

.5 Reset field parameters.

.5 Communications:

.1 RS232-C output.
.2 RS485 serial output for modem connection.
.3 Modbus communication.
.4 BACnet/IP communication.
.5 Ethernet communication.

.6 Accuracy:

.1 One per cent for:

.1 Voltage
.2 Amperes.

.2 One Hertz for frequency.

.3 Three per cent for:

.1 KVA.
.2 KW.
.3 MWH.

.7 Alarm Contacts:

.1 Set Point: adjustable for when measured load exceeds setting.
.2 Output: form C dry contacts, 120 volt, 5 Ampere.

.8 Range of Operation:

.1 Voltage: 120, 208, 480, 600 volts, field programmable.

.2 Ampacity: 10 to 9,999 amperes field programmable.
.3 Frequency: 50 to 70 Hertz.
.4 Power Factory: 0.50 leading to 0.50 lagging.
.5 Kilo-Volt-Amperes: 0 to 30,000.
.6 Kilowatts: 0 to 30,000.
.7 MWH: 0 to 3,000 repeated.

.9 Mounting: Panel mounted.

.10 Power supply: 100 - 130 volts AC 60 Hz.

2.3 CURRENT AND POTENTIAL TRANSFORMERS

.1 Current Transformers:

.1 Type: metering accuracy class.
.2 Ratios: 208:5 Amperes.
.3 Provide shorting bars for current transformer secondary.

.2 Potential Transformers:

.1 Type: metering accuracy class.
.2 Mounting: Drawout compartment with HRC fuse on primary side.

3. Execution

3.1 INSTALLATION

.1 Co-ordinate installation of current transformers and potential transformers with installation of instrument transformers for utility metering and protective relaying.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Colour coding and identification of cabinets and enclosures: Section 26 05 53.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Electrical equipment backboards: Section 06 10 00.

1.3 SOURCE OF SUPPLY

.1 All cabinets and enclosures larger than 300 mm square and 100 mm deep shall be by a single manufacturer.

1.4 COORDINATION

.1 Coordinate size and depth of cabinets and enclosures with systems specified in other Sections which require enclosures.

.2 Coordinate installation and identification of cabinets and enclosures with painting of mechanical and electrical work specified in Division 09.

2. Products

2.1 CABINETS AND ENCLOSURES

.1 Cabinets and Enclosures: to CSA C22.2 No. 40-M1989 (R2014) and as follows:

.1 Material: sheet steel.
.2 Finish: galvanized prime coated
.3 Covers: hinged.
.4 Hinges: concealed flush type.
.5 Latches: flush lock and catch assembly.

.2 Backboards for Mounting of Cabinets and Enclosures: as specified in Division 06.

.3 Terminal strips: 250 V screw terminal types, barriers between terminals.

3. Execution

3.1 INSTALLATION

.1 Install surface or flush mounted cabinets at locations and heights indicated on drawings.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Grounding:	Section 26 05 26.
.3	Boxes and Fittings:	Section 26 05 33.
.4	Electrical Identification:	Section 26 05 53.
.5	Testing of wiring devices:	Section 26 08 20.

1.2 SOURCE OF SUPPLY

.1 Each of the following shall be by a single manufacturer:

.1 All switches.
.2 All receptacles.
.3 All plates.
.4 All dimmers.

1.3 PRODUCT DATA

.1 Provide manufacturer's literature including applicable reference standards, performance and test data.

1.4 COORDINATION

.1 Coordinate installation of wiring devices and cover plates with site painting and finishing work specified in Division 09.

.2 Coordinate installation of dimmers with associated area switches.

2. Products

2.1 SWITCHES

.1 Switches to CSA C22.2 No. 111-10 and as follows:

.1 Rating: except where otherwise indicated or specified, 15 A, 125 V, full load rated for fluorescent, 80% for motor load.

.2 Type: single pole, three-way or four-way as indicated.

.3 Operation: toggle, quiet action.

.4 Features:

.1 Totally enclosed, 2-piece phenolic case.
.2 Large silver cadmium oxide contacts.
.3 Rust resistant continuous steel mounting strip.
.4 Captive mounting screws.
.5 Large head terminal screws.

2.2 RECEPTACLES

.1 Receptacles, plugs and similar wiring devices to CSA C22.2 No. 42-10.

.2 General Purpose Receptacles:

.1 Rating: 15 A, 125 V except where otherwise indicated.

.2 Configuration: 5-15R, 2 pole, 3 wire grounding.

.3 Features:

.1 Ground terminal and poles connected to continuous mounting yoke.
.2 Wiring terminals: 8 back-wired entrances, 4 side screws.
.3 Split feed operation.
.4 Nylon face.
.5 Double wipe heavy phosphor bronze contacts.

.3 House Keeping Receptacles:

.1 Rating: 20 A, 125 V except where otherwise indicated.

.2 Configuration: 5-20R, 2 pole, 3 wire grounding.

.3 Features:

.1 Same as general purpose receptacles.

.3 Ground Fault Circuit Interrupter Receptacles: same as general purpose receptacles, except for following features:

.1 Solid state ground fault sensing and signaling.
.2 5 milliamperes ground fault trip level.
.3 Feed-through type.

.4 USB Charging Receptacles: same as general purpose receptacles, except for following features:

.1 2 port USB charging station
.2 Where located within 1.5 meters of sink, then the connected circuit breaker in the panel shall be ground fault protection type.

.5 Dryer Receptacles:

.1 Rating: 30 A, 125/250 V.
.2 Configuration: 14-30R, 3 pole, 4 wire and ground.
.3 Features: black porcelain face.

.6 Range Receptacles:

.1 Rating: 40 A, 125/250 V.
.2 Configuration: 14-40R, 3 pole, 4 wire and ground.
.3 Features: black porcelain face.

.7 Range Receptacles:

.1 Rating: 40 A, 125/250 V.
.2 Configuration: 14-40R, 3 pole, 4 wire and ground.
.3 Features: black porcelain face.

.7 Rooftop Maintenance Receptacles:

.1 Rating: 20 A, 125 V except where otherwise indicated.

.2 Configuration: 5-20R, 2 pole, 3 wire grounding, ground fault circuit interrupter class A type.

.3 Complete with rooftop type pedestal:

.1 Nema 3R.
.2 HD galvanized construction.
.3 ASA 61 Grey powder paint finish.
.4 24” high.
.5 All required mounting supports and sealants for mounting to roof deck.
.6 In-use weather-proof cover.

2.3 COVER PLATES

.1 Plastic: 3.9 mm thick plastic with reinforcing ribs, smooth, rounded edges, nylon screws.

.2 Stainless Steel: type 302/304 with #4 finish, protective release paper, stainless steel screws.

.3 Steel: press formed with rounded edges and corners, prime painted finish, screws to match.

.4 Weatherproof: cast metal with reinforcing ribs, in-use cover, resilient rubber or closed cell foam urethane gasket, four mounting screws.

3. Execution

3.1 INSTALLATION, GENERAL

.1 Install wiring devices as indicated and in accordance with manufacturer's written instructions.

.2 Install wiring devices only in electrical boxes which are clean.

.3 Install devices and cover plates flush and level.

.4 Provide a matching male plug for all receptacles other than 15 A, 5-15R configuration receptacles.

.5 Mounting and installation of rooftop pedestals shall be coordinated with the roof deck supplier, and in accordance with manufacturer’s installation instructions.

3.2 COVER PLATE INSTALLATION SCHEDULE

.1 Use stainless steel plates in following locations:

.1 Mechanical Room.
.2 Electrical Rooms.
.3 Custodial Room.
.4 Unfinished areas.
.5 Above accessible ceilings.
.6 On surface mounted boxes.

.2 Use stainless steel plates for interior wiring devices in all other locations.

.3 Use weatherproof plates for exterior wiring devices.

3.3 COLOUR SCHEDULE

.1 Receptacles: white colour, except as otherwise indicated below.

.2 Switches: white colour.

.3 Plastic cover plates:

.1 White for white devices.
.2 Brown for brown devices.
.3 Ivory for all other device colours.

3.4 REPLACEMENTS

.1 Replace all wiring devices and cover plates damaged during construction.

3.5 TESTING

.1 Test wiring devices as specified in Section 26 08 20.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Colour coding and identification of disconnects: Section 26 05 53.

1.2 REFERENCE DOCUMENTS

.1 Canadian Standards Association (CSA International):

.1 C22.2 NO. 4-16 - Enclosed and dead-front switches (Tri-national standard with NMX-J-162-ANCE-2016 and UL 98).

.2 CSA C22.2 No.39-13, Fuseholder Assemblies.

1.3 PRODUCT DATA

.1 Comply with requirements of Section 26 00 10.

.2 Provide manufacturer's product data for all systems and components.

1.4 SOURCE OF SUPPLY

.1 All disconnects shall be by a single manufacturer.

1.5 COORDINATION

.1 Coordinate installation of disconnects for equipment specified in other Divisions with installation of such equipment.

2. Products

2.1 UNFUSED DISCONNECTS

.1 Unfused Disconnects: to CAN/CSA-C22.2 No. 4-16 and as follows:

.1 Poles, Voltage, Amperage, kW Rating and Enclosure: as indicated on drawings or schedules; if not indicated, select disconnect to suit application.

.2 Type: heavy duty.

.3 Operation: lever handle, capable of being locked in "On" or "Off" position.

2.2 SOLAR PHOTOVOLTAIC (PV) SYSTEM – DISCONNECTS

.1 Provide heavy duty, quick-make quick-break, load break type Class 'S' industrial rated disconnect switches only.

.2 Interlock door and switch so that door cannot be opened with the switch in the closed position.

.3 Provide switches of the fused, or unfused type as required.

.4 Provide a non-automatic moulded case circuit breaker as a disconnecting device in lieu of a disconnect switch where recessed mounting is required.

.5 Provide CSA Type II enclosure for all disconnect switches to suit location.

3. Execution

3.1 INSTALLATION

.1 Use unfused disconnects, except where fused disconnects are indicated on the drawings.

.2 Use general duty disconnects, except in following applications where heavy duty disconnects shall be used:

.1 Mechanical Room.
.2 Roof top.

.3 Label each disconnect to indicate service being fed and from where.

3.2 INSTALLATION, SOLAR PHOTOVOLTAIC (PV) SYSTEM – DISCONNECTS

.1 Install disconnect switches with fuses as required by Code and as indicated.

.2 Mount disconnect switches on common fire retardant plywood backboard.

.3 Provide additional labeling for solar photovoltaic requirements as noted on drawings.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.

1.2 REFERENCE STANDARDS

.1 Provide motor protection switches of the NEMA size listed. Maximum rating of units not using NEMA rating to be equivalent to NEMA size indicated.

2. Products

2.1 MANUAL STARTERS

.1 Manual motor starting switches less than 1 horsepower:

1. NEMA 1 unless otherwise noted
2. Complete with associated heaters.

.2 Manual motor starting switches between 1 and 10 horsepower:

1. NEMA 1 unless otherwise noted
2. Complete with associated heaters.
3. Pushbutton operated complete with LED type pilot light.

2.2 COMBINATION MAGNETIC STARTERS

.1 Molded case circuit breaker style complete with rotary type switch with operating handle and lock-off facility. Opening starter enclosure restricted by the use of a defeater screw, unless switch is in the "Off" position.

.2 Each combination magnetic motor protection switch installed in unit motor control centre to house the following facilities:

1. Moulded case automatic MCP circuit breaker.
2. Contactor with three overload relays.
3. 24 V holding coil.
4. Pilot light in cover (resistor, transformer, or neon type).

5. Reset button, HOA switch in cover, field convertible to Off/Auto or Start/Stop push button as indicated.

6. Two sets of normally open auxiliary contacts in addition to the standard auxiliary holding contacts supplied with each contactor. One set of auxiliary contacts convertible to normally closed.

7. Control transformer primary and secondary fusing - primary fusing to be HRC type.

8. Control transformer of sufficient VA to operating coil and associated controls.

3. Execution

3.1 INSTALLATION

.1 In finished area, provide flush mounted motor protection switches complete with stainless steel coverplates.

.2 Select overload device trip setting for combination starters to suit the motors. Select heaters to suit full load current of motors.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Identification:	Section 26 05 53.
.3	Circuit and Motor Disconnects:	Section 26 28 17.

1.2 GENERAL REQUIREMENTS

.1 This Section covers solar photovoltaic (PV) system comprising: solar panels, racking system, combiner box(es), inverter system, disconnect switches and net meter.

.2 Instructions to Bidders, any Supplements and/or Addenda thereto form an integral part of this Specification and must be read in conjunction herewith.

1.3 SCOPE

.1 The scope of the electrical work includes, but not limited to, the following. The ratings of equipment and details of work are shown on the drawings:

.1 Provide quantity and type of solar PV panels as shown on the drawings.
.2 Provide racking system for the PV panels.
.3 Provide inverter system for the solar PV system.
.4 Provide all conduit, wire, combiner box(es), junction boxes and disconnect switches as required and as shown.
.5 Provide net meter at the service entrance in accordance with the Local Distribution Company (LDC) requirements.
.6 Connect PV system to the main service entrance switchboard. A breaker in the switchboard will be provided for this connection.
.7 Provide labeling on PV equipment as indicated.
.8 Provide testing and commissioning of PV system. Engage the services of PV equipment manufacturer to complete the testing and commissioning.
.9 Provide grounding and bonding of PV system in accordance with CSA C22.1-15 (CEC).
.10 Coordinate all work related to connecting the PV system to the building distribution with LDC.

2. Products

2.1 PV PANELS

.1 Solar PV panels (modules) shall be polycrystalline type. Rating of panel shall be as shown on drawings. The panels shall be manufactured with 72 cell configuration and shall lay embedded in transparent ethylene vinyl acetate behind tempered glass. The glass shall be inset deep in an aluminum frame providing maximum protection.

.2 Ingress protection rating IP67.

.3 Low irradiance performance up to 96.5%.

.4 Module efficiency minimum 17.5%.

.5 Heavy snow load capability, 5 kPa.

.6 Wind load 2.4 kPa.

.7 25 year linear power output warranty.

.8 Wiring shall be terminated in an enclosure on the backside of the panel with surge protective device.

2.2 RACKING SYSTEM

.1 Racking system shall be suitable for supporting 72 cell PV panels in landscape orientation.

.2 Racking system shall be of aluminum construction with bottom rails that are non-penetrating to avoid damage to the roofing system. Bottom rails shall be fitted with factory attached rubber mats for protection of roof.

.3 Racking system shall be wind tunnel tested and suitable for wind speeds up to 180mph.

.4 Ballasting shall be customizable to wind zone and exposure category.

.5 System shall provide PV module tilt of 20°.

.6 Adjustable row spacing.

.7 Certified (ETL, ULC, etc.) ground clamps shall be included on the rails for grounding and bonding.

2.3 COMBINER BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting. Sizes shall be as required for the number of strings as shown on drawings.

.2 Number of inputs, sizes and disconnecting means as per the drawings.

.3 Combiner box(es) shall be equipped with dc arc fault circuit protection.

.4 Combiner box(es) shall be labelled in accordance with the Section 26 05 00 Electrical General Requirements and as noted on drawings.

.5 Combiner box(es) shall be CSA 3 (NEMA 3) rated.

2.4 INVERTER SYSTEM

.1 Inverter input and output ratings and parameters shall be as noted on the drawings.

.2 Ingress protection: IP67.

.3 Voltage stability in steady state operation: +/- 1%.

.4 Voltage stability in dynamic state: In compliance with IEC 62040-3.

.5 Output frequency: 60Hz +/-2Hz.

.6 Waveform: Pure sine wave.

.7 Duty: Continuous.

.8 Efficiency: Min. 95%.

.9 Protection and control functions: as indicated on drawings.

.10 Noise level maximum 55 dBA at 1m.

.11 Inverter shall be equipped with an Ethernet output port or equivalent for monitoring and display of energy production data such that school's IT department can extract data for displaying on school's mobile friendly website.

2.5 DISCONNECT SWITCHES

.1 Disconnect switch per Section 26 28 17 – Circuit and Motor Disconnects.

2.6 NET METER

.1 Provide net meter base as per LDC requirements.

.2 Net meter to be supplied and installed by the LDC. Coordinate all work related to the net meter installation with the LDC.

3. Execution

3.1 INSTALLATION

.1 Racking system to be installed by the racking system supplier as shown on structural drawings. All other work related to the solar PV installation shall be by a qualified solar PV or electrical contractor as listed below:

.1 Install solar PV panels as per manufacturer's instructions.

.2 Provide all wiring and connections to the PV panels.

.3 Provide all DC wiring as shown on drawings.

.4 Provide all AC wiring as shown on drawings.

.5 Provide combiner box(es) as shown and as required to accommodate the number of strings.

.6 Supply and install inverter system in accordance with the manufacturer's instructions.

.7 Install disconnect switches as shown.

.8 Provide all feeders, conduit and wire as required and as shown.

.9 Provide all pull boxes and junction boxes in accordance with the CEC and as required by the field conditions.

.10 Install correct identification for boxes in accordance with Consultant requirements and to meet CEC.

.11 Provide labelling as noted on drawings.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Interior Lighting Fixtures: Section 26 51 13.
.2 Exterior Lighting Fixtures: Section 26 56 00.

1.3 WORK INCLUDED

.1 This section includes for supply and installation of luminaires, lamps, ballasts/drivers, supports and accessories.

1.4 COORDINATION WITH OTHER SECTIONS

.1 Confirm compatibility and interface with other materials with luminaire and ceiling system. Report discrepancies to the Minister and defer ordering until clarified.

.2 Coordinate with work specified in Divisions 20 to 23 to avoid conflicts between luminaires, supports and fittings and mechanical equipment. Do not suspend fixtures from mechanical equipment, pipes or ducts.

1.5 SHOP DRAWINGS

.1 Comply with requirements of Section 26 00 10.

.2 Provide shop drawings for luminaires. Include all pertinent physical characteristics. Manufacturer's standard catalogue literature, clearly marked, may be used where applicable. Provide photometric data for each fixture and lamp combination.

1.6 RECESSED FIXTURES

.1 Install recessed fixtures to permit removal from below, to gain access to outlet or pre-wired fixture box. Connect recessed fixtures to boxes with flexible conduit and approved fixture wire.

.2 Supply recessed fixtures complete with trim type required for ceiling system installed. Before ordering, confirm the ceiling construction details and architectural finish for each area.

.3 Depth of recessed LED fixtures to be 150 mm maximum including mounting yokes or bridges with distance from backface of fixture or lens to centre of lamp 65 mm minimum. Design reflector and lamp positions to provide high efficiency, even brightness and lack of lamp lines.

1.7 SAMPLE FIXTURES

.1 Comply with requirements of Section 26 00 10.

.2 Submit for approval of the Minister one of each fixture type required before manufacturing commences. If directed by the Minister set up fixture to show coordination with ceiling, mechanical diffuser assemblies and other equipment, Fixture, if approved, will be retained as a control standard. Fixtures not approved must be resubmitted.

1.8 MOCK-UP CEILING

.1 Install one or more sample fixtures in a mock-up of specified ceiling. Pay all costs in connection with construction of mock-up, installation and connection of fixtures and lamps.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Identification:	Section 26 05 53.
.3	Electrical Starting and Testing by Contractor:	Section 26 08 20.
.4	Security System, Access Control & Intrusion Detection:	Section 28 13 00.

1.2 CONTROL PHILOSPHY

.1 As noted on the drawings.

.2 General areas:

.1 Classrooms & Offices: Manual On/Off, local dimming, and vacancy sensor Off after 10 minutes.

.2 Washrooms: Occupancy On/Off.

.3 Gathering space: Manual On/Off, daylight harvesting dimming.

.4 Public corridors: connection and control via security system, refer to section 28 13 00.

2. Products

2.1 RELAY PANEL

.1 Power supply transformers: 120/24 V as required, rated at 35 VA current limiting type, complete with selenium rectifier on the 24 V side.

.2 Low voltage relays: electrically operated, mechanically latching, rated at 20 A, mounted in rubber grommets. Dimming where required.

.3 Programmable relay scanners:

.1 When groups of relays are to be switched by master switches or time controls and it still must be possible to switch individual relays by local switches.

.2 Solid state.

.3 An output shall be capable of switching the connected relay ON and OFF and sensing if the connected relay is ON or OFF.

.4 0-10V Dimming controller for dimming ballasts/drivers as required.

.5 The programming of the scanner shall be user friendly with instructions printed on the scanner label.

.4 Network nodes:

.1 Relay panels shall be able to operate as a stand-alone system or shall be able to be integrated as a part of a Building Automation System that includes other functions of the building such as HVAC and Security.

.2 The stand-alone system shall not require the services of an integrator or other software specialist to program the system. No PC or extra device shall be required for setting which relays are controlled by a group switch input. It shall be possible to view and edit which relays are controlled by a switch input with indicators and buttons built into the relay control devices.

.3 Web interface must use standard HTML pages that allow any PC with a Web Browser access to the system.

.4 Security access available.

.5 Diagnostic tools for queries of status of network devices, relays and log reports.

.6 Full backup and restore capabilities.

.5 Input Controller:

.1 Connection to addressable switching devices.

.6 Time clock:

.1 Digital time clock, AM/PM format, 7 day with Daylight Savings and Leap Year adjustments.

.2 Astronomic settings.

.3 10 programmable control settings.

.4 Manual override.

.7 Cabinets:

.1 Code gauge metal, prime coated, locking door, flush hinge, lock and latch assembly.

.2 In each cabinet, provide space for relays and spacers indicated and a minimum of two transformers.

.8 Barrier cabinet into two compartments, one for line voltage wiring and one for 24 V wiring.

.9 Barriers to be full height, full depth and containing 20 mm knockouts.

.10 Provide terminal strips in both compartments for termination and connection of line and low voltage wiring. Line voltage terminal strips to be rated at 600 V.

2.2 LOW VOLTAGE SWITCHING DEVICES

.1 Switching devices shall be networkable, addressable and capable of daisy-chaining.

.2 Switches to CSA C22.2 No. 111-10 and as follows:

.1 Rating: momentary contact, rocker action type, bakelite with clearly identified "On" and "Off" positions. Key operated switches of matching type. Pilot light type switches of matching type with red integral pilot light.

.2 Type: normal or dimming as indicated.

.3 Vacancy switches to CSA C22.2 No. 111-10 and as follows:

.1 Operation:

.1 Ceiling mounted PIR.

.2 Features:

.1 Programmable auto-off between 5 to 30 minutes.

.3 Occupancy switches to CSA C22.2 No. 111-10 and as follows:

.1 Operation:

.1 Wall mounted PIR and push button action.

.2 Ceiling mounted PIR.

.2 Features:

.1 Programmable auto-off between 5 to 30 minutes.

.4 Day-light sensors as follows:

.1 Operation:

.1 Ceiling mounted photo-cell dimming.

2.2 WIRE AND CABLE

.1 As specified in Section 26 05 13 and Section 27 10 10.

.2 As per manufacturer's recommendations.

3. Execution

3.1 INSTALLATION OF SWITCHES

.1 Install low voltage relay switches complete with mounting brackets and plates.

.2 Mount 1, 2 or 3 switches in single gang box, with box mounted horizontally and four switches in a 2 gang box.

.3 Provide special back box with one piece stainless steel faceplate when housing more than four switches.

3.2 RELAY CABINETS

.1 Mount metal cabinet on backing board.

3.3 WIRING

.1 Leads for line and low voltage connections to be 250 mm length minimum.

.2 Strap or clip wiring into position.

3.4 LOW VOLTAGE SWITCH WIRING

.1 No. 18 AWG colour coded, installed in conduit within walls or above non-removable ceilings and exposed in other areas. Band multiple groups of wiring together.

3.5 TESTING AND VERIFICATION

.1 Comply with testing and performance verification requirements of Sections 26 08 10, 26 08 20 and 26 08 40.

.2 As per manufacturer's recommendations.

.3 Test and commissioning the entire system in operation.

.4 Provide a written report.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Hangers and Supports: Section 26 05 29.
.2 General Requirements for Lighting: Section 26 50 13.
.3 Low Voltage Lighting Controls: Section 26 50 94.

2. Products

2.1 MOUNTING CHANNELS

.1 Provide wiring channel for mounting of fluorescent fixtures and wiring in between fixtures, suspended below mechanical piping, ductwork, etc., as directed on 12 mm rigid conduit or 10 mm galvanized rod hangers, on 2.4 m centres.

.2 Nominal size of channels 72 mm x 70 mm, 1.2 mm steel minimum, baked white enamel finish, complete with channel connectors, end closure pieces, cover pieces, mounting hickeys, fixture connectors, etc., with jointer pieces 300 mm in length minimum to form a rigid assembly.

2.2 LED FIXTURES

.1 LED’s:

.1 As per the latest version of IES TM-21-11 "Projecting Long Term Lumen Maintenance of LED Light Sources”, lumen maintenance shall be a minimum of 60,000 hours at L70.

.2 As per the latest version of IES LM-79 "Electrical and Photometric Measurements of Solid State Lighting Products", luminaires shall have photometric data.

.3 As per the latest version of IES LM-80 "Measuring Lumen Maintenance of LED Light Sources", LED's shall be tested and have testing results available.

.4 Manufacturer to provide a ten (10) year warranty on all components of the luminaire.

.2 Drivers & Modules:

.1 Shall meet IES LM-79 and LM-80 requirements.

.2 Power Factor: Greater than 0.95.

.3 Total Harmonic Distortion: Less than 20%.

.4 Minimum Efficiency: 85% at full load.

.5 Minimum Rated Life: 60,000 hours as per IES L70.

.6 Integral short circuit, open circuit, and overload protection.

.7 Ensure that the manufacturer will have the drivers LED arrays readily available from a local supplier for a minimum of ten (10) years.

3. Execution

3.1 SUPPORTS

.1 Refer to Section 26 05 29.

.2 Support fixtures directly from building structure by rod hangers and inserts, on metal angle headers supported from framing structure of ceiling suspension system.

.3 Provide plaster frames or plaster trim as required and turn same over to the ceiling section for installation.

.4 Support fixtures larger than 600 mm in width by four hangers per fixture minimum independent of ceiling structure or tee bars.

.5 For recessed fixtures mounted in suspended ceiling with exposed tee bar grid structure.

3.2 LUMINAIRE WIRING

.1 Connect recessed luminaires to outlet boxes with 10 mm flexible conduit and 90°C wire.

3.3 ADJUSTMENT AND CLEANING

.1 Align luminaires and clean diffusers prior to final acceptance.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Electrical Starting and Testing by Contractor: Section 26 08 20.

1.2 DESIGN

.1 Provide battery operated emergency lighting units in accordance with latest Alberta Building Code requirements and as indicated.

2. Products

2.1 BATTERY OPERATED EMERGENCY LIGHTING UNIT

.1 Full automatic operation on power failure with minimum operating time of 1.0 hours with all connected sealed beam(s) on.

.2 Unit complete with nickel cadmium battery, fully automatic charger with automatic high and low rates, battery state indicator and mounting brackets.

.3 Lights: as indicated on drawings.

2.2 EXIT SIGNS

.1 Exit signs: as indicated on drawings, complete with LED lamps, 120 V single circuit operations, battery back-up.

2.3 COMBO EXIT SIGNS & EMERGENCY LIGHTING

.1 Shall meet the requirements of Battery Operated Emergency Lighting Unit and Exit Signs above.

3. Execution

3.1 INSTALLATION

.1 Securely fasten to mounting bracket to prevent normal removal.

3.2 TESTING

.1 Provide testing in accordance with specifications section 26 08 20.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Wire and Cable: Section 26 05 13.
.2 Conduits: Section 26 05 34.
.3 General Requirements for Lighting: Section 26 50 13.

2. Products

2.1 FIXTURES

.1 Provide fixtures complete with gaskets forming weatherproof assembly where exposed to weather.

.2 Fixture finishes to be non-corrosive types.

.3 Provide low temperature ballasts as required.

2.2 UNDERGROUND CONDUIT

.1 Conduit: as specified in Section 26 05 34.

.2 Conductors: as specified in Section 26 05 13.

3. Execution

3.1 INSTALLATION

.1 Install underground wiring in specified conduit, with watertight connections.

.2 Steel conduit to be finished in two coats of asphaltum base paint.

.3 Install green insulated grounding conductor in all runs.

.4 Seal all conduit runs at building panels, pullboxes, etc.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Starting and Testing by Contractor's Testing Agent:	Section 26 08 30.

1.2 ABBREVIATIONS

.1	ETL	Electronic Testing Laboratories
.2	IDC	Insulation Displacement Connectors
.3	UTP	Unshielded Twisted Pair
.4	NEXT	Near End Crosstalk
.5	ACRF	Attenuation to Crosstalk Ratio, Far-end
.6	PSNEXT	Power-Sum NEXT
.7	PSACRF	Power-Sum ACRF

1.3 INSTALLER QUALIFICATIONS

.1 Personnel installing communications cabling shall be trained and conversant with communications cabling practices required for this project.

.2 Personnel splicing fiber optic cabling shall be trained and certified.

1.4 SCOPE

.1 System to be complete with all data and voice outlets, patch panels, patch cords, wire and cable required to from a complete system.

.2 Install cable in raceway in exposed locations or where concealed in inaccessible walls and ceilings. Elsewhere cable may be installed without raceway.

.3 Relocation and extension of existing SuperNet system.

1.5 STANDARDS

.1 Comply with the following standards:

.1 ANSI/TIA 568-C.0 Generic Telecommunications Cabling for Customer Premises
.2 ANSI/TIA 568-C.1 Commercial Building Telecommunications Cabling Standard
.3 ANSI/TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard
.4 ANSI/TIA 568-C.3 Fiber Optics Cabling Components Standard
.5 J-STD-607-B Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
.6 CAN/CSA T529 Telecommunications Cabling Systems in Commercial Buildings
.7 IEEE 802.3ba 40G / 100G Ethernet
.8 IEEE 802.3at Power Over Ethernet (POE)

.9 TIA TSB-184 Power Over Twisted Pair Cabling

2. Products

2.1 HORIZONTAL CABLING TO WORKSTATION

.1 UTP: to CAN/CSA T529-95 (R2000) and TIA/EIA 568, Category 6.

.1 Physical Characteristics:

.1 Conductors: four-pair, 23 AWG, thermoplastic insulated, solid copper wire.
.2 Twists: pairs variably twisted relative to one another.
.3 Cable Size: maximum OD 7.5 mm.
.4 Breaking strength: 40.8 kg at temperature of -20°C ±1°C without jacket or insulation cracking.
.5 Colour coding of pairs: tracer coloured white paired with each of blue, orange, green and brown.
.6 Fire Rating: plenum-rated overall jacket, CSA FT-4 compliant.

.2 Transmission Characteristics: to ANSI/TIA 568-C.2.

2.2 BACKBONE CABLING

.1 SuperNet extension – Fiber Optic Cable:

.1 Fiber Optic Cable: to ANSI/TIA 568-C.3, and to match existing cable type and characteristics.

.2 Provide splice kit and all required appertunances.

2.3 COMMUNICATIONS OUTLET ASSEMBLIES

.1 Communications Outlet - Boxes:

.1 1gang recessed box, 63 mm minimum depth with 19 mm deep two device adapter ring, 1.6 mm 16 AWG thickness.
.2 19 mm EMT or flexible conduit, stubbed from box to above wall or bushed hole in top partition plate.

.2 Communications Outlet - Housings:

.1 Formed Outlet Plate.

.1 Maximum dimensions: 150 mm x 150 mm x 38 mm deep.
.2 Rear and side entry of cable. Strain relief provisions for side entry of cable.
.3 Flat plate: minimum thickness 3.9 mm.

.2 Accepts minimum of two (for 1 gang) or six (for two gang) snap-in or slide-in outlet inserts.

.3 Mounts to standard one or two device opening or mounting ring.

.4 Constructed of high-impact fire-retardant thermoplastic.

.3 Communication Outlet - Jacks:

.1 Copper-Based Inserts: to TIA/EIA 568, Category 6 standards, worst pair:

.1 Termination via fixed or removable IDC, AT&T 110, Krone LSA-Plus, or NT BIX IDC's with hinged or separate stuffer cap.

.2 If removable IDC type is used, they must meet the following physical specifications:

.1 Connection of removable IDC's via 8-position edge connectors plated with minimum 40 microns of nickel. Capable of minimum 250 insertion and withdrawal cycles.

.2 Connection of removable IDC's via 8-pin header connector. Maximum 8.9 N engagement force and minimum 2.25 N disengagement force. Pins minimum 1.4 mm square.

.2 Modular Outlet - UTP:

.1 8-position unkeyed jack for voice and data compatible with 4-pair 100 ohm unshielded twisted pair.

.2 Capable of minimum of 200 insertion and withdrawal cycles.

.3 Copper-based contacts with 50 to 100 microns of nickel overlay uniformly coated with minimum 50 microns of gold overlay.

.4 Minimum contact force 1.1 N per contact. Minimum plug retention force 76 N.

.5 Conductors separated and aligned internally by comb structure.

.6 Electrical Specification:

.1 Contacts:

.1 Dielectric strength: 1000 V rms @ 60 Hz.

.2 Insulation resistance: 10 megohms, minimum.

.3 Contact resistance: 0.02 ohms, maximum.

.4 Current rating: 1.5 amps, maximum.

.2 Insulation Displacement Connectors:

.1 Voltage Rating: 250 VAC.

.2 Current Rating: 5 amps.

.3 Resistance: 0.02 ohms maximum.

.4 Dielectric Withstanding: 2000 VAC for 60 sec.
.5 Insulation Resistance: 500 megohms minimum.

.7 Rated for data transmission up to 500 MHz.

.8 Wire configuration to T568A pair assignment

2.4 HARDWARE

.1 Provide all components of a particular type of the same manufacture. (for example: all rack components shall be of common manufacture)

.2 Phone service extension – Phone Entry BIX Blocks:

.1 Cross connect termination system rated for Category 5e cabling.

.2 4-pair and 5-pair connecting blocks.

.3 As per utility's requirements.

.3 SuperNet extension – Wall Mounted Panel Brackets & Shelf:

.1 Equipment Shelf:

.1 Equipment Shelf: 500mm W x 250 mm D x 19 mm thick, painted gray on both sides and edges. Brace shelf from bottom with 1 triangle or other supports, painted to match shelf.

.2 Hinged Wall Brackets: to accommodate 483 mm wide panel, mounting space 267 mm. ASA 61 Grey colour.

.3 Drip shield.

.4 Racks: Free-standing open 2-post rack:

.1 Body fabricated of 2.5 mm minimum metal,

.2 Equipment mounting rails minimum 2.0 mm metal

.3 Designed to accept EIA standard 483 mm wide panels. Drilled and tapped for No 10 screws for vertical panel of 2134 mm in increments of 44.5 mm

.4 Grounding provision

.5 Full height vertical wire management on both sides minimum 152mm x 152mm.

.6 Colour black.

.5 UTP Patch Panels: supply all hardware from the same manufacturer.

.1 Ports: same type as corresponding outlets Ports/Panel: maximum quantity 48.

.2 Physical, Electrical, Transmission Properties: not less than specified for outlets, worst pair.

.3 Horizontal cable management minimum 90 mm high.

.4 Grounding lug hardware kit.

.5 Panel:

.1 Width 483 mm.
.2 Multiple of EIA standard module height of 44.45 mm.
.3 EIA mounting hole spacing.

.6 Panel Height: 178 mm maximum

.7 Material: metal of the following minimum thickness:

.1 3 mm flat anodized aluminum.
.2 1.65 mm formed aluminum.
.3 1.9 mm flat steel.
.4 1.5 mm formed steel.

.6 Fibre Optic Cable Patch Panels

.1 Fibre interconnect center rack mounted, low profile, modular design.
.2 Ports: 12
.3 Connectors: feed through type to matchc existing.
.4 Cable management and slack storage designed to accommodate fibre optic cable bend radius.
.5 Lockable doors or covers for cable termination and patch compartments.
.6 Anchor points for strain relief of fiber cable entry.
.7 Grounding provisions.

2.5 PATCH CABLES

.1 UTP Type:

.1 Patch Cables to match installed cable's transmission and electrical specifications.
.2 Fire Rating: plenum rated overall jacket, CSA FT-4 compliant.
.3 Modular Connectors:

.1 Matching types and minimum specifications as for outlet components.
.2 Long body type.
.3 Suitable for solid or stranded conductor and wire gauge used.

.4 Tool-stuffed or plier-stuffed with IDC contacts and plier-latched cap.
.5 Factory manufactured

.4 Quantity: Provide one 1 m and one 3 m UTP patch cord for each new cable outlet.

.2 Optical fiber patch cords:

.1 Fiber Core and Cladding: identical to installed cable.

.2 Transmission Properties: match installed cable's transmission and electrical specifications.

.3 Configuration:

.1 To match existing.

.4 Factory manufactured

.5 Quantity – Provide one 1m patch cord for each patch panel outlet.

2.6 CABLE TRAYS, WIREWAYS AND SURFACE RACEWAYS:

.1 Provide slotted PVC raceway on rack sides in data room(s).

2.7 IDENTIFICATION MATERIALS

.1 Lamicoid Nameplates: 3 mm thick plastic engraving sheet, black face, white core, mechanically attached, sizes as follows:

.1 Size 1: 12 mm high with 5 mm high letters.

.2 Wire Identification Materials: Use one of the following:

.1 Heat shrink sleeves, blank.
.2 Clear plastic tape wrap-on strips with white writing section.
.3 Wrap-on strips, pre-numbered.
.4 Slip-on identification bead markers or sleeves, blank or pre-numbered.

3. Execution

3.1 EXTENSION OF EXISTING PHONE SERVICE

.1 Coordiante with the local telephone service provider to the relocation and extension of the existing service into the new data room location.

3.2 EXTENSION OF EXISTING SUPERNET

.1 The existing fiber optic SuperNet connection is located in the existing data room. This conractor shall splice and extend this connection to the new data room location.

.2 The existing conduit for the SuperNet connection shall be replaced and extended to the new data room location. The new conduit shall be 4".

.3 Ensure server room is ready 30 business days prior to the provided scheduled completion date.

3.3 INSTALLATION

.1 Cable Installation:

.1 In the server room, provide vertical cable tray from the server rack(s) up to the ceiling horizontal cable tray for cables to be installed in.

.2 Generally install FT4 rated data cable and voice cable without using raceway except where noted otherwise on drawings or as follows.

.3 Install data and voice cable in conduit where:

.1 concealed in inaccessible walls or ceilings
.2 exposed to mechanical damage
.3 cable runs require fire rating (for example in backbone shafts)

.4 Support cable runs independently of ceiling suspension system.

.5 Swab raceway system before installing wiring.

.6 Do not exceed manufacturer's maximum pulling force.

.7 Maintain not less than minimum bending radius for fiber and copper conductors.

.8 Install cable along or at right angles to building lines unless impractical to do so. Verify specific cases of deviation in advance.

.9 Maintain open copper-conductor cable at maximum practical distance from fluorescent ballasts and other EMF - or discharge-generating equipment.

.10 Ensure that cable is not flattened, squeezed, or crimped at any point along entire run. No splices or intermediate terminations in cable runs except by special permission in advance, with documentation detailing locations and nature of splices.

.11 Install cables in PVC raceway in data room(s) and fan individual cables to applicable patch panels in neat, logical fashion.

.12 Tie wrap cables neatly into logical bundles.

.13 Minimum 1 m of slack cable per run.

.2 Connectors:

.1 Use tooling specific to connector types in use.

.2 Use connectors suitable for nature of conductor in cable, eg. stranded vs solid copper.

.3 Ensure that connectors' strain relief provisions are used. Strip jackets only amount required.

.4 Maintain pair twists within 13 mm of termination.

.5 UTP Connection Configuration in accordance with EIA/TIA 568A or CAN/CSA-T529.

Pair	Colour	RJ-45 Pins
1	Blue	4
	White/Blue	5
2	White/Orange	3
	Orange	6
3	White/Green	1
	Green	2
4	White/Brown	7
	Brown	8

.3 Outlets, Boxes and Fittings:

.1 Ensure in advance that outlet box/data outlet installation methods yield vertically-mounted data outlets.

.2 Install all outlets flush with finished surfaces unless indicated otherwise on the drawings.

.4 Cabinets, Enclosures, Racks, Backboards:

.1 Install at locations and heights indicated on drawings.

.2 Use green insulated 6 AWG ground conductors for grounding racks. Use grounding bushing, solderless lug, clamp, or cup washer and screw.

.3 Protect ground conductors from mechanical injury.

.4 Install ground conductors such that neither ground conductors nor data cables interfere with one another in regards to future servicing of patch panel rear connections.

.5 Anchor or stabilize racks as required.

.5 Patch Panels

.1 Mount patch panels as required.

.2 Ground as required by system.

.3 Attach horizontal wiring in an ordered fashion following sequential numbering of outlets.

.4 Attach horizontal wiring in order of sequential numbering of outlets.

.5 Mount panels to racks with as many screws as there are mounting holes or slots in panels.

.6 Provide and install necessary strain reliefs and cable support brackets, plus trays for fibre cable loop behind panel and install cables utilizing such devices.

3.3 COMMUNICATIONS CABLE AND EQUIPMENT LABELING

.1 Label communication outlets, panels and ports with size 1 lamicoid nameplates.

.2 Label each of cables with other end's address using Wire Identification Materials.

.3 Label outlets with labels vertically aligned in each row.

.4 Position panel labels in the same position on each panel.

.5 Use the following naming convention when labeling communications cabling components

.1 Rack and panel room numbers: XYZ, where:

.1 "XY" is floor number represented by two digits.
.2 "Z" is a sequential letter (A,B, etc.) designating which room. Backbone and equipment rooms are considered equivalent.

.2 Outlet Assembly: 000-X where:

.1 "000" is a three-digit address.
.2 "X" is one of following outlet types:

- "A" for telephone outlet.
- "B" for data (copper) outlet.
- "C" for data (fiber) outlet.

.3 Panels:

.1 Horizontal Distribution: XYZ-H, where:

- "XYZ" is room number as described above.
- "H" indicates "Horizontal".

Port Labeling: three-digit address of workstation connected.

.2 Equipment: XYZ-E

- "XYZ" is room number as described above.
- "E" indicates "Equipment".
- Port Labeling: three-digit sequential number

.3 Backbone: XYZ-B

- "XYZ" is room number as described above.
- "B" indicates " Backbone".
- Port Labeling: three-digit sequential number

.4 Attach inter-room connection to identically numbered panel outlets, and, wherever possible, to outlets at same position on each panel.

.4 Cables:

.1 Horizontal Cables:

.1 Outlet End: XYZ, where "XYZ" designates panel room number to which cable goes.

.2 Panel Room End: PQR-[OUTLET TYPE], where:

PQR is a three-digit outlet address and OUTLET TYPE is one of the following:

- A for telephone
- B for data
- C for Fiber

.3 Equipment Room/Backbone Cables:

TYPE-[MN]/[XYZ][[0][00]] where destination is another panel room or outlet and where [TYPE] would be:

- VUTP for (voice UTP).
- DUTP for (data UTP).
- FO for (fiber optic).
- [MN] is sequential number (01, 02, etc.) of cable if multiple runs
- XYZ is destination room if cable goes to another panel room
- [0]00 is the address of the outlet if cable goes to outlet.

3.4 TESTING

.1 Provide testing in accordance with specifications section 26 08 30.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Electrical Starting and Testing by Contractor: Section 26 08 20.

1.2 SYSTEMS DESCRIPTIONS

.1 This section includes a public address & bell system with multi point microphone input facilities and provisions for background music.

2. Products

2.1 COMPONENTS

.1 Mixer Preamplifier: Modular digital matrix mixer/amplifiers for a multitude of applications including audio-visual, zone paging, room combining. Rack mounted with all required mounting hardware. TOA A9120SM2 Series.

.1 Dual Mic/Line Input Module: Two balanced Line outputs, Digital Signal Processing (DSP), 10-band parametric EQ, bass/treble, high and low pass filters, adjustable sensitivity (nine levels, -60 to -10 dBV). TOA D-001T Series.

.2 Dual Line Output Module: Two balanced Mic/Line inputs, Digital Signal Processing (DSP), 10-band parametric EQ, bass/treble, high and low pass filters. TOA T-001T Series.

.2 Audio Power Amplifier: 70V, 4 channel, 250W per channel, 120V. Rack mounted with all required mounting hardware. TOA DA-250FH Series.

.1 VOIP/SIP Connection Module: VoIP phone paging module supported SIP (Session Initiation Protocol) with Auto-answer function. 5 contact ouputs can be activated by keypad operation on any phone in the system for paging zone selections, or triggering pre-recorded messages. Power Source AC Adaptor AD-1215P. Network Interface RJ-45 connector. Control Output 5 channels open collector output. TOA SP-11N Series.

.3 Pro-audio direct box: Allows stereo devices to connect but the left and right channels are summed to mono. Unused jacks can be used as a thru-put allowing the summed signal to be passed to a local sub-mixer or instrument amplifier. Radial Engineering ProAV1 Series.

.4 Bell system:

.1 Two Channel Bell Timer: Ethernet based, high performance, mini I/O module that has two electromechanical relays, two optically-isolated inputs, non-volatile memory for logging, and a real-time clock for full-calender scheduling. It can be controlled and/or monitored over any IP network including private networks, IP-based industrial control networks, and the Internet. ControlledByWeb WebRelay-Dual X-301 Series.

.2 Switch-Selectable Tone Generator – two (2) units required: Generates one of four tones via switch-closure for class change or pre-announcement tone. Control Output 5 channels open collector output. TOA S-04S T Series.

.5 Ceiling Loudspeakers:

.1 Permanent magnetic cone type, diameter of 120 mm, nominal continuous wattage rating II watts, axial sensitivity with one watt input not less than 84.5 db at 3 m on axis.

.2 Permanent magnet - ceramic, mass of not less than 170 g.

.3 Voice coil - not less than 25 mm in diameter.

.4 Frequency response - 70 to 20 000 Hz, ±5 db.

.5 Matching Transformers: multi-top type 0.25 to 4 W 70 V line. Frequency response - 100 to 10 000 Hz ±1 db. Maximum insertion loss - 1 db. Output impedance - 8 Ohm. Loudspeaker enclosure - flush mounted. Exterior mounted speakers shall be in weather-proof enclosure.

.6 Baffles:

.1 Flush for recessed mounting in droped ceilings complete with all mounting hardware and trim rings.

.2 Enclosed back can for suspended from open ceilings complete with all mounting hardware and hanging supports.

.7 TOA F-2322C Full Range Series.

.6 Gym Loudspeakers:

.1 Permanent magnetic cone type, 2-way line array 8 cones and 24 tweeters.

.2 Frequency response - 70 to 20 000 Hz, ±5 db.

.3 Matching Transformers: multi-top type 0.25 to 4 W 70 V line. Frequency response - 100 to 10 000 Hz ±1 db. Maximum insertion loss - 1 db. Output impedance - 8 Ohm. Loudspeaker enclosure - flush mounted. Exterior mounted speakers shall be in weather-proof enclosure.

.4 Baffles:

.1 Enclosed for wall mounting complete with all mounting hardware and hanging supports.

.5 TOA SR-T5 Series.

.7 Weatherproof Loudspeakers:

.1 Permanent magnetic cone type, diameter of 120 mm, nominal continuous wattage rating II watts, axial sensitivity with one watt input not less than 84.5 db at 3 m on axis.

.2 Rated for exterior enviromments.

.3 Operating temperature -20°C to +55°C.

.4 TOA CS-154 Series.

.8 Wiring and Cable - 19/2 PVC insulated twisted pair for multi speaker hook-up.

.9 Conduit: Refer to Section 26 05 34.

3. Execution

3.1 INSTALLATION

.1 Install sound equipment as indicated on the drawings.

.2 Wiring shall be installed in conduit where installed in wall or above non-removeable ceilings. Open wiring in all removeable ceiling areas.

.3 Where loudspeaker enclosures are mounted in removeable acoustic tile type ceiling the backbox to be supported totally independent of ceiling tile by means of two metal angle channels fastened to the speaker enclosure spanning in between supporting tee bar ceiling channels. No wood type support or wire hanging type support to be used.

.4 On complete of installation check system for operation, adjust transformer tap settings and leave system fully operational.

3.2 TESTING

.1 Provide testing in accordance with specifications section 26 08 20.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Electrical Starting and Testing by Contractor: Section 26 08 20.

1.2 SYSTEMS DESCRIPTIONS

.1 This section includes classroom sound systems with wireless microphone input and provisions for audio connections from other devices.

2. Products

2.1 IN-CEILING CLASSROOM AUDIO SYSTEM

.1 Overall System:

.1 Power output: 20 Watts rms.

.2 Acoustic Frequency response: 60 Hz to 18 kHz -10dB.

.3 AC Mains Power Input: 100-240V ~ 50/60Hz 1.5A.

.4 DC Power Input: 24V/2.5A.

.5 Signal-to-noise: 60 dB.

.6 Total Harmonic Distortion: <1%, 10 W.

.7 Wireless Communication: Access Technology (1.9 GHz + RF4CE).

.8 Automatic power down after 2 hour of inactivity.

.9 Automatic power on when Flexmike is powered on and linked.

.10 Dimensions (W x D x H): 24” x 12” x 3.7” (Removable side spacers to fit international ceiling grids; 595mm x 295mm x 94mm).

.11 Weight: 13.5 lbs (6.1 kg).

.12 Controls:

.1 Microphone volume control.
.2 Tone control.
.3 Audio input volume control.
.4 PageFirst sensitivity adjustment.

.13 Connections:

.1 Direct AC mains power input.
.2 Optional DC Power Input.
.3 Audio input.
.4 Optional Page mute (PageFirst™) input (Euro-block).

.14 Device Registration: push button for transmitter(s), remote(s), speaker pods.

.15 Wireless audio range: up to 200 feet.

.16 Integrated 2-Way Hybrid Speaker System:

.1 Description: exciter technology sound panel plus low frequency cone driver.
.2 Integrated cross-over technology.
.3 Panel Size: 13.75” x 6.75”.
.4 Cone Driver Size: 5.25”.
.5 Overall Frequency Response: 60 Hz to 18 kHz -10dB.
.6 Impedance: 8 Ω.
.7 Power Handling: 25 W.

.2 The in-ceiling classroom audio system shall use bi-directional wireless Access Technology to communicate with up to two wireless microphones.

.3 The in-ceiling classroom audio system shall use bi-directional wireless Access Technology to integrate with other audio sources in the classroom.

.4 The in-ceiling classroom audio system shall use bi-directional wireless Access Technology to send a mixed audio output to a media connector located at a convenient/student accessible location in the classroom.

.5 The in-ceiling classroom audio system shall use bi-directional wireless Access Technology to communicate with up to 6 optional tabletop speaker pods available to facilitate small group instruction.

.6 The all-in-one system must contain a Page mute function that passively detects the audio signal of a page coming through the PA system without compromising system performance or voiding warranties. As an audio signal is sent to the PA speaker, the PageFirst passive sensor clip detects that signal and immediately mutes the Topcat.

2.2 WIRELESS MEDIA CONNECTOR

.1 Description: Wireless audio transmitter/receiver to integrate with classroom audio sources and send/receive the wireless to the Lightspeed Topcat system in the ceiling.

.2 Wireless Communication: Access Technology (1.9 GHz).

.3 Audio Inputs: (4) 3.5mm stereo jacks connect to classroom audio sources.

.4 Audio Outputs: (2) 3.5mm jack with volume control.

.5 Microphone volume control.

.6 Audio input volume control.

.7 Audio output volume control.

.8 Power button with LED.

.9 Tone control.

.10 Registration button with Registration LED and linked LED.

.11 Audio frequency response: 80 Hz to 7 kHz ±3 dB.

.12 Audio distortion: <1%.

.13 DC Power Input: USB 5V/0.2A (type micro-B).

.14 Mounting: table-top or wall.

.15 Dimensions (W x D x H): 7.6”x 4.1”x 1.1” (193 x 104 x 28mm).

2.3 WIRELESS FLEXMIKE PENDANT STYLE MICROPHONE / TRANSMITTER

.1 Description: the pendant-style wireless microphone.

.2 Lanyard: adjustable length with magnetic clasp.

.3 Wireless communication: bi-directional Access Technology (1.9 GHz).

.4 Audio distortion: <1%.

.5 Integrated microphone type: uni-directional electret.

.6 Audio input: 3.5mm.

.7 Earbud output: 3.5mm (for to monitor optional Flexcat pods).

.8 Push button volume control: +/- 6dB (total range = 12 dB).

.9 Power: on/off/mute button.

.10 Battery Power: 2.4V NiMH battery pack.

.11 Battery run time: 8 hours (fully charged).

.12 Charging: 5V USB; type micro B connector.

.13 Alkaline Charge Protection: Yes.

.14 USB Audio: interface with computer USB audio while charging.

.15 Registration: push button for registration with Topcat.

.16 Dimensions (L x W x H): 2.9" x 1.1" x 1.0" (74 x 28 x 25mm).

.17 Weight: 1.8 oz (51g).

3. Execution

3.1 INSTALLATION

.1 Install sound equipment as indicated on the drawings.

.2 Install sound equipment as per manufacturer's instructions.

.3 Wiring shall be installed in conduit where installed in wall or above non-removeable ceilings. Open wiring in all removeable ceiling areas.

.4 On complete of installation check system for operation, adjust settings and leave system fully operational.

3.2 TESTING

.1 Provide testing in accordance with specifications section 26 08 20.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Electrical General Requirements: Section 26 00 10.
.2 Electrical Starting and Testing by Contractor: Section 26 08 20.

1.2 SYSTEM

.1 Supervised, synchronous hard-wired clock and program system.

2. Products

2.1 SYSTEM MANUFACTURERS

.1 Primex Wireless.

2.2 MASTER CLOCK CONTROLLER

.1 IP connection connection to centralized server, and shall be monitored through a web interface.

.2 Supervision and correction of clocks on an hourly basis via wireless synchronization pulses through Wi-Fi network.

.3 Manual correction for outages greater than 12 hours or adjustments in time.

.4 Dry auxiliary contacts to connect to school bell system.

.5 120 V operation.

2.3 CLOCKS

.1 Analogue, 317 mm in diameter round dial, black case, white face, black hands, with black numbers, and red sweep second hand.

.2 Hard-wired 120 V ac power.

.3 Wireless synchronization.

.4 Silent operation, continuously moving hands.

.5 Provide appropriate box and connection.

.6 Mounting in corridors: double sided, side mounted.

.7 Mounting in other locations: single sided, surface mounted.

.8 Mounting in gymnasium: single sided, surface mounted, complete with wire guard cover.

3. Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

3.2 TESTING

.1 Provide testing in accordance with specifications section 26 08 20.

.2 Confirm all clocks properly synchronize.

.3 Confirm proper connection and operation with the school bell system.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Operation and Maintenance Manual:	Section 26 01 11.
.3	Boxes and Fittings for Electrical Systems:	Section 26 05 33.
.4	Electrical Starting and Testing - General Requirements:	Section 26 08 10.
.5	Electrical Starting and Testing by Contractor:	Section 26 08 20.
.6	Electrical Equipment and Systems Demonstration and Instruction:	Section 26 08 40.

1.2 APPROVALS

.1 The system shall have proper listing and/or approval from the following nationally recognized agencies:

.1 ULC Underwriters Laboratories Canada
.2 CSA Canadian Standards Association

1.3 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

.1 Comply with requirements of Section 26 00 10.

1.4 OPERATION AND MAINTENANCE DATA

.1 Comply with requirements of Section 26 01 11.

1.5 SCOPE OF WORK

.1 Provide conduit, junction boxes, device boxes, supports and wiring to locations of devices as shown on the drawings.

.2 Actual supply and install of head-end equipment and devices by separate Security Contractor (refer to Cash Allowances).

.3 This Contractor shall coordinate with the Security Contractor for exact locations and mounting of devices, wiring requirements, and commissioning of system.

1.6 COORDINATION

.1 Coordinate installation of system with:

.1 Door hardware.
.2 Fire alarm system.
.3 Other related work.

.2 Coordinate with the above noted work as required to provide a complete, integrated, and functional system.

1.7 WARRANTY

.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this guarantee period shall be included in the submittal bid.

2. Products

2.1 PRODUCT MANUFACTURERS

.1 Acceptable system manufacturers:

.1 DSC
.2 Johnson Controls Cardkey

.2 Systems shall be fully compatible with Johnson Controls Pegasys P2000 for system monitoring.

2.2 CONTROL PANEL

.1 Control Panels:

.1 Microprocessor based.
.2 16 programmable zones.
.3 Digital alarm communicator.
.4 Upload/download capability.
.5 8 system partitions.
.6 1000 user codes.
.7 3000 event buffer.
.8 Scheduling capability.
.9 Indication of trouble type at control panel upon failure of detector.

.2 Construction: Beige cabinet sheet steel construction, surface mounted and an integral battery compartment.

.3 Inputs:

.1 Intrusion alarm: the required number of detection circuits, plus 25% spare for future.

.2 Door access: the required number of door access control circuits, plus 25% spare for future.

.3 Digital for connections to:

.1 Fire Alarm System
.2 Building Automation System (BACnet and LonWorks compatible)
.3 Door Assist Operators

.4 Outputs:

.1 Intrusion alarm: the required number of audible signal circuits, plus 25% spare for future.

.2 Door controller: the required number of door access control circuits, plus 25% spare for future.

.3 Normally Open (NO) and Normally Closed (NC) Contacts for connections to:
.1 Lighting control system (NC)
.2 2 spare NC
.3 2 spare NO

.4 Telephone Dialer:
.1 Three (3) programmable telephone number(s)
.2 Programmable voice messages
.3 Dual line auto-dialer with automatic redial features

.5 Back-up Power Supply:

.1 Rectifier and Battery Charger:
.1 Designed to automatically maintain battery bank fully charged.
.2 Sized to recharge batteries in 12 hours minimum.
.3 Designed to operate system when batteries are disconnected.
.4 Temperature compensated.
.5 Provide battery connection supervision.

.2 Batteries:
.1 Sealed construction.
.2 Lead calcium alloy heavy duty grids.
.3 Maintenance free.
.4 Long cycle life, long shelf life.
.5 Position flexibility and leakage free.
.6 Low gas generation.
.7 Low pressure venting system.
.8 High recovery capability.
.9 3 to 5 year float life under trickle charge.

.3 Capacity: designed to operate system under supervisory load condition for 0.5 hours and then have sufficient power to operate system alarm devices for 15 minutes, without recharging.

.4 Mounting: integral.

.6 Mounting hardware:

.1 Backboard with Equipment Shelf.
.2 Supports as required.

.7 **Sequence of Operation**:

.1 The following is general scheduling information, exact requirements shall be coordinated with the owner prior to final programming.

.2 Schedule operating hours:

.1 Start of normal operating hours: 8 a.m.
.2 End of student-arrival hours: 8:35 a.m.
.3 End of normal operating hours: 5 p.m.
.4 End of day hours: 10 p.m.

.3 Intrusion Detection:

.1 Upon reaching scheduled end of day hours or user input of approved code at keypad(s):

.1 Detection devices are set to arm.
.2 Send signal to low voltage lighting system to turn common area lights off.

.2 Upon user input of approved code at keypad(s):

.1 Detection devices are set to disarm.
.2 Send signal to low voltage lighting system to turn common area lights on.

.3 Upon activation of intrusion detection device:

.1 Activate system alarm – initiate signal to monitoring station & activate local audible/visual device(s).
.2 Send signal to low voltage lighting system to turn common area lights on.

.4 Access Control:

.1 Upon signal from fire alarm system:

.1 All magnetic door locks are set to unlocked, and remain in effect until fire alarm signal is cleared. This condition shall override any other condition.

.2 Program schedule:

.1 Start of normal operating hours: Interior door magnetic lock devices are set to unlocked.
.2 End of student-arrival hours: Interior door magnetic lock devices are set to locked.
.3 End of normal operational hours: All door locking devices are set to locked.

.3 Upon card reader detection of approved access card or activation of request to exit device:

.1 Associated individual door locking devices are temporarily unlocked.

.4 Upon activation of handi-cap door assist operator paddle device (interior exiting side only):

.1 Associated individual door locking devices are temporarily unlocked.

.5 Upon activation of "Staff on site" Release pushbutton:

.1 All perimeter door electric strike/panic hardware locks are set to unlocked.

.6 Upon activation of Lockdown pushbutton:

.1 All card reader(s) are disabled.
.2 All door locking devices are set to locked.

.7 Upon release of Lockdown pushbutton:

.1 All card reader(s) are enabled.
.2 All door locking devices are returned to program schedule.

2.3 DEVICES

.1 Motion Sensors:

.1 Type: Passive infra-red (PIR).
.2 Addressable.
.3 Tamper switch.
.4 LED on/off jumper.
.5 Vertical adjustment.
.6 Narrow or wide angle lens to match room configuration.
.7 Wall, corner, or ceiling mount as site conditions dictate.

.2 Door Contacts:

.1 Magnetic door/window contact.
.2 Internal tamper switch.
.3 Weather-proof where indicated on drawings or for connection to existing exterior doors.

.3 Glass Break Sensors:

.1 Form C output.
.2 Cover tamper.
.3 Omni-directional microphone.
.4 RF Immunity.

.4 Request to exit:

.1 Mushroom-type push button complete with lamicoid nameplate.
.2 Momentary contact.
.3 Colour: Green.

.5 Keypads:

.1 Numeric keypad complete with 5 programmable function keys.
.2 Display: 2 line, 32 character digital display with a Liquid Crystal Display, backlit for low light viewing. To provide event queues with display control switches for Alarm, Trouble and Monitor conditions. Led indicators for trouble and armed.
.3 Piezo buzzer.
.4 Duress code.

.6 Card readers:

.1 Type: proximity.
.2 Weather-proof.

.7 Access cards/fobs:

.1 Provide 35 access fobs, coordinate labeling and programming with Minister.

.8 Lockdown & Release Station:

.1 Lockdown button:

.1 Mushroom-type push button complete with lamicoid nameplate.
.2 Twist to unlock.
.3 Colour: Red.

.2 "Staff on site" Release button:

.1 Push button complete with lamicoid nameplate.
.2 Momentary contact.
.3 Colour: Green.

.9 Horns:

.1 Output: 100dBA @ 10 feet.
.2 450 - 10000 Hz.
.3 30W.
.4 4 or 8 ohms.

2.4 WIRE AND CABLE

.1 As specified in Section 26 05 13.

.2 Wire size to accommodate installed load as well as voltage drop.

.3 Intrusion alarm wiring method (conduit & wire or armoured cable) shall match power wiring method in same area.

.4 As per manufacturer's recommendations.

3. Execution

3.1 INSTALLATION

.1 Install system in accordance with manufacturer's requirements.

.2 External AC Power Source:

.1 Provide 120 V AC supply, circuits as indicated on the drawings.

.3 Telephone Tie-In:

.1 Provide 21 mm conduit and 3 pairs conductors to telephone panel for remote annunciation.

.4 Wiring:

.1 As specified in Section 26 05 13.

.2 As per manufacturer's recommendations.

.3 Provide grounding.

.5 Cabinets and enclosures:

.1 The bottom of control panels shall not be less than 1000mm above the finished floor level.

.6 Door hardware:

.1 Supplied under the architectural trade package and wired under the electrical trade package.

.7 Intrusion Motion Sensors:

.1 2.3m (7.5') nominal mounting height in finished areas.

.2 3.5m (12') mounting height in high ceiling areas.

3.2 TESTING AND VERIFICATION

.1 Comply with testing and performance verification requirements of Sections 26 08 10 and 26 08 40.

.2 As per manufacturer's recommendations.

.3 Test entire system in operational and alarm modes.

.4 Provide a written report.

3.3 DEMONSTRATION AND INSTRUCTION

.1 Comply with requirements of Section 26 08 40.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Operation and Maintenance Manual:	Section 26 01 11.
.3	Boxes and Fittings for Electrical Systems:	Section 26 05 33.
.4	Electrical Starting and Testing - General Requirements:	Section 26 08 10.
.5	Electrical Starting and Testing by Contractor:	Section 26 08 20.
.6	Electrical Equipment and Systems Demonstration and Instruction:	Section 26 08 40.
.7	Voice & Data Cabling:	Section 27 10 10.

1.2 APPROVALS

.1 The system shall have proper listing and/or approval from the following nationally recognized agencies:

.1 ULC Underwriters Laboratories Canada
.2 CSA Canadian Standards Association

1.3 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

.1 Comply with requirements of Section 26 00 10.

1.4 OPERATION AND MAINTENANCE DATA

.1 Comply with requirements of Section 26 01 11.

1.5 DESCRIPTION OF SYSTEM

.1 The CCTV camera surveillance security system is to be comprised of CCTV cameras, conduit and cabling infrastructure, and rack mounted patch panels.

1.6 COORDINATION

.1 Coordinate installation of system with:

.1 Security system, intrusion detection.
.2 Other related work.

.2 Coordinate with the above noted work as required to provide a complete, integrated, and functional system.

1.7 WARRANTY

.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least five (5) year from the date of

acceptance. The full cost of maintenance, labor and materials required to correct any defect during this guarantee period shall be included in the submittal bid.

2. Products

2.1 CAMERAS – INTERIOR

.1 Type:

.1 Network IP Category 6 PoE.
.2 Colour.
.3 Fixed or Pan/Tilt/Zoom as indicated on drawings.
.4 Zoom: 10 x digital.
.5 Focus: Auto with manual override.
.6 Adjustable angular field of view in the horizontal and vertical plane.
.7 1/3" Megapixels.
.8 Day/night.

.2 Construction:

.1 Smoked polycarbonate dome.
.2 High impact plastic.
.3 IP-66 compliant weatherproof housing.
.4 IK10 vandal-proof housing.

.3 Voltage: as per manufacturer's requirements.

.4 Mounting: brackets for surface, wall or ceiling mount as required.

.5 DLink DSC-4602ev series.

2.2 CAMERAS - EXTERIOR

.1 Type:

.1 Connection type:
  .1 Building mounted: Network IP Category 6 PoE.
.2 Colour.
.3 Fixed or Pan/Tilt/Zoom as indicated on drawings.
.4 Zoom: 10 x digital.
.5 Focus: Auto with manual override.
.6 Adjustable angular field of view in the horizontal and vertical plane.
.7 1.3 Megapixels.
.8 Day/night.
.9 High resolution.

.2 Construction:

.1 Weather-proof.
.2 IP66 rated water & dust resistant.
.3 Smoked polycarbonate dome.
.4 High impact plastic.
.5 Vandal resistant.
.6 Built-in heater & fan.
.7 Temperature range: -40°C to +50°C.

.3 Voltage: as per manufacturer's requirements.

.4 Mounting: brackets for parapet gooseneck with vertical base, surface, wall or pole mount as required.

.5 DLink DSC-6511 series.

2.3 CAMERAS – EXTERIOR 360°

.1 Type:

.1 Connection type:
.1 Building mounted: Network IP Category 6 PoE.
.2 Colour.
.3 Fixed 360°.
.4 Zoom: 10 x digital.
.5 Focus: Auto with manual override.
.6 Adjustable angular field of view in the horizontal and vertical plane.
.7 2.9 Megapixels.
.8 Day/night.
.9 High resolution.

.2 Construction:

.1 Weather-proof.
.2 IP66 rated water & dust resistant.
.3 Smoked polycarbonate dome.
.4 High impact plastic.
.5 Vandal resistant.
.6 Built-in heater & fan.
.7 Temperature range: -40°C to +50°C.

.3 Voltage: as per manufacturer's requirements.

.4 Mounting: goose neck brackets for surface, wall or pole mount as required.

.5 DLink DSC-4622 series.

2.4 WIRE AND CABLE

.1 As specified in Sections 26 05 13 and 27 10 10.

.2 Wire size to accommodate installed load as well as voltage drop.

.3 Similar to voice/data structured cabling.

.4 Provide all wiring/accessories and include for all costs.

.5 As per manufacturer's recommendations.

3. Execution

3.1 INSTALLATION

.1 Install system in accordance with manufacturer's requirements.

.2 Exact location, focusing, and other adjustments are to be determined on site in coordination with the manufacturer/agent.

.3 Wiring:

.1 As specified in Section 26 05 13.

.2 As per manufacturer's recommendations.

3.2 TESTING AND VERIFICATION

.1 Comply with testing and performance verification requirements of Sections 26 08 10, 26 08 20 and 26 08 40.

.2 As per manufacturer's recommendations.

.3 Test entire system in operation in conjunction with Minister. Coordinate with Minister for Minister's equipment installation and scheduling of system tests.

.4 Provide a written report.

3.3 DEMONSTRATION AND INSTRUCTION

.1 Comply with requirements of Section 26 08 40.

END OF SECTION

1. General

1.1 RELATED SECTIONS

.1	Electrical General Requirements:	Section 26 00 10.
.2	Electrical Operation and Maintenance Data:	Section 26 01 10.
.3	Electrical Spare Parts and Maintenance Materials:	Section 26 01 90.
.4	Wire and Cable:	Section 26 05 13.
.5	Boxes and Fittings for Electrical Systems:	Section 26 05 33.
.6	Conduit for Electrical Systems:	Section 26 05 34.
.7	Electrical Identification:	Section 26 05 53.
.8	Electrical Starting and Testing – General Requirements:	Section 26 08 10.
.9	Electrical Starting and Testing – By Contractor:	Section 26 08 20.
.10	Electrical Starting and Testing – By Contractor's Testing Agent:	Section 26 08 30.
.11	Electrical Equipment and Systems Demonstration and Instruction:	Section 26 08 40.

1.2 REFERENCED DOCUMENTS

.1 Alberta Building Code, ABC-2014

.2 Canadian Electrical Code Part 1, CSA C22.1-15

.3 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC-S524-06, Standard for the Installation of Fire Alarm Systems
- .2 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems
- .3 CAN/ULC-S537-13, Verification of Fire Alarm Systems
- .4 ULC-S527-99, Control Units for Fire Alarm Systems
- .5 CAN/ULC-S561-03, Installation and Services for Fire Signal Receiving Centres and Systems
- .6 CAN/ULC-S526-07, Visual Signal Appliances for Fire Alarm Systems
- .7 ULC-S525-99, Audible Signal Devices for Fire Alarm Systems
- .8 CAN/ULC-S528-05, Manual Pull Stations for Fire Alarm Systems
- .9 CAN/ULC-S529-09, Smoke Detectors for Fire Alarm Systems
- .10 CAN/ULC-S530-M91, Heat Actuated Fire Detectors for Fire Alarm Systems

.4 Underwriters Laboratories (UL)

- .1 UL-1481, Standard for Power Supplies for Fire Protective Signaling Systems

.5 All requirements of the Authority Having Jurisdiction (AHJ)

1.3 REQUIRED DOCUMENTS ON SITE

.1 Provide the CAN/ULC-S524 document to be maintained on site at all times during construction.

.2 Provide the CAN/ULC-S537 document to be maintained on site at all times during verification.

1.4 DESCRIPTION OF SYSTEM

.1 The existing main fire alarm control panel may be reused for this project. If the Contractor chooses to reuse this panel, then all required upgrades of this panel to accommodate the new system requirements becomes the Contractor's responsibility. Also, if this panel is reused, then the Contractor shall ensure the batteries are replaced, and provide the same warranty as if the panel was a new panel.

.2 Single stage, addressable, supervised, annunciated, fire alarm system consisting of the following major components:

.1 Control panel with integral annunciator
.2 Manual fire alarm stations
.3 Thermal detectors
.4 Products-of-combustion detectors
.5 Audible and visual signal appliances
.6 End-of-line resistors

1.5 SUBMITTALS

.1 Provide marked up conduit routing drawings indicating the new class "A" circuits to the Consultant for review and approval prior to commencement of work.

1.6 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

.1 Comply with requirements of Section 26 00 10.

.2 Provide complete riser diagram and detail drawings indicating:

.1 All alarm devices
.2 Control panel
.3 Component layout
.4 Identification schedule
.5 Zone wiring designations
.6 Panel interconnect wiring
.7 Detailed wiring connections and wire designations

.3 Provide factory data sheets for the following:

.1 Annunciator panels: indicating materials, finishes, layouts, and proposed labeling.
.2 System devices: indicating typical wiring connection, installation instructions, control settings, and component limitations
.3 If data sheets show more than one product, the proposed product to be clearly indicated by arrows or other suitable means. Any photocopied sheets must be clearly legible or submission will be rejected
.4 Battery calculations listing amperage draw for standby and alarm conditions and supplied batteries amp/hour rating.
.1 For design criteria, de-rate Manufacturer's listed battery capacity by 15%.
.2 Manufacturer shall provide the measured standby supervisory and full load current readings to the engineer as part of the battery calculations.

.4 If requested by Minister, submit samples of following components:

.1 Products-of-combustion detector
.2 Thermal detector
.3 Manual alarm station.
.4 Audible and visual signaling devices
.5 Special cables

1.7 OPERATION AND MAINTENANCE DATA

.1 Comply with requirements of Section 26 01 10.

1.8 PROJECT RECORD DRAWINGS

.1 Refer to Section 26 00 10 for general requirements.

.2 Record actual locations of all conduit/cabling routing and fire alarm devices including fault isolation modules, relays and End-Of-Lines.

.3 Record device addresses.

.4 Record strobe candela settings.

.5 Record actual room names and numbers from site. These are also to be used for the descriptors.

1.9 SUPPLIER QUALIFICATIONS

.1 System supplier, that is, manufacturer or manufacturer's authorized agent, shall have an office in Alberta established for a minimum of one-year, with full in-house technical service and maintenance capabilities. Suppliers utilizing third party or subcontracted maintenance services are not acceptable.

.2 Manufacturer's technician(s) assigned to the project shall be registered with the Canadian Fire Alarm Association and have successfully passed a factory training course on the equipment.

.3 Electrical foreman and lead hands electricians assigned to the project shall be registered with the Canadian Fire Alarm Association or holding a valid fire alarm ID recognized by the Authority Having Jurisdiction. Provide certifications to consultant prior to work progress for confirmation.

1.10 SOURCE OF SUPPLY

.1 Complete fire alarm system shall be supplied by a single manufacturer.

1.11 COORDINATION

.1 Coordinate installation of fire alarm system with:

.1 Security equipment controls specified in Division 28.

.2 Coordinate with the above noted work as required to provide a complete, integrated, and functional system.

1.12 GUARANTY

.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this guarantee period shall be included in the submittal bid.

1.13 APPROVALS

.1 The system shall have proper listing and/or approval from the following nationally recognized agencies:

.1 ULC Underwriters Laboratories Canada
.2 CSA Canadian Standards Association

2. Products

2.1 PRODUCT MANUFACTURERS

.1 Acceptable fire alarm system manufacturers:

.1 Chubb Edwards
.2 Tyco Simplex Grinnell
.3 Notifier
.4 Honeywell
.5 Siemens
.6 Mircom

2.2 SYSTEM OPERATION

.1 Operation of System Alarm:

.1 Operation of an alarm initiating device shall cause:
.1 Audible signals to sound at 15-20 pulses per minute (ppm).
.2 Visual signals to operate.
.3 Text display indicating type and location of alarm on control panel and any associated remote annunciator(s).
.4 Contacting of fire department via central station tie-in.
.5 Other actions as indicated:
.1 Other auxiliary relays will activate as required (where applicable).

.2 Operation of System Supervision:

.1 Fault on system or power failure condition shall cause:
.1 Trouble signal to operate.
.2 Text display indicating type and location of trouble on control panel and any associated remote annunciator(s).
.3 Silence switch to de-activate trouble signal only.

.2 Trouble signal to reset automatically on system restoration.

.3 Supervisory Trouble to initiate upon sprinkle valve monitor tamper switch, and signal to reset upon manual restoration. Transmit associated supervisory or trouble signal to central station tie-in.

2.3 FIRE ALARM CONTROL PANEL (FACP)

.1 Construction: CSA enclosure 1, semi-flush mounted, hinged door(s), integral battery compartment, and integral annunciator panel. The doors shall be provided with a key-lock assembly.

.2 Features:

.1 Suitable for DCLB or DCLA communication style: to CAN/ULC-S524.
.2 Fire Alarm Control Panel (FACP) with trouble and alarm indications for class "A" circuits.
.3 Minimum eighty (80) character text display.
.4 Minimum of two (2) Spare zones: compatible with smoke detectors and open circuit devices.
.5 Space for future modules without the requirement to replace the control panel.
.6 "LED test" switch if applicable.
.7 Trouble buzzer and "acknowledge" switch.
.8 Standby power supervision pilot light.
.9 Software capable to operate variable sensitivity addressable smoke detectors and annunciate their status and sensitivity settings at control panel.
.10 Auxiliary contacts for central station tie-in.
.11 Signal circuits:
.1 Zoned as indicated on drawings.
.2 Audible signal and output circuits complete with terminals for wiring and plug-in modules for dc signals up to 2.0A load with trouble indication with class B connections.
.12 Auxiliary relays for:
.1 Security system connections
.13 Separate bypass switches for:
.1 Master Bypass (All Outputs)
.2 Audible devices
.3 Visual devices
.4 Security magnetic door lock devices
.5 Building maintenance system (BMS) connection

2.4 MANUAL FIRE ALARM STATIONS

.1 Manual Fire Alarm Stations:

.1 Type: addressable, single action.
.2 Construction: metal.
.3 Mounting: flush.
.4 Operation: manual lever.
.5 Mounting boxes: to CAN/CSA-C22.2 No. 18-92 and as follows:
.1 Dimensions: 38mm deep by 100mm wide by 100mm high.
.2 Opening: angular.
.3 Surface mounted box colour: red.
.4 Iberville Model CI Series or approved equal.

.6 Extensions to existing mounting boxes: to CAN/CSA-C22.2 No. 18-92 and as follows:
.1 Dimensions: sized to accommodate the additional addressable components.
.2 Opening: angular.
.3 Surface mounted box colour: red.
.4 Iberville Model CI Series or approved equal.

2.5 THERMAL DETECTORS

.1 Thermal Detectors:

.1 Mounting: semi flush, trim ring.
.2 Operation:
.1 Projecting centre disk shall indicate when alarmed.
.2 Fixed Temperature Type: non reset shall operate at 57°C.
.3 Fixed Temperature and Rate of Rise Type:
.1 Rate of rise element: reset type.
.2 Fixed temperature element: 57°C non reset type.
.3 Rate of rise: 8°C per minute.
.3 Analog addressable heat detector, combination fixed temperature/rate of rise heat detector, rated for 21.3 meter (70 feet) spacing. Detector to be complete with a green polling LED and a red alarm LED.
.4 Analog addressable heat detector, 57°C fixed temperature heat detector, rated for 21.3 meter (70 feet) spacing. Detector to be complete with a green polling LED and a red alarm LED.
.5 Conventional 90°C fixed temperature heat detector, rated for 15.2 meter (50 feet) spacing. Detector to be wired to an addressable input module via a supervised Class “B” circuit.

2.6 PHOTO-ELECTRIC PRODUCTS-OF-COMBUSTION DETECTORS

.1 Photo-Electric Products-of-Combustion Detectors:

.1 Features:

.1 Twistlock plug-in base
.2 2-wire operation
.3 Supervisory lamp
.4 Alarm lamp

.2 Operation:

.1 Detect smoke obscuration of light by 1.5% within device chamber.
.2 Temperature Range: 0°C to 35°C.
.3 Voltage: 10 - 24 V DC.
.4 Supervisory current: 100 microamperes.

.5 Alarm current: 65 milliamperes.

.3 Analog addressable type, photo electric type, complete with a green polling LED and a red alarm LED. Detector to have automatic environmental compensation, day/night sensitivity adjustment, and dirty warning indication.

2.7 BASES

.1 Provide trim skirt attachments or adapter plate to conceal base for all detectors.

.2 Detector to mount on a standard base.

2.8 SIGNAL APPLIANCES

.1 Audible signal appliances:

.1 Voltage: 24 V DC.
.2 Mounting: flush or surface, wall or ceiling mount.
.3 Horns:

.1 Sound pressure levels of 95 dBA at 3 m.
.2 Non-addressable.

.2 Visual signal appliances:

.1 Voltage: 24 VDC.
.2 Mounting: surface, wall or ceiling mount.
.3 Construction:
.1 Field selectable output of 15, 30, 75 or 95 candela. Set to 15 candela for corridors.
.2 Clear lens.
.3 Red lexan lens with white “fire” lettering.
.4 Operation: 1 stroke flashes per second.
.5 All visual strobes shall be synchronized.
.6 Non-addressable.
.7 Weather-proof as indicated on the drawings.

.3 Combination audible and visual signal appliances:

.1 Mounting: as specified above.
.2 Audible component: as specified above.
.3 Visual component: as specified above.

2.9 ISOLATION MODULES

.1 Isolation Modules: flush or surface wall mounted.

.2 Isolation modules shall be provided to automatically isolate wire-to-wire short circuits on a Class A loop. The isolation module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the loop segment or branch.

.3 Provide isolator modules as required for each floor or protected zone of the building. Mount isolator modules as required. The location of isolation modules will depend on the contractors suggested wiring route.

.4 If a wire-to-wire short occurs, the isolation module shall automatically open-circuit (disconnect) the loop. When the short circuit condition is corrected, the isolation module shall automatically reconnect the isolated section.

.5 The isolation module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolation module after its normal operation.

.6 The isolation module shall mount in a standard 2 gang deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.10 RELAY MODULES

.1 Provide relays as required for connections to ancillary devices.

.2 Relays shall be of form ‘C’ dry contact.

.3 Rated at 0.5A at 120VAC, or 2A at 24VDC. Where higher power requirements are used, provide additional higher rated relay complete with controls powered from the same source that feeds the ancillary devices.

.4 Complete with a green “polling” LED and a red “alarm” LED.

2.11 END-OF-LINE RESISTOR ASSEMBLY

.1 End-of-line Resistor Assembly: single gang steel plate, terminal strip on back, resistor, red enamel finish and lamicoid nametag on front identifying zone.

.2 End of line devices may be installed within the field device if there is only one (1) device on the circuit. In such cases, the nameplate to be attached to the field device in a visible location.

2.12 BOOSTER POWER SUPPLY (SIGNAL CIRCUITS)

.1 The booster power supply shall function as a stand-alone auxiliary power supply with its' own fully supervised battery compliment.

.2 The booster power supply shall be complete with 4 Class "B" audible/visual signal circuits, each rated for 2.5 amps at 24 Vdc and programmable for a continuous, temporal or sense following output.

.3 Booster power supply to provide 500 mA of auxiliary power output and as specified under System Power Supply.

.4 Booster power supply to be individually supervised for trouble conditions and annunciate a signal circuit fault on the main control panel.

.5 Power source: as specified under External AC Power Source.

.6 Signal Riser Synchronization Modules as follows:

.1 Provides a synchronized output for the activation of strobes or booster power supplies.
.2 Complete with a green "polling" LED and a red "alarm" LED.
.3 The module shall mount in a booster power supply, a standard 2 gang deep electrical box or in a surface mounted backbox.

.7 Signal Riser Monitor Modules as follows:

.1 Provides monitoring for trouble conditions for the booster power supplies.
.2 The module shall mount in a booster power supply, a standard 2 gang deep electrical box or in a surface mounted backbox.

2.13 SYSTEM POWER SUPPLY

.1 Power Supply:

.1 Rectifier and Battery Charger:
  .1 Designed to automatically maintain battery bank fully charged.
  .2 Sized to recharge batteries in 12 hours minimum.
  .3 Designed to operate system when batteries are disconnected.
  .4 Temperature compensated.
  .5 Provide battery connection supervision.
.2 Battery Bank: nickel cadmium type.
.3 Capacity: designed to operate system under supervisory load condition for 24 hours and then have sufficient power to operate system alarm devices for 30 minutes, without recharging.
.4 Mounting: integral with control panel.

2.14 DUAL INPUT MODULES

.1 Dual Input Modules: to be provided for connection to sprinkler flow and tamper devices to separate the flow and tramper zones.

2.15 WIRE AND CABLE

.1 Remote Control and Signal Cable: as specified in Section 26 05 13.

2.16 PASSIVE GRAPHIC

.1 Graphic display shall be minimum size 450 mm x 600 mm, sized as required to accommodate features include the following:

.1 Passive type, as shown on drawing and to include:

.1 Title, Facility Name.
.2 "You are here".
.3 "Entrance".
.4 North arrow.
.5 Schedule indicating all fire zones.
.6 Coloured fire alarm zone boundaries with zone name.
.7 Locations of individual zoned devices (such as duct smoke detectors and sprinkler devices).
.8 Room names and numbers (a minimum of all rooms indicated in the descriptors to be included).
.9 Symbol legend.

.2 Scaled floor plan.
.3 Passive graphic shall be picture glass framed and drawn in ink, professional quality drafting. Hand-written type will not be acceptable.
.4 Orientation:

.1 Floor plans are to be oriented such that the wall that the Graphic Display is mounted on, whichever direction the wall is facing, that the floor plans are to use that direction as the top of the floor plan.

.5 Owner approval is required prior to installation.

3. Execution

3.1 INSTALLATION, GENERAL

.1 Install system in accordance with CAN/ULC-S524.

.2 Unless otherwise noted, raceway for fire alarm system shall be conduit.

.3 Mount end-of-line resistors at a height not more than 1.8-metres above floor level.

.4 Mount manual stations at 1200-mm above finished floor (AFF).

.5 Multi-function detectors, such as combination smoke/heat detectors, shall not be allowed unless otherwise noted.

.6 Spot type smoke detectors shall not be installed directly above equipment that prevents easy access for maintenance. If in doubt as to whether the location is suitable, request clarification from the consultant.

.7 Horn and/or strobe devices shall be wall or column mounted at a height of 2300mm and not closer than 150mm from the ceiling. Horns shall not be mounted on ceilings unless indicated otherwise.

.8 External AC Power Supply:

.1 Provide 120 V AC supply.
.2 Provide separate breaker(s) clearly marked "Fire Alarm System" and painted red.
.3 Provide locking device on breaker(s).
.4 Provide power supply disconnect breaker location in control panel.

.9 Central Station Tie-In:

.1 Provide 21 mm conduit and 3 pairs conductors to telephone panel for central station tie-in.
.2 Monitoring of the fire alarm system shall in installed and verified in accordance with CAN/ULC-S561-03 “Installation and Services for Fire Signal Receiving Centres and Systems” and a copy of the ULC Certificate be provided to the Consultant as part of the verification documentation.
.3 Provide 120 V AC, one circuit.

.10 Wiring:

.1 Make conductor terminations in panel on terminal strips with separate terminal for each conductor.
.2 Neatly install wiring clamped with nylon cable straps or laced with jute cord.
.3 Number identify all strips as indicated on shop drawings.
.4 Attach wiring diagram to inside of panel door.
.5 As specified in Section 26 05 13.

.11 Connect the fire alarm system components as indicated on drawings.

.12 Cabinets and enclosures:

.1 The top of control panels shall not be more than 2400mm above the finished floor level.

.2 Legend or operating controls shall not be more than 1800mm above the finished floor level.

.13 Field Device Descriptors:

.1 Prior to programming descriptors, request an updated list of room names and numbers to prepare descriptors.

.2 All devices shall have the corresponding zone indicated at the annunciator(s).

.3 Submit a list of text descriptions for each addressable point to the owner and the Consultant in Excel spreadsheet format for review and acceptance from the owner in writing prior to any software downloads to the fire alarm system.

.4 All DCL descriptors shall be programmed in the following format:

.1 **Room Number, Description of Area**

Example: **OFFICE RM1003**
or
CORR1001 N.E. BY RM1003

.5 The contractor shall use appropriate abbreviations for the descriptions of areas in the case of limited character display and/or where necessary. Below is a list of approved abbreviations:

FLR	FLOOR
MEZZ	MEZZANINE
RM	ROOM
CORR	CORRIDOR
RM	ROOM
STAIRS	STAIRWELL
ENTR	ENTRANCE
EXIT	EXIT
VEST	VESTIBULE
W/C	WASHROOM(WATER CLOSET)
N.	NORTH
E.	EAST
S.	SOUTH
W.	WEST
CTR	CENTRE
MID	MIDDLE
SPRKLR	SPRINKLER

3.2 TESTING AND VERIFICATION

.1 Verify completed system in accordance with requirements of CAN/ULC-S537.

.2 The Minister will be responsible for appointing a verification agent to direct verification of fire alarm system in accordance with:

.1 CAN/ULC-S537, "Verification of Fire Alarm System Installations", and

.2 Alberta Labour General Safety Services Division, "Fire Alarm Systems Manual, Rev. 8", and

.3 Requirements of authority having jurisdiction.

.3 Contractor to include for all testing and verification associated costs.

.4 Design Engineer’s verification service costs by Contractor.

.5 Prior to requesting verification of Fire Alarm system by Contractor, Verification Agent, and Fire Safety system manufacturer's technical staff shall:

.1 Inspect system in conjunction with the Manufacturer to ensure that Fire Alarm system is correctly installed, connected and fully operational in accordance with requirements of the Contract Documents and Manufacturers recommendations. As part of this testing ensure all circuits are free from open circuit trouble and grounding issues, signaling devices operate, and initiating devices operate (magnets may be used for automatic devices in this test only, magnets are not acceptable for use during the verification). This includes all auxiliary equipment connected to fire alarm system such as elevators, central station tie-in, fan shut-down, sprinklers, door hold-open devices, etc.

.2 Ensure that any subsequent work remaining to be performed on the above-noted items will not invalidate examinations and test performed during verification procedure.

.3 Ensure that operation and maintenance data has been submitted.

.4 Ensure that spare parts and maintenance materials have been delivered.

.5 Ensure that air balancing has been completed on ventilation systems with duct smoke detectors, prior to testing airflow and/or differential pressure limits.

.6 Ensure that all doors and finishes are in place, as well as all ceiling tiles, prior to testing sound pressure levels.

.6 Certify to the Minister in writing that above prerequisites have been fulfilled and specifying known exceptions in the form of a list of items to be completed or corrected, prior to proceeding with verification.

.7 The Minister will proceed with verification, or advise Contractor that prerequisites are not adequately fulfilled.

.8 Fire Alarm Verification:

.1 Assist and cooperate with Minister in verification procedure.

.2 Do not proceed with verification unless the following parties are present at all times during verification procedure:

.1 Electrical Contractor.
.2 Fire Alarm System Manufacturer's Representative.
.3 Minister's verification representative.
.4 Responsible Professional engineer’s representative.

.3 Installing Contractor shall be responsible for the following:

.1 Co-ordinate and schedule verification.
.2 Provide ladders, scaffolding, lifts etc. in order to provide access to all devices and equipment.
.3 Remove and reinstall devices. Provide additional personnel to prepare the devices for removal beforehand and reinstall afterwards, separate for the personnel assigned to assisting in the verification testing.
.4 Perform testing of wiring supervision at EOL devices.
.5 Activate devices for alarms, supervisory and trouble signals.
.6 Correct any deficiencies identified.
.7 Adjust switches on horns where the sound level significantly exceeds or is significantly less than the 100-dBA level.
.8 Co-ordinate and schedule other trades required to be present during verification (i.e. sprinklers).

.4 Manufacturer shall be responsible for the following:

.1 Ensure system is programmed as per the sequence of operation.
.2 Test and confirm correct operation of all equipment and devices.
.3 Correct any deficiencies identified.

.4 Provide all testing and communication equipment including but not limited to:

.1 Testifire Multi-Stimulus Detector Testing or approved equal:
.1 Artificial Smoke.
.2 Testing heat source.
.3 Rate of Rise Heat Detector Tester.
.2 Minimum of four portable communication devices.
.3 AC and DC volt meter.
.4 DC current meter (clamp on style).
.5 Calibrated dBA sound pressure level meter.

.5 Manufacturer's representative shall be trained and knowledgeable in the operation of all supplied testing equipment.
.6 Record the dBA readings throughout the facility. Allow for sound testing to occur outside of the battery testing period.
.7 Record all data and issue verification report similar to that shown in appendix C of the CAN/ULC-S537 to design engineer.

.5 Design Engineer shall be responsible for the following:

.1 Witness the verification.
.2 Provide guidance to the contractor and manufacturer as to the requirements of the verification as required.
.3 Check and insure that the system is installed to all applicable Codes.
.4 Review manufacturer's verification documentation and provide comments where required.
.5 Issue verification certificate to the owner upon successful completion of the verification.

.6 Submit completed verification report as required by the Alberta Building Code, stamped and sealed by the responsible Professional Engineer, to the Minister.

3.3 DEMONSTRATION AND INSTRUCTION

.1 Comply with requirements of Section 26 08 40.

END OF SECTION

1. General

1.1 INTENT

.1 Read this Section in conjunction with:

.1	Fill Materials:	Section 31 05 13.
.2	Earthwork General Requirements:	Section 31 20 10.
.3	Other Sections which specify earthwork.	

1.2 RELATED REQUIREMENTS

.1 Quality Control: Division 01.

OR

.1 General Requirements: Division 01.

1.3 REFERENCE DOCUMENTS

.1 Applicable test methods for earthwork testing specified in this Section:

.1 Particle Size Analysis of Fill Materials: Testing for conformance with specified graduation limits will utilize testing sieves complying with CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.2 Compaction Testing: to ASTM D698-07e1, Laboratory Compaction Characteristics Of Soil Using Standard Effort.

SPEC NOTE: Add additional references to other test methods, as applicable.

1.4 TESTING AGENCY SERVICES

.1 Comply with requirements of Division 01.

.2 Minister will appoint and pay for services of testing agency to perform earthwork quality control testing and related functions.

.3 Cooperate with testing agency in site sampling for testing.

1.5 FILL MATERIAL TESTING

.

.1 Provide on site, for testing purposes, 1 m^3 of each type of imported fill material.

.2 Imported fill materials will be tested, before placement, for conformance with requirements specified in Section 31 05 13 and to confirm suitability for intended uses.

.3 Native excavated material to be used as fill material will, before placement, be inspected for compliance with requirements specified in Section 31 05 13 and tested to confirm suitability for intended uses.

1.6 COMPACTION TESTING

.1 Compaction testing will be performed during fill material placement operations to ensure that specified minimum compaction requirements are met.

2. Products

2.1 NOT USED.

3. Execution

3.1 NOT USED.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Read this Section in conjunction with:

.1	Earthwork Testing:	Section 31 00 10
.2	Earthwork General Requirements:	Section 31 20 10
.3	Other Sections which specify the location, use or placement of fill materials.	
.4	Geotechnical report	

.2 This Section is intended to be used as a reference Section; it is not a "section of work". All materials specified in Part 2, Products, may not necessarily be required.

.3 Refer to other Sections for location, use, and placement of fill materials specified herein.

1.2 REFERENCE DOCUMENTS

.1 Canadian Standards Association (CSA):

.1 CAN/CGSB-8.2-M88 Sieves, Testing, Woven Wire, Metric

.2 Specified sieve sizes are based on the nominal sieve opening sizes, in millimetres, under the Canadian Metric Sieve Series, as contained in Table 1 of CAN/CGSB-8.2.

1.3 SOURCE OF SUPPLY - IMPORTED FILL MATERIALS

.1 For bidding purposes, assume that only fill materials which fully meet specified requirements, including gradations, may be used, regardless of proximity to the Place of the Work of sources of supply for such materials.

1.4 SOURCE OF SUPPLY - NATIVE EXCAVATED MATERIAL

.1 For bidding purposes, assume that where Native Excavated Material is specified to be used, only native material required to be excavated under this Contract, [and native excavated material which has been stockpiled under separate contract and specified for use under this Contract,] may be used.

.2 For bidding purposes, assume that where Native Excavated Material is specified to be used, sufficient quantities of such material, meeting specified requirements and acceptable to Minister, will be available for use.

.3 Notify Minister if sufficient quantities of Native Excavated Material, meeting specified requirements and acceptable to Minister, are not available for use where such material is specified to be used. Provide imported fill materials in lieu of Native Excavated Material, if and as directed by Minister.

.4 Provision of imported fill materials where Native Excavated Material is specified to be used, will, if directed by Minister, be considered a change in the Work and will be valued in accordance with the General Conditions of Contract.

2. Products

2.1 AGGREGATE QUALITY, GENERALLY

.1 Aggregate fill materials shall be comprised of clean, sound, hard particles, and be free from silt, clay, soft shale, flaky particles, organic matter and foreign substances.

2.2 GRAVEL FILL MATERIAL

.1 Gravel: mixture of natural gravel, crushed gravel or crushed stone, and natural or crushed sand, meeting the gradation limits specified below for each type.

Fill Type	Sieve Size	% Passing By Weight
150 mm Gravel	150	100
	50	50 - 85
	5	30 - 50
	0.8	20 - 30
	0.063	2 - 9
80 mm Gravel	80	100
	50	78 - 95
	20	42 - 82
	10	31 - 70
	5	22 - 60
	2	15 - 47
	0.4	9 - 28
	0.16	5 - 16
	0.063	2 - 9
Pit Run Gravel	200	100
	10	40 - 100
	0.063	0 – 5

2.3 CRUSHED GRAVEL FILL MATERIAL

.1 Crushed Gravel: mixture of crushed gravel or stone and natural or crushed sand, meeting the gradation limits specified below for each type and meeting following requirements:

.1 Liquid limit of material passing 0.4 mm sieve shall not exceed 25%.

.2 Plasticity index of material passing 0.4 mm sieve shall not exceed 6%.

.3 Minimum of 50%, by weight, of material retained on 5 mm sieve shall have at least one face resulting from fracture.

Fill Type	Sieve Size	% Passing By Weight
25 mm Crushed Gravel	25	100
	10	57 - 79
	5	38 - 63
	0.8	14 - 37
	0.4	9 - 28
	0.16	6 - 19
	0.063	2 - 7
20 mm Crushed Gravel	20	100
	10	64 - 86
	5	42 - 69
	2	24 - 45
	0.8	17 - 37
	0.4	10 - 29
	0.16	5 - 20
	0.063	2 – 8

2.4 WASHED GRAVEL FILL MATERIAL

.1 Washed Gravel: natural gravel, washed, meeting gradation limits specified below for each type.

Fill Type	Sieve Size	% Passing By Weight
Washed Pea Gravel	20	90 - 100%
	6	0 - 55%
	3	0 - 10%

2.5 WASHED CRUSHED GRAVEL FILL MATERIAL

.1 Washed Crushed Gravel: angular shaped particles of crushed gravel or stone, washed, meeting the gradation limits specified below for each type. Minimum of 50% by weight, of material retained on 5 mm sieve shall have at least one face resulting from fracture.

Fill Type	Sieve Size	% Passing By Weight
50 mm Washed Crushed Gravel	50	100
	20	50 - 80
	10	10 - 40
	5	0 - 20
	2	0 - 5
25 mm Washed Crushed Gravel	25	100
	10	10 - 70
	5	0 - 20
	2	0 - 5
13 mm Washed Crushed Gravel	13	100
	3	0

2.6 SAND FILL MATERIAL

.1 Sand: natural or crushed sand, meeting the gradation limits specified below for each type.

Fill Type	Sieve Size	% Passing By Weight
Coarse Sand	5	100
	2	80 - 90
	0.4	40 - 55
	0.063	2 – 10

2.7 EARTH FILL MATERIAL

.1 Native Excavated Material: Clean, native excavated soil, free from organic matter, frozen materials, stones larger than 75 mm, building debris and other foreign substances.

.2 Imported Clay: inorganic fine grained soil, free from organic matter, stones larger than 50 mm, building debris, and other foreign substances.

3. Execution

3.1 PLACEMENT

.1 Refer to other Sections for location, use, and placement of fill materials specified herein.

END OF SECTION

1. General

1.2 PROTECTION

.1 Protect trees, shrubs and other vegetation indicated to remain in place, against unnecessary cutting, breaking and any other damage.

.2 Protect root systems exposed during clearing operations from damage.

.3 Protect fences, sidewalks, roadways and other existing site improvements that are to remain, from damage.

.4 Protect bench marks and reference lines from damage.

1.4 UNIT PRICES

.1 Site Clearing

.1 Unit Description: Site clearing includes clearing and removal of obstructions interfering with the Work or otherwise required to be removed, as specified in this Section or indicated on Drawings.

.2 Unit of Measurement: square metre.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

.1 Not used.

3. Execution

3.1 CLEARING

.1 Remove trees, stumps, shrubs, vegetation, loose surface rock, site improvements and other obstructions interfering with the Work or required to be removed.

.2 Dig out and remove trunks and root systems where no further excavation work is required.

.3 Carefully and cleanly cut roots and branches of trees indicated to remain, where such roots or branches interfere with new construction. Treat freshly cut roots or branches with non-toxic horticulturally accepted emulsion.

3.2 DISPOSAL

.1 Debris may be burnt on-site provided all necessary permits are obtained and complied with.

.2 Do not undertake any burning operation until all required permits have been obtained. Provide continuous supervision during burning operation.

.3 Remove debris, left after burning, from site.

.4 If permits cannot be obtained, remove all debris from site.

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies general requirements common to all earthwork. Read this Section in conjunction with related Sections which specify requirements for specific types of earthwork.

1.2 RELATED REQUIREMENTS

.1	Changes in Sub-Surface Conditions:	General Conditions of Contract.
.2	Subsurface Soils Information:	Division 00.
.3	Earthwork Testing:	Section 31 00 10.
.4	Fill Materials:	Section 31 05 13.

1.4 DEFINITIONS

.1 Earthwork: Earthwork means excavating of all types, backfilling, filling, compacting, grading and related work.

1.5 CLASSIFICATION OF EXCAVATION

.1 The following classifications of excavation will be made when solid rock, rock in ledges, rock-hard cementitious aggregate deposits, large boulders or other similar obstructions are encountered:

.1 Earth Excavation.
.2 Rock Excavation in Trenches and Pits.
.3 Rock Excavation in Open Excavations.

.2 "Earth Excavation" includes:

.1 Removal and disposal of obstructions, the extent of which is visible on ground surface.

.2 Removal and disposal of underground structures and utilities, the extent of which is indicated, reflected or referred to in the Contract Documents.

.3 Removal and disposal of earth and other materials encountered, of any classification, except rock as defined below.

.3 "Rock Excavation in Trenches and Pits" includes:

.1 Removal and disposal of materials and obstructions encountered which cannot be dislodged and excavated with a Caterpillar Model No. 215C LC equipped with a short stick and a 1070 mm wide rock bucket, or equivalent modern, track-mounted power excavator, rated at not less than 86 kW flywheel power and 142 kN drawbar pull, without prior drilling or blasting.

.2 Trenches in excess of 3 m in width and pits in excess of 9 m in either length or width will be classified as open excavation.

.4 "Rock Excavation in Open Excavations" includes:

.1 Removal and disposal of materials and obstructions encountered which cannot be dislodged and excavated with a Caterpillar Model No. 973 or equivalent modern, track-mounted, heavy-duty, excavating equipment rated at not less than 157 kW flywheel power and 183 kN breakout force (with rock bucket) without prior drilling, blasting or ripping.

.5 Intermittent drilling, blasting or ripping performed to increase production and not necessary to perform the Work, will be classified as earth excavation.

1.7 UNAUTHORIZED EXCAVATION

.1 Unauthorized excavation shall be any excavation beyond elevations and dimensions indicated, without specific direction by Minister.

.2 Fill unauthorized excavation to elevations and dimensions indicated, as directed by Minister.

.3 Unauthorized excavation and remedial work shall be at Contractor's expense.

1.8 EXCAVATION LEVELS

.1 For bidding purposes, assume that excavation levels will be as indicated on Drawings.

.2 Notify Minister if unsuitable bearing materials are encountered at indicated elevations. Carry excavation deeper and replace excavated material with suitable materials if and as directed by Minister.

.3 Notify Minister if bearing conditions are fulfilled at elevations above those indicated. Adjust excavation elevations if and as directed by Minister.

.4 Adjustments in levels, if directed by the Minister, will be considered a change in the Work and will be valued in accordance with the General Conditions of Contract.

2. Products

2.1 FILL MATERIALS

.1 Refer to Section 31 05 13 for fill material product specifications.

3. Execution

3.1 PREPARATION

.1 Notify Minister minimum 2 days prior to beginning excavating operations.

.2 Prior to commencing excavation:

.1 Contact all affected utility companies regarding exact location and current status of all utilities, voltage of underground and overhead power lines and pressure of natural gas lines.

.2 Notify Minister if any utility lines have been omitted from or incorrectly indicated on Drawings.

.3 Identify known underground utilities. Stake and flag locations. Identify and flag surface and aerial utilities.

.3 Expose building connections, service connection, and utilities to be crossed to confirm horizontal and vertical alignment of existing utilities.

.4 Expose existing utility lines by hand excavation to confirm location before machine digging within 600 mm of lines.

.5 Maintain and protect existing above and below grade utilities which pass through work area. Protect active utility lines exposed by excavation, from damage. Hand excavate to final elevations and dimensions.

.6 Where existing pipes, ducts or other underground services intersect a trench, support trench in a manner approved by Utility.

.7 Where existing overhead line poles are adjacent to excavations, temporarily support poles in a manner approved by Utility.

3.2 SHORING AND BRACING

.1 If required to provide safe working conditions and to prevent cave-ins and loose soil from falling into excavations, protect excavations by shoring, bracing, sheet piling, underpinning, or other suitable methods.

.2 Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases or cuts.

3.3 DEWATERING

.1 Maintain excavations free of water. Provide pumps, piping, temporary drains, trenches, sumps, and related equipment to remove water.

.2. Submit for Engineer's approval details of proposed dewatering or heave prevention methods, such as dikes, well points, and sheet pile cut-offs.

.3 Protect open excavations against flooding and damage due to surface run-off.

.4 Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction.

.5 Do not use sanitary sewers or private property for discharge of water.

3.4 EXCAVATING

.1 Strip topsoil from areas to be excavated or filled.

.2 Do not excavate under wet conditions or when such conditions are anticipated.

.3 When excavating is necessary through roots of plant materials, which are to remain, perform work by hand and cut roots with a sharp axe.

3.5 MATERIAL STORAGE

.1 Excavated topsoil, acceptable and required for use under this Contract: subgrade on site until required.

.2 Native excavated material, other than topsoil, acceptable and required for use as fill material under this Contract: Stockpile on site until required.

.3 Stockpile locations shall be subject to Minister's approval.

.4 Protect stockpiles fom contamination and compaction.

3.6 DISPOSAL OF EXCESS AND WASTE MATERIAL

.1 Excavated topsoil, acceptable but in excess of that required for use under this Contract: Remove from site unless indicated otherwise.

.2 Native excavated material, other than topsoil, acceptable but in excess of that required for use as fill material under this Contract: Remove from site unless indicated otherwise.

.3 Unacceptable excavated topsoil, unacceptable native excavated material, waste material, trash and debris: Remove from site and ensure proper disposal.

3.7 BACKFILLING

.1 Compact Backfill using equipment approved by the Engineer

.2 Do not proceed with backfilling operations until Engineer has inpected and approved installation.

.3 Ensure areas to be backfilled are free of debris, snow, ice, water and that surfaces are not frozen. Do not backfill over porous, wet, or spongy subgrade surfaces.

.4 Backfill systematically, as early as possible, to allow maximum time for natural settlement.

.5 Backfill around installation.

- .1 Place unshrinkable fill in areas as indicated. Consolidate and level unshrinkable fill with internal vibrators
- .2 Place bedding and surround material as specified elsewhere
- .3 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete
- .4 Place layers simultaneously on both sides of installed work to equalize loading. Difference in backfill height not to exceed the value specified by the Engineer
- .5 Where temporary or permanent 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. Obtain the Engineer's approval before backfilling

3.8 COMPACTION

.1 Compact fill materials using only mechanical methods. Do not use hydraulic methods.

.2 Do not perform compaction using vehicles and other equipment not designed for compacting.

.3 Maintain optimum moisture content of materials being compacted, as required to attain specified compaction density.

3.8 RESTORATION

.1 Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as directed by Engineer.

.2 Place topsoil as indicated.

.3 Reinstate pavement, sidewalks, other structures and landscaping to condition and elevations which existed before excavation.

.4 Clean and reinstate areas affected by work as directed by Engineer.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Read this Section in conjunction with:

.1	Earthwork Testing:	Section 31 00 10.
.2	Fill Materials:	Section 31 05 13.
.3	Earthwork General Requirements:	Section 31 20 10.

1.2 SECTION INCLUDES

.1 This Section includes requirements for all excavating, backfilling, filling, compacting and grading outside perimeter of buildings or structures, except:

.1 building and structures excavating and backfilling,

.2 trench excavating and backfilling, and

.3 granular base construction for paving and surfacing.

1.4 UNIT PRICES

.1 Topsoil Excavation:

.1 Unit Description: Stripping and disposal off-site.

.2 Unit of Measurement: Cubic metre by cut measure

.2 Subsoil Excavation:

.1 Unit Description: Stripping and disposal off-site.

.2 Unit of Measurement: Cubic metre by cut measure

2. Products

2.1 FILL MATERIALS

.1 Refer to Section 31 05 13 for fill material product specifications.

3. Execution

3.1 EXCAVATION

.1 Excavate to elevations and dimensions indicated on Drawings within a tolerance of plus or minus 50 mm.

3.2 PLACEMENT AND COMPACTION OF FILL MATERIALS

.1 Backfill excavations and fill to required subgrade elevations using fill materials specified in Site Filling Schedule.

.2 Place fill materials in layers not exceeding loose thickness specified in Site Filling Schedule.

.3 Compact each layer of fill to minimum percentages of Standard Proctor Density specified in Site Filling Schedule.

3.3 GRADING

.1 Make changes in grade natural. Blend slopes into level areas.

.2 Unless otherwise indicated on Drawings, slope grade away from building minimum 1:20.

.3 Grade and shape surfaces within following tolerances from subgrade elevations indicated on Drawings:

.1 Landscaped areas: plus or minus 30 mm.
.2 Under paved areas: plus or minus 30 mm.
.3 Under sidewalks: plus or minus 30 mm.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Read this Section in conjunction with:

.1 Earthwork General Requirements: Section 31 20 10.

1.2 SECTION INCLUDES

.1 This Section includes requirements for excavating for buildings and structures inside perimeter of each building or structure, and within a nominal distance outside perimeter of each building or structure, as required for foundation and other substructure construction.

2. Products

Not Used.

3. Execution

3.1 EXCAVATION

.1 Excavate to elevations and dimensions indicated on Drawings within a tolerance of plus or minus 50 mm, and extending a sufficient distance from footings and foundation walls to permit placing and removal of concrete formwork, installation of services, other required construction, and for inspection.

.2 In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

.3 Protect bottom of excavations and soil around and beneath footings from frost.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Read this Section in conjunction with:

.1	Fill Materials:	Section 31 05 13.
.2	Earthwork General Requirements:	Section 31 20 10.

1.2 SECTION INCLUDES

.1 This Section includes requirements for:

.1 Backfilling, filling, and compaction inside perimeter of each building or structure and outside perimeter of each building or structure, adjacent to foundations.

.2 Granular base construction, above subgrade, for floor slabs supported on grade, within perimeter of building or structure.

2. Products

2.1 MATERIALS

.1 Refer to Section 31 05 13 for fill material product specifications.

3. Execution

3.1 PLACEMENT AND COMPACTION OF FILL MATERIALS

.1 Backfill excavations and fill to required subgrade elevations using fill materials specified in Backfilling and Filling Schedule.

.2 Place fill materials in layers not exceeding loose thickness specified in Backfilling and Filling Schedule.

.3 Compact each layer of fill to the minimum percentages of Standard Proctor Density specified in Backfilling and Filling Schedule.

.4 Ensure that adequate permanent or temporary horizontal bracing is in place prior to backfilling against walls.

.5 Take care to prevent damage to or displacement of waterproofing, insulation, weeping tile installation, pipe, conduit and other work.

3.2 GRANULAR BASE CONSTRUCTION UNDER SLABS

.1 Directly under floor slabs supported on grade, provide a minimum 600 mm thick compacted layer of 20 mm crushed gravel.

.2 Where slab is to be directly underlain by a sheet moisture/vapour barrier, provide a uniform top dressing of coarse sand, applied and compacted to produce a smooth surface to receive sheet and slab.

3.3 BACKFILLING AND FILLING SCHEDULE

Location	Fill Material	Max. Lift Thickness	Minimum Compaction
Under interior slabs-on-grade	20 mm Crushed Gravel	150 mm	100 %
Under exterior slabs-on-grade	20 mm Crushed Gravel	150 mm	100 %
Against exterior side of foundations and under paved areas	Crushed Gravel, Pit Run Gravel Or Sand	150 mm	98 %
Against exterior side of foundations and under landscaped areas	Crushed Gravel, Pit Run Gravel, Sand, or General Engineered Fill	300 mm	95 %

END OF SECTION

1. General

1.1 SECTION INCLUDES

.1 This Section includes requirements for asphalt concrete pavement over a granular base course. This Section does not include requirements for the base construction.

1.2 RELATED REQUIREMENTS

.1	Site Excavating, Filling and Grading:	Section 31 23 10.
.2	Soil Cement Base Course:	Section 31 32 13.
.3	Granular Base:	Section 32 11 16.
.4	Asphalt Concrete Pavement Repairs:	Section 32 12 17.
.5	Road and Parking Appurtenances:	Section 32 17 10.
.6	Pavement Markings:	Section 32 17 23.

1.3 REFERENCE DOCUMENTS

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

.1	ASTM D242-09	Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
.2	ASTM D692-09	Standard Specification for Course Aggregate for Bituminous Paving Mixtures.
.3	ASTM D946-09a	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
.4	ASTM D979-01 (2006)e1	Standard Practice for Sampling Bituminous Paving Mixtures.
.5	ASTM D995-95b (2002)	Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
.6	ASTM D1073-07	Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
.7	ASTM D2027-97 (2004)	Standard Specification for Cutback Asphalt (Medium-Curing Type).

.2 Canadian General Standards Board (CGSB):

.1	CAN/CGSB-8.2-M88	Sieves, Testing, Woven Wire, Metric.

1.4 SUBMITTALS

.1 Comply with requirements of Division 01.

.2 Submit mix design for pavement to Minister for approval, not less than three days prior to commencing paving.

1.5 MIXING PLANT QUALIFICATIONS

.1 Asphalt concrete mixing plants shall conform to ASTM D995.

1.6 TESTING AND INSPECTION BY MINISTER

.1 The Minister will engage the services of a testing agency to take samples and test them for conformance to this Section. Sampling will follow recommended practice of ASTM D979.

1.7 SEQUENCING AND SCHEDULING

.1 Sequence and schedule work so as to provide access to building[s] at all times. Arrange work so as not to interfere with normal use of premises.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

2. Products

2.1 BITUMINOUS MATERIALS

.1 Primer: to ASTM D2027, MC-30.

.2 Asphalt Cement: to ASTM D946, penetration grade [150 - 200A] [200 - 300A].

2.2 AGGREGATE

.1 Aggregate shall consist of crushed stone, crushed gravel, sand, mineral filler, to ASTM D692 and ASTM D1073.

.2 Mineral filler may be portland cement, pozzolan, or commercially ground stone dust conforming to ASTM D242.

.3 A minimum of 60% of aggregate retained on the 5 mm sieve shall have at least one fractured face.

2.3 AGGREGATE GRADATION SCHEDULE

.1 Gradation of aggregate shall be through sieves to CAN/CGSB-8.2, as follows:

Nominal Sieve Opening	Percent By Weight Passing Sieve Sizes 10.0*	12.5*	16.0*	20.0*	Mineral Filler
20.0 mm				100	
16.0 mm			100	85-95	
12.5 mm		100	80-95	70-90	
10.0 mm	100	83-95	70-85	63-87	
5.0 mm	55-85	48-77	50-70	40-68	
2.5 mm	32-67	35-60	35-55	28-55	
1.25 mm	25-54	25-48	25-45	20-45	
630 µm	17-40	15-40	18-40	13-35	100
315 µm	8-30	10-30	10-30	8-28	95-100
160 µm	5-20	5-20	5-20	5-18	
80 µm	2-10	2-10	2-10	2-10	70-100

*Maximum size of aggregate (mm).

2.4 PAVEMENT MIXTURE

.1 Design and prepare hot-mixed, hot-laid pavement mixtures utilizing asphalt cement and aggregate to meet the Marshall Mix Design Schedule, as follows:

Marshall Mix Design Property	Maximum Aggregate Size (mm)			
	10.0	12.5	16.0	20.0
Number of blows per specimen	50	50	50	50
Minimum stability at 60°C (kN)	5.4	5.4	5.4	5.4
Flow (0.25 mm units)	8-18	8-18	8-18	8-18
Percent air voids in mix	3-5	3-5	3-5	3-8
Minimum percent voids in mineral aggregate	15.5	15	14.5	14
Minimum asphalt film thickness (μm)	6.5	6.5	6.5	6.5

.2 Do not change approved mix design without written approval by the Minister.

2.5 ACCESSORIES

.1 Adjustment Rims: as required to adjust elevation of manhole rims and valve chambers.

3. Execution

3.1 EXAMINATION

.1 Examine prepared base before paving. Report any defects in base to Minister. Do not commence work if base is frozen or otherwise unsatisfactory.

3.2 PROTECTION OF EXISTING WORK

.1 Protect structures, buildings, sidewalks, landscaping and other surface features against damage caused by paving operations and asphalt spray.

3.3 PRIMER APPLICATION

.1 Apply primer at [0.90 - 1.50][1.20 - 2.20] litres per square metre.

.2 Allow primer to be absorbed completely by base surface.

3.4 PAVEMENT MIX AND PLACEMENT TEMPERATURES

.1 Mix and place asphalt concrete heated to temperatures between 121 - 163 degrees Celsius.

.2 Place pavement at ambient air temperatures at or above 5 degrees Celsius.

3.5 PAVING, GENERALLY

.1 Place pavement to elevations and grades indicated on drawings.

.2 Uniformly grade pavement surfaces. Provide gradual transitions in slopes. Maximum surface depressions shall be 5 mm below a 3.0 m long straight edge.

.3 Compact pavement to minimum 97% of Marshall Design Density.

.4 Do not use pneumatic-tire rollers with wobbly type wheels.

3.6 SINGLE LIFT PAVEMENT

.1 Place pavement in a single lift to a minimum total compacted thickness of 50 mm and as indicated on drawings.

.2 Maximum Aggregate Size: 12.5 mm or 16.0 mm.

3.7 TWO LIFT PAVEMENT

.1 Place pavement in two lifts as follows [and as indicated on drawings]:

.1 Base lift: [50] [75] mm thickness.

.2 Surface lift: [50] [40] mm thickness.

.3 Maximum Aggregate Size:

.1 Base Course: 12.5, 16.0 or 20.0 mm.
.2 Surface Course: 10.0, 12.5 or 16.0 mm.

3.8 PAVING AT CATCH BASINS, MANHOLES AND VALVES

.1 Ensure surface drainage to catch basins.

.2 Ensure that surface runoff will not drain into manholes and valve chambers.

.3 Do not pave over manholes or valve chambers. Adjust valve chambers and manhole rims to finished adjacent pavement elevation [as indicated on drawings].

3.9 CLEAN-UP

.1 Remove loose pavement and aggregate from site.

.2 Remove all spillage and over-spray of liquid asphalt from pavement, sidewalks, buildings and other listed features.

.3 Clean out manhole pits and ensure free operation of valves after completion of paving operations.

3.10 PROTECTION OF COMPLETED WORK

.1 Keep vehicular traffic off newly paved areas until pavement surface temperature has cooled below 39 degrees Celsius. Do not permit stationary loads on pavement until 24 hours after placement.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Fill Materials: Section 31 05 13.
.2 Site Excavating, Filling and Grading: Section 31 23 10.

1.2 REFERENCE DOCUMENTS

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

.1	ASTM A185/ A185M-07	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
.2	ASTM C295-08	Standard Guide for Petrographic Examination of Aggregates for Concrete.
.3	ASTM C309-07	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
.4	ASTM D1751-04 (2008)	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.2 Canadian Standards Association (CSA):

.1	CAN/CSA-A5-98	Portland Cement.
.2	CSA A23.1-09/ A23.2-09	Concrete Materials and Methods of Concrete Construction/ Methods of Test for Concrete.
.3	CAN3-A266.1-M78	Air-Entraining Admixtures for Concrete.
.4	CSA A23.4-09	Precast Concrete - Materials and Construction.
.5	CSA G30.18-09	Carbon Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

.1 Comply with requirements of Division 01.

.2 Submit product literature for curing compound.

1.4 FIELD SAMPLES

.1 Prepare minimum 0.9 m x 0.9 m field sample of V-Joint finish.

.2 Approved sample will establish minimum standard and may be incorporated into work of this Section.

2. Products

2.1 MATERIALS

.1 Sand Cushion: sand as specified in Section 31 05 13.

.2 Granular Cushion: 20 mm crushed gravel as specified in Section 31 05 13.

.3 Portland cement: to CAN/CSA-A5, grey color.

.4 Aggregates For Concrete: to CSA A23.1 and as follows:

.1 Ironstone content of aggregate shall not exceed the following percentage by mass when tested to ASTM C295:

.1 Coarse Aggregate: maximum 1%.
.2 Fine Aggregate, Retained on 2.5 mm Sieve: maximum 1.5%.

.5 Water: to CSA A23.1.

.6 Air Entraining Admixture: to CAN3-A266.1.

2.2 REINFORCEMENT

.1 Deformed Steel Bars: to CSA G30.18.

.2 Welded Wire Fabric: to ASTM A185.

.3 Tie Bar for Construction Joints: plain steel bars to CSA G30.18.

.4 Anchor Pins: plain steel bar to CSA G30.18, hot dip galvanized, as detailed.

2.3 CONCRETE MIX

.1 Conform to CSA A23.1 except as otherwise specified.

.2 Supply concrete mix as follows:

	Min. Comp. Strength @ 28 Days (MPa)	Max. Water/ Cement Ratio	Nominal Aggreg. Size (mm)	Slump Range (mm)	Air Content Range %	Minimum Cement Content (kg/m^3)	Cement Type
All Concrete Paving, Curbs, and Gutters	30	0.45	20-5	30-70	6-8	335	[10][50]

.3 Temperature of concrete mix at placing shall be no less than 10°C and no greater than 27°C. Provide mix toward lower end of temperature range during hot weather and toward higher end of temperature range during cold weather, in accordance with CSA A23.1.

.4 Use of admixtures, other than air-entraining admixtures, are not permitted without prior written approval of Minister. Use of fly-ash is **not** permitted.

2.4 WHEEL STOPS

.1 Wheel Stops: Precast, air-entrained concrete, 20 MPa minimum compressive strength, nominal 115 mm high X 225 mm wide X 1830 mm long; with chamfered corners and drainage slots on underside and holes for anchoring to substrate.

.2 Dowels: Galvanized steel, 19 mm diameter, 250 mm minimum length.

2.5 ACCESSORIES

.1 Form oil: non-staining mineral type.

.2 Formwork: premanufactured and profiled steel or wood forms.

.3 Poured Joint Filler: Asphalt elastic compound.

.4 Preformed Joint Filler: asphalt impregnated type to ASTM D1751.

.5 Curing Compound: to ASTM C309, Type 2 white pigmented, Class B resin-based, liquid membrane-forming type.

3. Execution

3.1 SUBGRADE PREPARATION

.1 Construct subgrade to elevation and grade indicated.

.2 Compact subgrade to 95% Standard Proctor Maximum Dry Density.

.3 Excavate soft spots and fill with 50 mm crushed gravel compacted to 95% Standard Proctor Maximum Dry Density.

3.2 SAND AND GRANULAR CUSHION

.1 Place 50 mm thick [sand layer] [and] [crushed gravel layer] on prepared subgrade, and compact to 95% Standard Proctor Dry Density.

.2 Place 50 mm thick sand cushion layer for precast sidewalk blocks and compact to 95% Standard Proctor Dry Density.

3.3 REINFORCEMENT

.1 Clean reinforcement of loose rust and mill scale.

.2 Place reinforcement as indicated on drawings.

.3 Place 10M tie bars at 300 mm spacing and extend 300 mm into both sides of construction joints. Set half of tie bar lengths in capped sleeves to allow longitudinal movement.

3.4 PLACING CONCRETE

.1 Obtain Minister's approval of formwork and reinforcement before placing concrete.

.2 Moisten sand and granular cushion to prevent absorption of water from freshly placed concrete.

.3 Coat surfaces of manholes, catch basins and with form oil to prevent bond with concrete.

.4 Place concrete in accordance with requirements of CSA A23.1 unless otherwise specified.

.5 Do not place concrete on, or against, any surface that is at less than 5°C or will lower the temperature of the concrete in place, below the values specified in CSA A23.1.

.6 Vibrate by means of vibrating screed or pencil vibrator.

.7 Ensure reinforcement, inserts, embedded parts, formed joints and [ ] are not disturbed during concrete placement.

.8 Screed concrete and float. Do not float while bleed water is still present.

.9 End all pours using construction joints coinciding with surface or contraction joints.

3.5 JOINTS

.1 Construct joints true to line with faces perpendicular to surface of paving. Construct transverse joints at right angles to paving centreline and longitudinal joints, unless otherwise indicated.

.2 Expansion Joints At Building Face or Other Vertical Abutments: place 15 mm wide preformed joint filler 5 mm below finished surface for full width and depth of concrete.

.3 Contraction Joints For Concrete Paving, Curbs and Gutters: construct 35 mm deep by 5 mm wide joints where shown on drawings by means of marking tool or other approved method.

.4 Surface Joints: construct 15 mm deep by 5 mm wide joints where shown on drawings by means of marking tool or other approved method.

.5 Align curb, gutter, and sidewalk joints.

3.6 FINISHING

.1 Remove face-of-curb and gutter forms after initial set of concrete.

.2 Finish concrete surfaces as follows:

Item	Description of Finish
Sidewalks	Light broom pulled perpendicular to centreline
Curbs & Gutters	Trowel; and light broom pulled parallel to length
Inclined Vehicular Drivewaysand Ramps	Herringbone V-joint as indicated on drawings

.3 Do not trowel surfaces while bleed water is still present. Work surfaces as little as possible to achieve finish.

.4 Edge Finishing: finish edges, including joints, with 50 mm wide edgeing tool having 6 mm radius edge.

.5 Where broom finish specified, use approved nylon brush to provide uniform texture and pattern.

.6 Do not add water before or during finishing operation.

3.7 CURING AND PROTECTION

.1 Cure freshly deposited concrete in accordance with CSA A23.1.

.2 Apply curing compound immediately after finishing, in accordance with manufacturer's instructions. Promptly re-coat areas subjected to heavy rainfall within 3 hours after initial application.

.3 When ambient air temperature is at or below 5°C, or when there is a probability of it falling to 5°C within 24 hours of placing, provide cold weather protection until a period of 7 days of concrete temperature at or above 10°C has been attained. Protection shall meet requirements of CSA A23.1.

.4 Estimate rate of surface moisture evaporation in accordance with CSA A23.1 and provide protection from drying as required.

.5 Keep vehicular traffic off paved areas until paving has cured sufficiently to support such loads.

3.8 WHEEL STOPS

.1 Securely attach wheel stops into pavement with a minimum of two galvanized steel dowels embedded in holes drilled or cast into wheel stops at ¼ to 1/3 points.

.2 Firmly bond each dowel to wheel stop and to pavement.

.3 Securely install dowels into pavement and bond to wheel stop.

.4 Recess head of dowel beneath top of wheel stop.

3.9 TOLERANCES

.1 Meet following criteria for exposed concrete surfaces:

.1 Trueness of surface: 6 mm maximum deviation in 3 m length.

.2 Elevation: 15 mm maximum deviation from [drawings] [grade on survey stakes].

.3 Alignment: 25 mm maximum deviation from [drawings] [survey stakes].

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Asphalt Concrete Pavement: Section 32 12 16.
.2 Asphalt Concrete Pavement Repairs: Section 32 12 17.

1.2 REFERENCE DOCUMENTS

.1 The following documents, referenced in this Section, are published by the Master Painters Institute (MPI)

.1 Architectural Specification Manual

.2 Maintenance Repainting Manual

.3 Approved Product List

1.3 SUBMITTALS

.1 Comply with requirements of Section 01 33 00 – Submittal Procedures.

.2 Submit product data for traffic marking paint, including MPI product number.

1.4 QUALITY ASSURANCE

.1 Materials and workmanship for new work shall meet or exceed requirements of the APS Manual.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials in sealed original labeled containers bearing manufacturer's name, type of material, brand name, colour designation.

2. Products

2.1 MATERIALS

.1 Materials are specified by the designated MPI systems, with colours specified herein.

.2 Only products listed in the MPI “Approved Product List” are acceptable for use.

2.2 TRAFFIC MARKING PAINT SYSTEM

.1 System for New Work: EXT 2.1B, Alkyd, yellow colour.

.2 System for Maintenance Work: REX 2.1B, Alkyd, yellow colour.

3. Execution

3.1 PROTECTION OF EXISTING WORK

.1 Protect structures, buildings, sidewalks, landscaping and other surface features against spillage and over-spray during painting operation.

3.2 PREPARATION OF SUBSTRATE

.1 Prepare new pavement in accordance with manufacturer's instructions and in accordance with "Architectural Painting Specification Manual", Chapter 2, Section 3.

3.3 APPLICATION OF PAVEMENT LINE MARKINGS

.1 Clean pavement surface as recommended by paint manufacturer.

.2 Paint lines straight and in uniform width, at locations indicated on drawings.

.3 Apply paint using marking machine or line stencil, and as recommended by manufacturer, to minimum 0.18 mm dry film thickness.

.4 Line Width:

.1 Roadways and Parking Areas: 100 mm, except where otherwise indicated.

3.4 CLEAN-UP

.1 Remove spillage and over-spray of paint from pavement, sidewalks, building and other site features. Use methods and materials without damaging and leaving visible residue on substrates.

3.5 PROTECTION OF COMPLETED WORK

.1 Keep traffic off pavement markings for a time as recommended by paint manufacturer.

END OF SECTION

1. General

1.1 RELATED REQUIREMENTS

.1 Disposal of excess and unacceptable topsoil: Section 31 20 10.
.2 Site Excavating, Filling and Grading: Section 31 23 10.

1.3 SUBMITTALS

.1 Conform to requirements of Section 01 33 00 – Submittal Procedures. Submit the following, for Minister's review and approval as applicable:

.1 Copies of all permits and licenses as applicable to work of this contract.

.2 Site supervisor's credentials submitted prior to commencement of work.

1.4 SOIL ANALYSIS

.1 Contractor shall be responsible for ensuring all samples of imported soil are submitted for testing well in advance of commencement of work. Imported topsoil shall not be placed on site until approved by Minister.

.2 Minister reserves the right to inspect and evaluate all sources of soil selected by Contractor.

.3 Submit original copy of soil analysis report to Minister as required.

.4 Perform and pay for additional soil tests to confirm compliance with recommendations of soil analysis for soil amendments, where applicable. Minister will randomly select various locations to be tested.

1.5 SOURCE OF TOPSOIL SUPPLY

.1 Use native topsoil previously stripped and stockpiled under this Contract, provided it meets specified requirements. Contractor shall be responsible for estimating quantity of stockpiled topsoil available on site.

.2 If native topsoil is inadequate in quantity, quality, or both, use imported topsoil meeting specified requirements for balance of topsoil required.

1.6 MEASUREMENT AND PAYMENT

.1 Payment for work specified under this section shall be in accordance with payment conditions for either sodding or seeding in Contract.

1.7 QUALITY ASSURANCE

.1 Contractor experienced and knowledgeable in landscape work of contract.

.2 Site Supervisor: competent, experienced and knowledgeable to direct and supervise all staff and work of contract. Supervisor shall possess a Landscape Journeyman Gardner certification or other similar qualification acceptable to Minister. Submit supervisor's credentials for Minister's approval prior to commencement of work.

.3 Staffing: provide experienced, competent and trained landscape personnel who will perform all tasks and services in a knowledgeable and professional manner. Workers shall act safely and professionally at all times while working on site. Contractor shall not assign any worker that the Minister deems incompetent, careless, insubordinate, or otherwise objectionable to work on site.

.4 Contractor shall be responsible for ensuring that contract specifications are being adhered to. Failure of the Minister to immediately reject unsatisfactory workmanship or to notify the Contractor of their deviation from the specification shall not relieve the Contractor of their responsibility to repair and/or replace unsatisfactory work.

.5 Contractor shall obtain approvals as required by contract for suppliers, sub-contractors, and all materials.

.6 Pre-Construction Conference: prior to commencement of work, Contractor shall meet with Minister to review overall work of contract.

1.8 EXAMINATION

.1 Contractor shall advise Minister, in writing, of any conditions or defects encountered on site before or during construction upon which the work of this section depends and which may adversely affect its performance.

.2 Do not commence work until these conditions or defects have been evaluated by the Minister and corrective measures taken.

.3 Commencement of work shall imply acceptance of existing surfaces and conditions. No claims for damages or extras resulting discovering such conditions or defects will be accepted later, except where such conditions could not have been known prior to commencing work.

2. Products

2.1 MATERIALS

.1 Topsoil: fertile natural loam, capable of sustaining healthy growth. Topsoil to be loose and friable, free of subsoil, clay lumps, stones in excess of 20 mm, live plants, roots or any other deleterious material greater than 20 mm diameter, free of litter, foreign matter and toxic materials harmful to plant growth. Topsoil containing construction debris, sod clumps, quackgrass or other noxious weeds is not acceptable. Topsoil to meet the following requirements:

.1 Minimum 6% organic matter.
.2 Acidity/alkalinity shall range from 5.9 pH to 7.0 pH.
.3 Electrical Conductivity (E.C.) - level of soluble salts shall not exceed 1.5 dS/m.
.4 Texture: "Loam Topsoil" in accordance with *Canadian System of Soil Classification*. Topsoil to fall within an allowance of ±2% of the values stated in the table below:

Soil	Sand (%)	Silt (%)	Clay (%)	Class
Topsoil	35	35	30	Loam

.2 Peat Moss: decomposed plants, fairly elastic and homogeneous, free of decomposed colloidal residue, wood, sulphur and iron. Minimum of 80% organic matter by mass, pH value between 4.5 and 6.0. Furnished in an air-dry state, packed in standard bags or bales showing name of manufacturer.

.3 Sand: washed course sand, medium to course textured, free of impurities, chemical or organic matter.

.4 Lime: dry ground agricultural limestone containing minimum 85% of total carbonates meeting gradation requirements: percentage passing by weight – 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.

.5 Sulphur: finely crushed agricultural elemental sulphur, free of impurities.

3. Execution

3.1 VERIFICATION OF CONDITIONS

.1 Inspect and verify that rough subgrade preparation and elevations conform to specified requirements before proceeding with work of this section.

.2 If discrepancies occur, notify Minister. Do not commence work until base conditions are corrected as instructed by Minister.

3.2 PROTECTION OF EXISTING WORK

.1 Exercise caution against injury to, or defacement of, existing conditions. Repair or replace all items and site features damaged from installation operations to original or better condition at Contractor's own expense.

.2 Locate utility lines before commencement of work and protect from damage.

3.3 PREPARATION OF NATIVE STOCKPILED TOPSOIL

.1 Control and eliminate all perennial grass and weeds including their root systems until native stockpiled topsoil is required for use. Stockpile topsoil shall be reasonably free of all perennial grass and weed growth before being placed and spread on site.

.2 Perform weed control, as necessary, in accordance with relevant government chemical pesticide application legislation. Obtain Minister's approval for all pesticide applications.

.3 Submit detailed pesticide applicator's log for verification after each application of approved pesticide.

.4 Screen stockpiled topsoil as directed by Minister prior to re-spreading on site. Provide a screener capable of removing stones, soil lumps, foreign debris, undesirable plants and roots from soil to meet requirements of specifications.

3.4 PREPARATION OF SUBGRADE

.1 Remove foreign material, debris, roots, branches, stones in excess of 25 mm diameter, and other deleterious materials. Remove subsoil contaminated with toxic materials or petroleum products. Remove foreign debris that protrudes above subsoil surface.

.2 Dispose of removed materials off site. Do not bury any foreign material beneath areas to be landscaped.

.3 Grade and finish subgrade to required levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas. Eliminate uneven areas and low spots, ensuring positive drainage. Finish subgrades to:

.1 150 mm below final grade for seeded areas.
.2 125 mm below final grade for sodded areas.

.4 Cultivate subgrade area to minimum depth of 75 mm where topsoil will be placed. Scarify or till subsoil using discs, harrows or other suitable equipment that will loosen subsoil before placing any topsoil. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted subgrade soil.

3.5 PLACEMENT AND SPREADING OF TOPSOIL

.1 Do not place and spread topsoil until Minister has approved subgrade preparation.

.2 Place topsoil in dry weather on loose, friable, and graded subgrade surface. Do not spread topsoil when ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the Work, as determined by Minister.

.3 Evenly spread topsoil to a uniform depth, which, after settlement and compaction, shall provide a minimum depth of:

.1 150 mm depth for seeded areas.
.2 125 mm depth for sodded areas.

.4 Manually spread topsoil around trees, plants and surface obstacles to prevent damage.

3.6 PREPARATION OF FINAL GRADE

.1 Remove all surface debris, stones in excess of 20 mm diameter, soil clods, vegetation, roots, grass and weeds, litter and other foreign debris. Dispose of collected materials off site.

.2 Fine grade and loosen topsoil. Eliminate rough spots and low areas to ensure positive drainage away from building faces and walkways. Prepare a loose friable bed by means of cultivation and subsequent raking. Maintain levels, profiles and contours of subgrade.

.3 Float and leave surfaces smooth, uniform, and sufficiently firm against deep foot printing with a fine loose texture. Finish surface shall be clean, even and free from irregular surface changes.

.4 On larger surfaces, use hydraulic power box rake or similar mechanical equipment that will effectively and efficiently remove soil lumps, rocks and debris; fill and level low areas; and correct other grading deficiencies.

.5 Keep topsoil 25 mm below finish grade for sodded areas adjacent to walkways, curbs, edging materials, other hard surfaces and crown of adjacent existing turf. Elsewhere, bring topsoil up to finished grade.

.6 Do not cover catch basins, valve covers or manholes. Cut smooth falls to catch basin rim, finish flush. Provide smooth transitions at top and bottom of slopes.

.7 Grading work shall not be performed when moisture content of soil is such that excessive compaction will occur, or when soil is so dry that clods will not break readily or dust will form in the air. Apply water as required to prevent the formation of an airborne dust nuisance and to provide ideal soil moisture content for tilling.

.8 Ditches: finish ditches and swales to ensure proper flow and drainage. Conduct final rolling operations to produce a hard, uniform and smooth cross-section.

3.7 SOIL AMENDMENTS

.1 Apply and evenly spread soil amendments at specified rate as recommended in soil analysis report.

.2 Mix soil amendment well into full depth of topsoil. Retest amended topsoil to confirm compliance with soil analysis report.

3.8 PROTECTION OF GRADED AREAS

.1 Protect newly graded areas from traffic and erosion. Keep site clean.

.2 Repair and reestablish grades in settled, eroded and rutted areas.

3.9 ACCEPTANCE

.1 Minister will inspect and test topsoil in place and determine acceptance of material, depth and finish grading.

3.10 CLEAN-UP

.1 Clean up, immediately, any soil or debris spilled onto roads, walkways and other finished surfaces. Keep site clean and tidy at all times.

.2 Restore stockpile topsoil areas to a clean and fine graded condition in preparation for turf grass and other landscaping. Obtain Minister's approval.

.3 Excess topsoil not required for landscape use on site shall be [removed off site by Contractor] [spread on site by Contractor as directed by Minister].

END OF SECTION

1. General

1.1 UNIT PRICES

.1 Unit Description: Restoration of grassed areas, landscaping, concrete curbs and sidewalks, asphalt paving and gravel paving to match existing.

.2 Unit of Measurement: lump sum.

2. Products

.1 Not Used.

3. Execution

3.1 RESTORATION, GENERALLY

.1 Restore all existing areas and sitework damaged or disturbed due to earthwork or other work of this Contract, back to their original condition and to finish grades indicated on Drawings.

END OF SECTION

1. General

1.1 INTENT

.1 This Section specifies general requirements common to all piped utility systems. Read this Section in conjunction with Sections which specify detailed requirements for specific types of piped utilities.

1.2 RELATED SECTIONS

.1	Earthwork General Requirements:	Section 31 20 10.
.2	Restoration of Site Work:	Section 32 99 90.

1.3 DETAIL DRAWINGS

.1 Following detail drawings are appended hereto and form part of this Section:

33 05 10.01	Existing Utility Crossing
33 05 10.05	Pipe Bedding Details
33 05 10.06	Typical Service Trench
33 05 10.07	Horizontal Thrust Block Detail
33 05 10.08	Vertical Thrust Block Detail

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Place materials in safe storage. Keep interiors of pipes, fittings and accessories clean. Store and protect valves and hydrants from damage and freezing.

.2 Prevent shock or damage during loading and unloading of materials.

.3 Repair all coating and lining damage to pipe and fittings.

.4 Replace materials found to be defective in manufacture or damaged in handling after delivery.

2. Products

2.1 MATERIALS

.1 Refer to other Sections for product specifications for specific types of piped utilities.

.2 Miscellaneous Concrete: 20 MPa, 80 mm slump, sulphate resistant portland cement.

3. Execution

3.1 EXISTING UTILITIES

.1 Maintain, re-route or extend existing lines which remain.

.2 Cap, plug, or seal abandoned lines that remain.

3.2 BEDDING

.1 Do not perform any work on frozen ground. Remove and replace the frozen material with bedding material compacted to 95% Standard Proctor Maximum Dry Density.

.2 Compact bedding material to 95% of Standard Proctor Maximum Dry Density.

.3 Use class of bedding specified or indicated on drawings.

.4 Compact material around pipe with hand tampers properly shaped to ensure full compaction below haunches.

.5 Do not use mechanical tampers over top of pipe where cover is less than 300 mm.

3.3 PIPE LAYING

.1 Follow manufacturer's recommended installation procedures.

.2 Prevent dirt from entering ends of pipe.

.3 Do not exceed amount of deflection recommended by manufacturer.

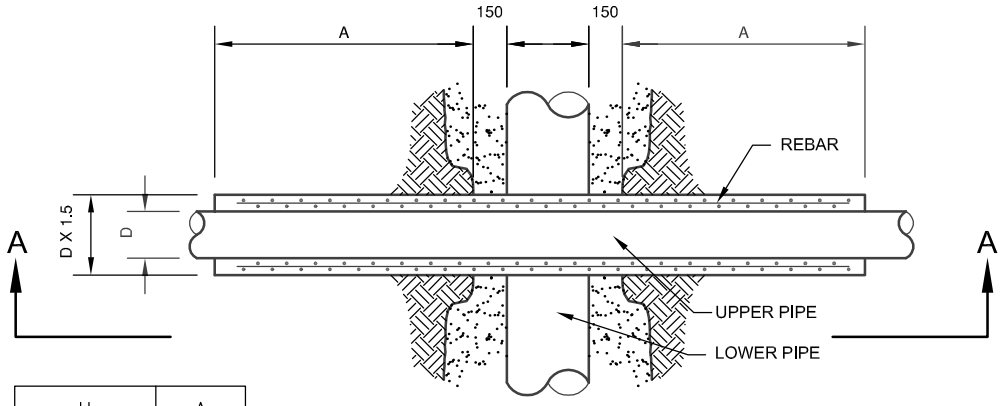
.4 Support bends, tees and dead ends with 20 MPa concrete thrust blocks to undisturbed ground as detailed on drawings.

.5 Construct anchor blocks of 20 MPa concrete as shown on drawings.

3.4 PIPE INSTALLATION TOLERANCES SCHEDULE

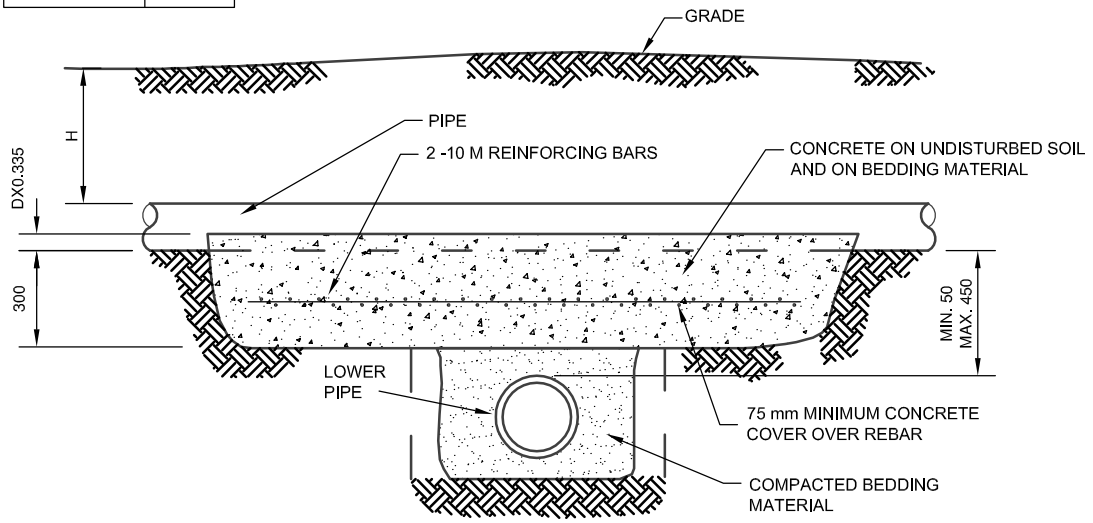
	Horizontal Tolerance (Max.)	Vertical Tolerance (Max.)
Graded Pipe	200 mm	5 mm plus 5 mm per 200 mm dia.
Upgraded Pipe	200 mm	20 mm

END OF SECTION



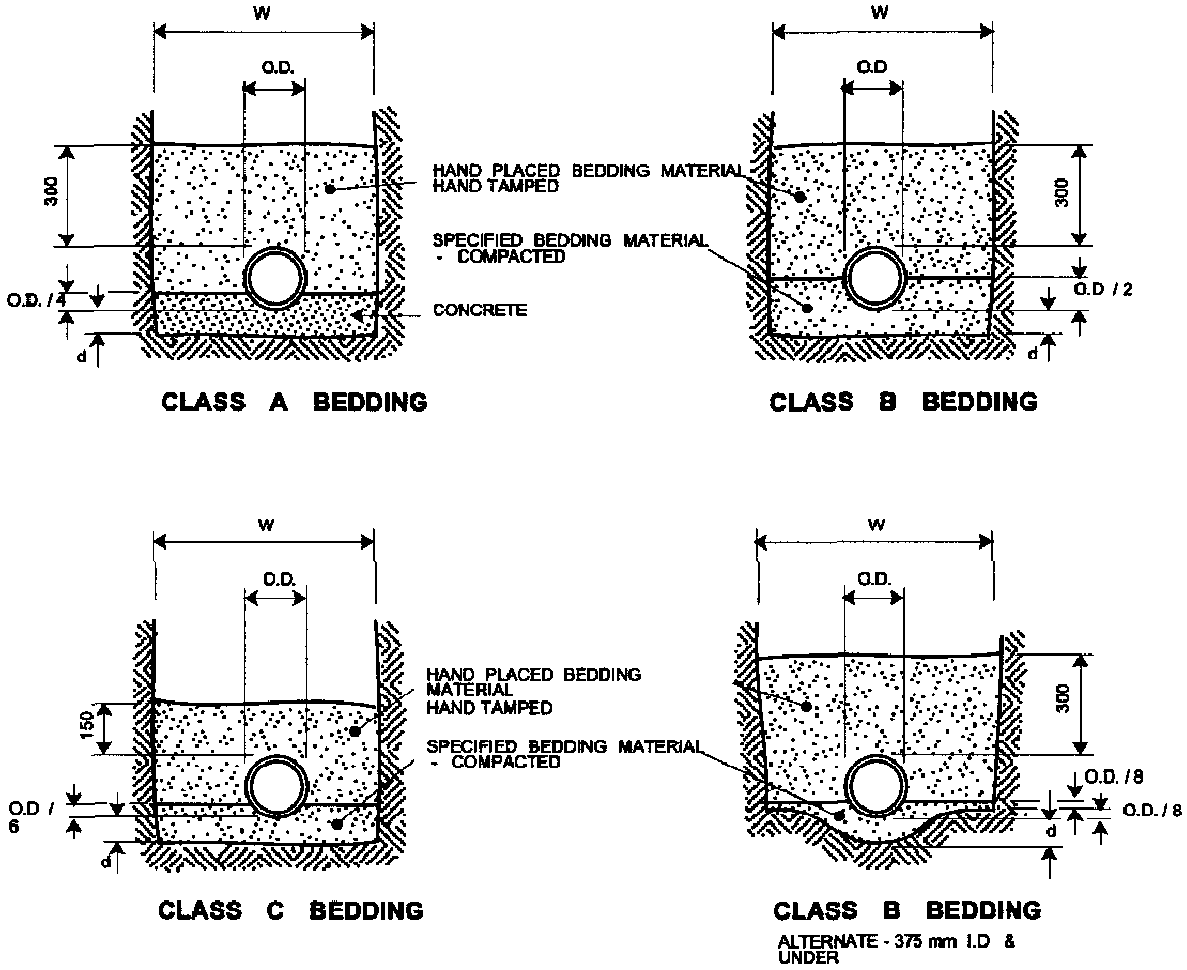
H	A
0.0 to 2.4 m	0.9 m
2.4 to 4.3 m	1.2 m
4.3 to 6.1 m	1.5 m

PLAN



SECTION A – A

NOTE:
PLACE POLYETHYLENE SHEET
BETWEEN LOWER PIPE &
CONCRETE



W = TRENCH WIDTH
O.D. = OUTSIDE PIPE DIAMETER
I.D. = INSIDE PIPE DIAMETER

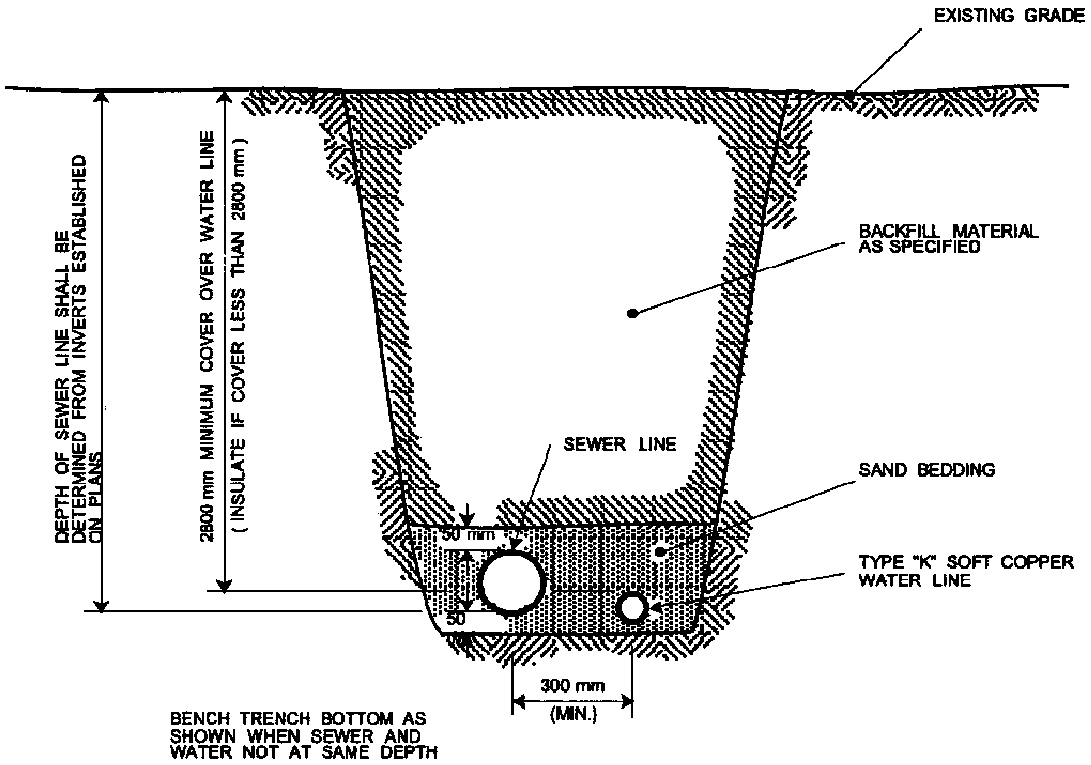
NOTES:
1) CONCRETE OR BEDDING MATERIAL TO EXTEND TO UNDISTURBED TRENCH WALLS

2) COMPACTION - 95 % STANDARD PROCTOR MAX. DRY DENSITY (MIN.)

3) FOR TRENCH WIDTH 'W' REFER TO SPECIFICATIONS

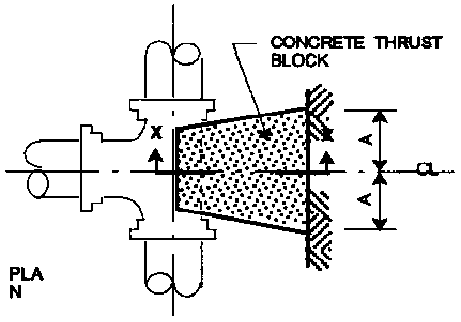
MINIMUM DEPTH OF BEDDING BELOW PIPE = d
ID mm = 675 mm & SMALLER: d = 75
ID mm = 750 mm to 1500 mm: d = 100
ID mm = 1500 mm & LARGER: d = 150

Pipe Bedding Details	2008 - 06 - 02
	Detail 33 05 10 05

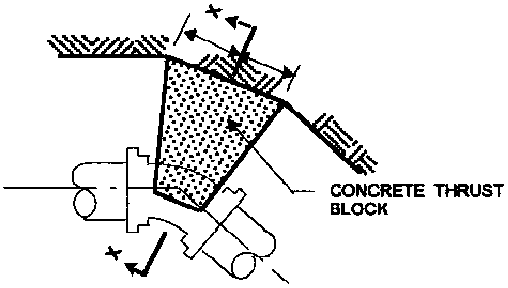


SECTION

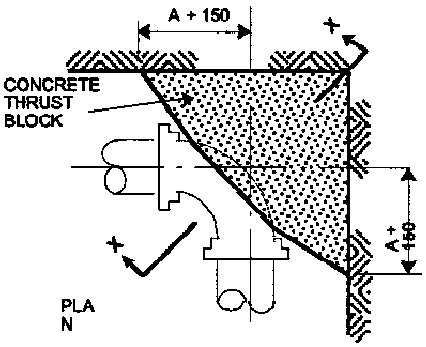
Typical Service Trench	2008 - 06 - 02
	Detail 33 05 10 06



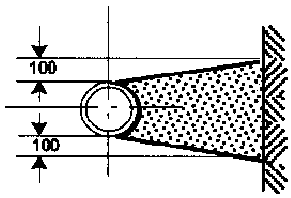
TEE



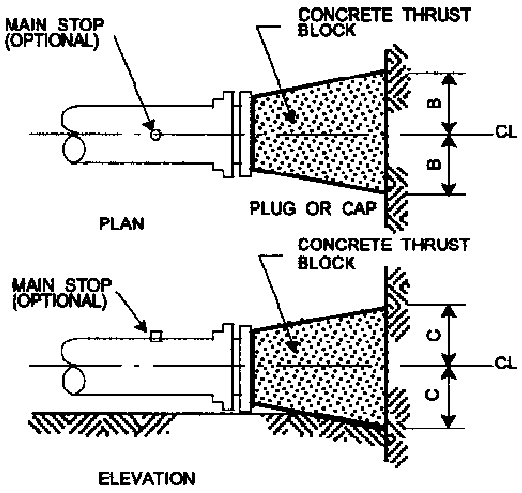
45° BEND



90° BEND



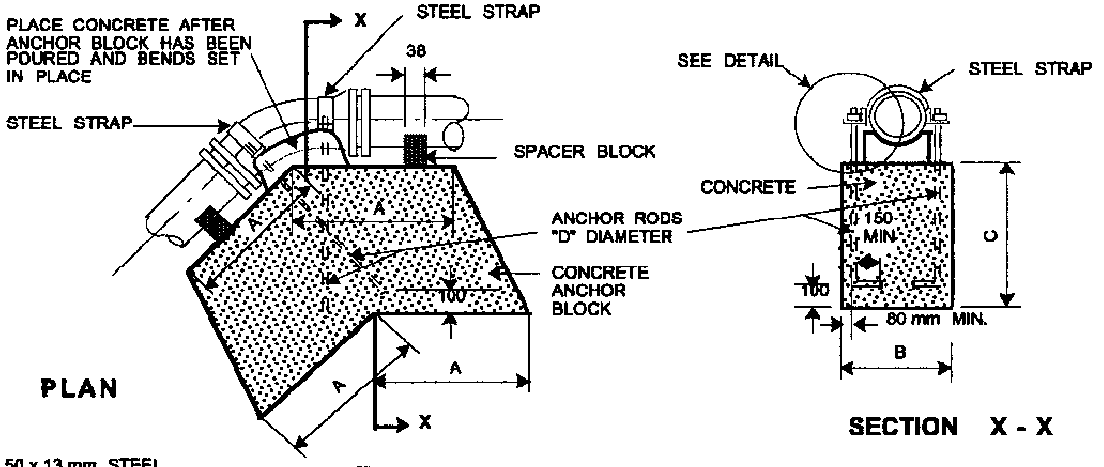
SECTION X - X

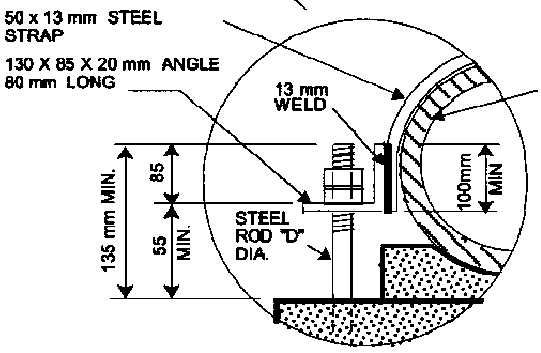


DEAD END SECTION

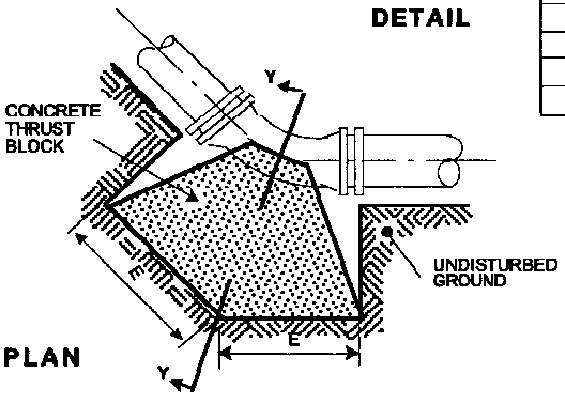
MINIMUM DIMENSIONS			
PIPE SIZE (mm)	A (mm)	B (mm)	C (mm)
100	150	150	150
150	230	230	200
200	230	300	200
250	300	380	250
300	380	450	300
350	450	550	380

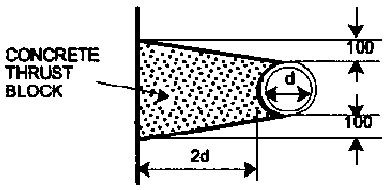
NOTES:
A. MAINTAIN CLEARANCE OF 80 mm FROM FACE OF BELL TO CONCRETE.
B. THIS BLOCKING DESIGN APPLIES ONLY WHERE 1035 KPa PRESSURE IS NOT EXCEEDED.
C. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
D. PROVIDE POLYETHYLENE FILM BETWEEN CONCRETE AND FITTINGS.
E. REFER TO SPECIFICATIONS.





PIPE SIZE (mm)	MINIMUM DIMENSIONS				
	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
100	450	600	750	13	150
150	600	900	900	13	300
200	600	900	1500	13	450
250	900	900	1500	20	600
300	1200	900	1650	20	800
350	1200	1200	1650	25	1000





NOTES:

A. MAINTAIN CLEARANCE OF 80 mm FROM FACE OF BELL TO CONCRETE.
B. USE POLYETHYLENE BOND BREAKER BETWEEN CONCRETE AND FITTINGS.
C. THIS BLOCKING IS FOR BENDS UP TO 45 ONLY.
D. THIS BLOCKING DESIGN APPLIES ONLY WHERE 1035 KPa PRESSURE IS NOT EXCEEDED.
E. FOR 100 AND 150 mm DIA. BENDS USE A SINGLE STRAP.
F. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
G. REFER TO SPECIFICATIONS.

1. General

1.1 INTENT

.1 Read this Section in conjunction with Section 33 05 10 - Piped Utility Systems General Requirements.

1.2 RELATED SECTIONS

.1	Soil for Earthwork:	Section 31 05 13.
.2	Trench Excavating and Backfilling:	Section 31 23 38.

1.3 DETAIL DRAWINGS

.1 Following detail drawings are appended hereto and form part of this Section:

33 10 10.01	Hydrant Installation
33 10 10.02	Valve Installation
33 10 10.03	Water Curb Stop Connection

1.4 UNIT PRICES

Unit of Work Description	Unit of Measurement	Method of Measurement
Pipe and fittings Water 150 PVC	M 150	Length installed, measured along pipe invert, through all fittings and appurtenances (to include excavation and backfilling)

Cont'd

1.4 UNIT PRICES (cont'd)

Unit of Work Description	Unit of Measurement	Method of Measurement
Pipe fittings 150- Elbow 45° 150- Elbow 90° 150x150 Tee 150 Plug	Each 3 2 1 1	Number installed
Valves and valve boxes 150 Valve	Each 2	Number installed
Hydrants,	Each 1	Number installed
Connection to existing mains	Each 1	Number of connections
Pipe bedding	m 150	Length of trench measured along pipe invert
Bedding stabilization including removal and disposal of unsuitable materials (allowance)	m^3 20	Volume of material installed, by truck measure

1.5 TESTING BY CONTRACTOR

.1 Arrange and pay for labour, equipment and materials required to perform specified hydrostatic and leakage tests.

.2 Notify Minister at least 24 h in advance of all proposed tests. Perform tests in Minister's presence.

.3 Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least 5 Days after placing concrete or 2 Days if high early strength concrete is used.

.4 Before testing, bed and cover pipe between joints to prevent movement or snaking of pipe line when test pressure is applied.

.5 Leave joints, fittings and valves exposed for visual inspection.

.6 Prevent water line from freezing.

.7 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.

.8 Ensure minimum disruption to existing water supply during testing.

.9 Test procedure for polyethylene pipe:

.1 Follow manufacturer's recommended procedures.

.2 Locate and repair defects.

.10 Test procedure:

.1 Open valves. Expel air from main by slowly filling with potable water.

.3 Thoroughly examine exposed parts and correct for leakage as necessary.

.4 Apply hydrostatic test pressure of 50% greater than operating pressure or 750 kPa whichever is greater, based on elevation of lowest point in system and corrected to elevation of test gauge, for a period of 1 h.

.5 Examine exposed pipe, joints, fittings, and appurtenances while system is under pressure.

.6 Measure amount of water required to maintain test pressure for 1 h.

.7 For pipe with rubber gasket joints, leakage shall not exceed that determined by the following formula:

$$L = \frac{(ND)\,(\text{SQUARE ROOT OF } P)}{70{,}500}$$

where L = allowable leakage in litres per hour.
N = number of joints in length tested.
D = nominal diameter of pipe in millimetres.
P = average test pressure kilopascals.

.8 For pipe with other than rubber gasket joints, leakage shall be 0 L/h.

.9 Locate and repair defects if leakage is greater than amount specified.

.10 Repeat test until leakage is within amount specified.

2. Products

2.1 PIPE AND PIPE FITTINGS

.1 General: Provide factory-fabricated pipe and pipe fittings of sizes, types, pressure ratings, and joining methods indicated. Where not indicated, provide proper compatible products as required to provide a functional system.

.2 Polyvinyl Chloride (PVC) Pipe and Fittings:

.1 Pipe: to CSA B137.3-93, CI DR 18.

.2 Fittings: to CSA B137.3-93.

.3 Joints: gasketed bell end, to CSA B137.3-93.

2.2 VALVES AND VALVE BOXES

.1 Gate Valves: to ANSI/AWWA C500-93, non-rising stem, square body, to open counter-clockwise.

.2 Valve pressure rating: 1380kPa for valves 300mm or smaller.

.3 Butterfly Valves: to ANSI/AWWA C504-94, handwheel operated.

.4 Valve Boxes: cast iron, adjustable over a minimum of 450 mm complete with valve operating extension rod.

2.3 HYDRANTS

.1 Hydrants: to ANSI/AWWA C502-94, compression type, complying with requirements of local authority having jurisdiction.

.2 Accessories: chain for nozzle, tap and plug drain hole.

2.4 BEDDING MATERIALS

.1 Granular Material: Sand as specified in Section 31 05 13.

3. Execution

3.1 BEDDING

.1 Provide Class B bedding as indicated on detail drawing appended to Section 33 05 10.

3.2 INSTALLATION OF PIPE AND PIPE FITTINGS

.3 PVC Pipe: Install in accordance with manufacturer's installation instructions.

3.3 JOINT CONNECTION METHODS

.1 PVC to PVC:

.1 Gasketed Bell-End Joints: to CSA B137.3-93.
.2 Solvent Cemented Joints: to CSA B137.3-93.

.2 PVC to Cast Iron Fittings:

.1 Rubber Gasket Joints: to ANSI/AWWA C111/A21.11-95.

3.4 VALVE AND VALVE BOX INSTALLATION

.1 Install as indicated on detail drawings.

.2 Centre and plumb valve box over valve. Set box cover flush with finish grade.

.3 Install so that valve box does not transmit shock or stress to valve.

3.5 HYDRANT INSTALLATION

.1 Locate and set hydrants plumb. Locate pumper nozzle perpendicular to the roadway with easy and immediate access.

.2 Set hydrants to grade, with nozzles 500 mm above ground minimum.

.3 Locate control valve 900 mm from hydrant.

.4 Install drainage pit 900 mm square by 600 mm deep filled with 50 mm washed gravel. Encase elbow of hydrant in gravel to 150 mm above drain opening. Do not connect drain opening to sewer.

.5 Brace barrels of hydrants against unexcavated earth using concrete backing. Assure that drain openings remain free.

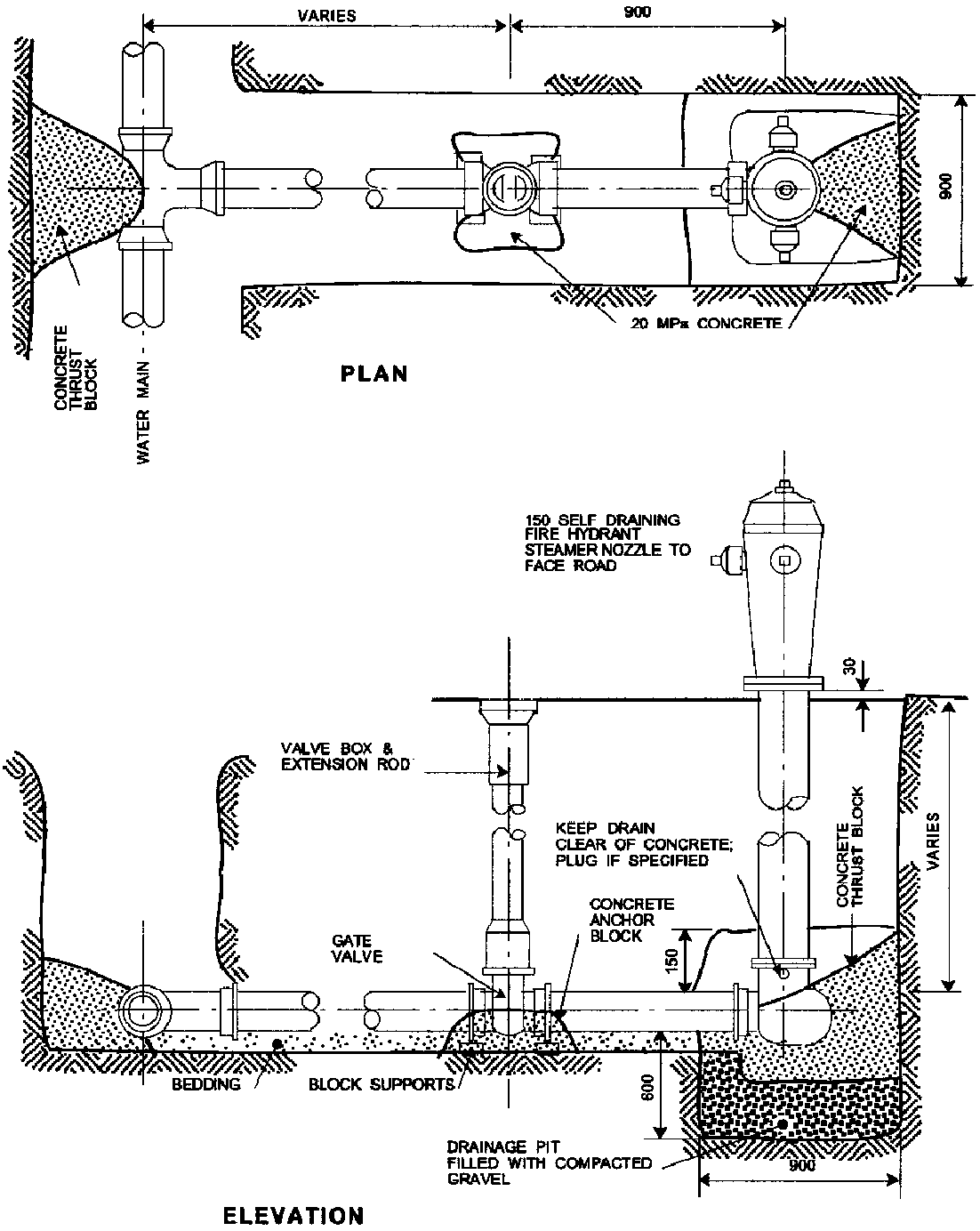
.6 In areas where water table reaches drain opening, plug opening to prevent infiltration of ground water.

3.6 DISINFECTION

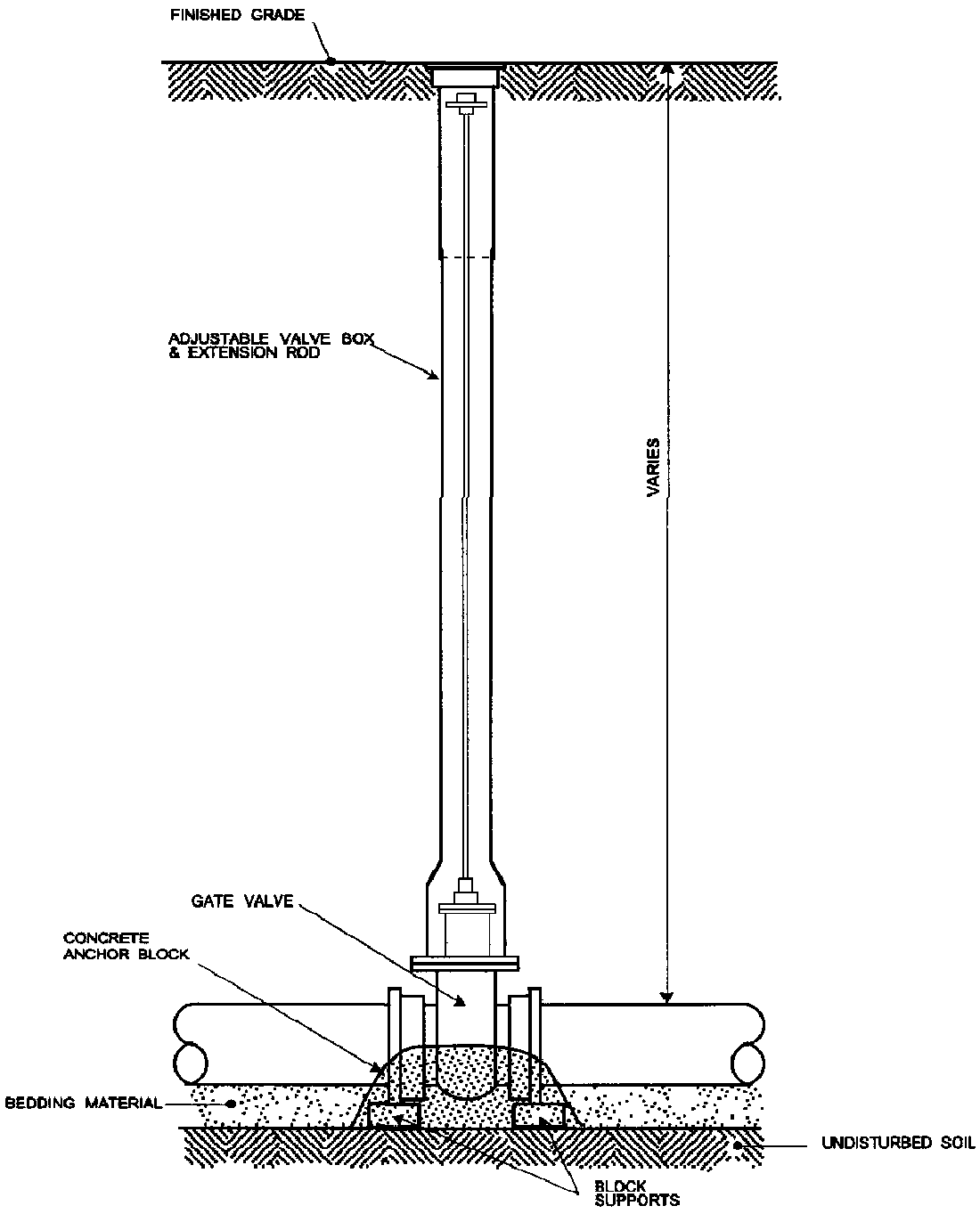
.1 Disinfect water line by maintaining a minimum concentration of 50 mg/L of available chlorine throughout system for a period of 24 h.

.2 After the retention period, flush out line until chlorine concentration in water leaving main is not greater than 1 mg/L.

END OF SECTION

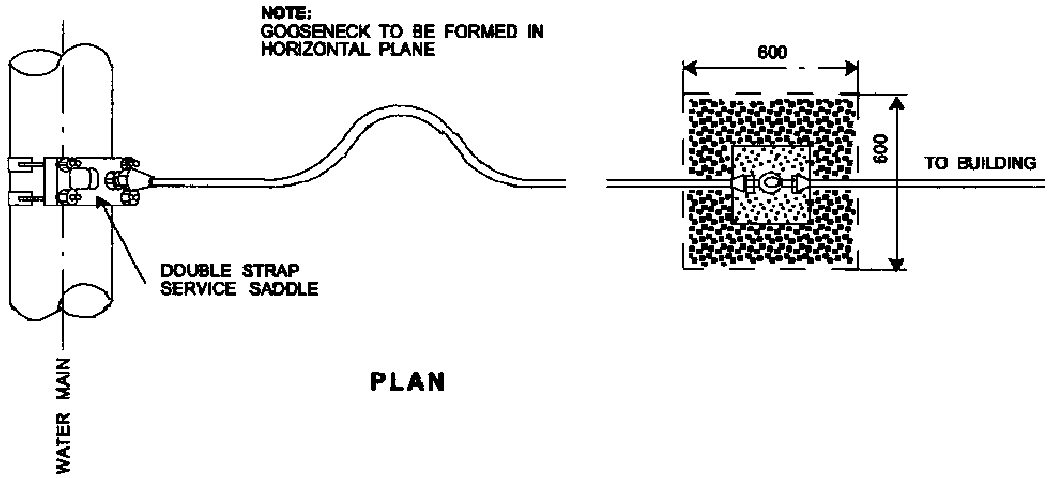


Hydrant Installation	2008 - 06 - 02
	Detail 33 10 10 01

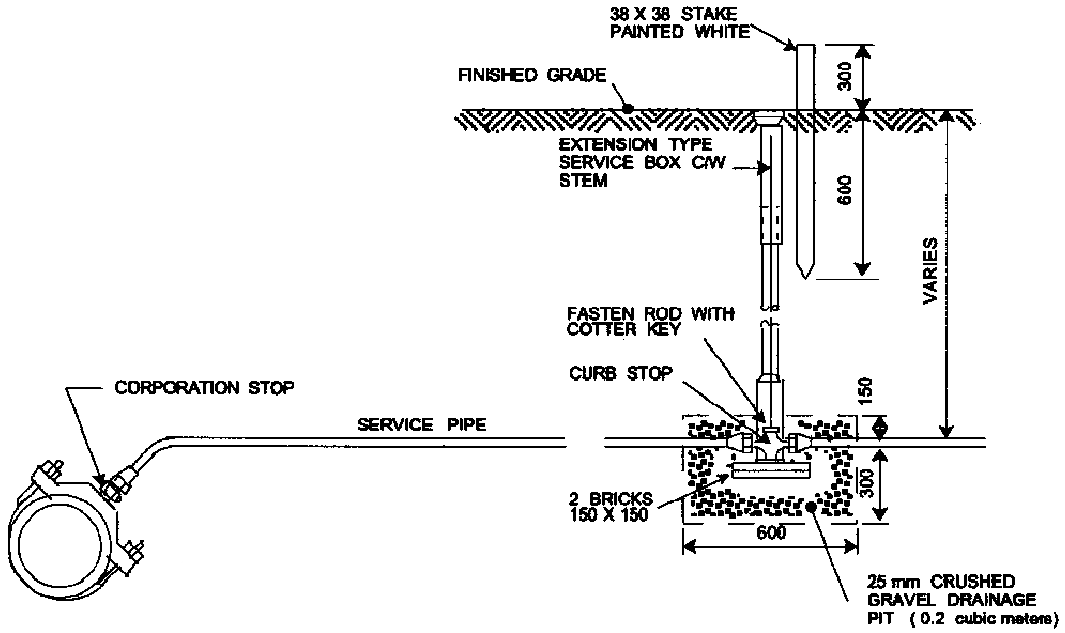


SECTION

Valve Installation - Section	2008 - 06 - 02
	Detail 33 10 10 02



PLAN



ELEVATION

1. General

1.1 INTENT

.1 Read this section in conjunction with Section 33 05 10 - Piped Utility Systems General Requirements.

1.2 RELATED SECTIONS

.1	Fill Materials:	Section 31 05 13.
.2	Trench Excavating & Backfilling:	Section 31 23 38.

1.3 SECTION INCLUDES

.1 This Section includes all requirements for sewer system, including materials, installation of pipes and appurtenances.

1.4 DETAIL DRAWINGS

.1 Following detail drawings are appended hereto and form part of this Section.

33 30 10.01	Precast Manhole
33 30 10.05	Sewer Service Connection

1.5 UNIT PRICES

Unit of Work Description	Unit of Measurement	Method of Measurement
Pipe S 150 PVC	m 70	Length installed, measured along pipe invert, through Manholes (to include excavation and backfilling)
Pipe Bedding	m 70	Length of trench measured along pipe invert
Bedding stabilization including removal and disposal of unsuitable Materials (allowance only)	m^3 10	Volume of material installed by truck measure
Manholes 5A Sanitary MH	unit 1	Length installed, measured from top of base to top of frame.

2. Products

2.1 MATERIALS SCHEDULE

Material	Standard	Type	Joints
PVC Pipe	CSA B182.1-96 (100 to 150 mm) CSA B182.2-95 (200 to 675 mm)	SDR 35	Rubber gasketed bell end
Precast Manhole	ASTM C76-95a	Sulfate resist-ant cement c/w galvanized ladder rungs	Rubber gasket to CSA A257.3-M92
Precast manhole base, slab top	-	Sulfate resist-ant cement	-

Manhole cover	Standard cast iron

2.2 BEDDING MATERIALS

.1 Granular Material: Sand as specified in Section 31 05 13.

3. Execution

3.1 BEDDING

.1 Provide Class B bedding as indicated on detail drawing appended to Section 33 05 10.

3.2 PIPE LAYING

.1 Lay pipes with bell-end upgrade.

.2 Provide and utilize "laser" type instrument to control line and grade for grades less than 0.5%. For steeper grades, use approved and accepted method of establishing grades.

.3 Ensure that the installed lines have a smooth and uniform invert.

3.3 MANHOLES AND CATCH BASINS

.1 Set precast base of manholes to proper grade and location specified.

.2 Construct poured-in-place concrete base for manholes to proper grade and location specified.

.3 Imbed manholes into soft concrete of base as soon after pouring as possible. Ensure correct grade and location.

.4 Set cast iron covers to finished grade.

.5 Form smooth channels across manhole base. Set inverts of channels to invert elevations specified for pipe. Ensure channels are as wide and deep as diameter of outlet pipe.

.6 Knock out openings for pipe in manholes 150 mm maximum larger than pipe diameter. Place cement grout in voids between pipe and manhole.

.7 Place cement grout in barrel joints during erection or use preformed rubber gaskets.

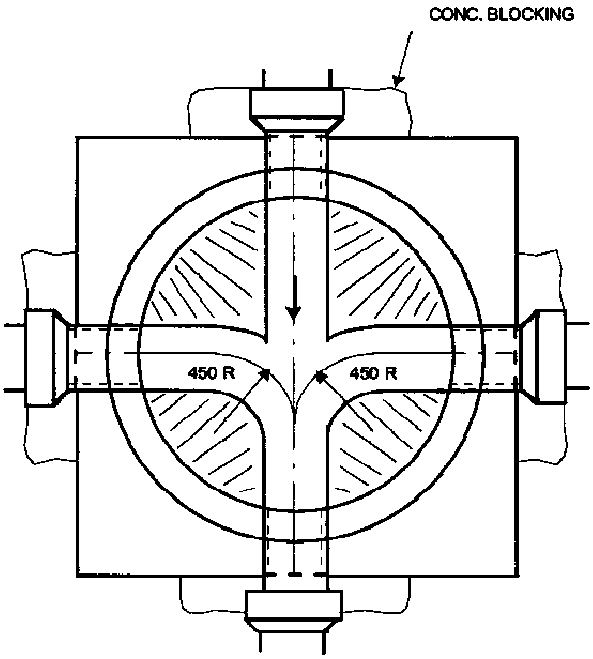
.8 Install manholes to provide minimum 500 mm and maximum 750 mm long neck.

3.4 FLUSHING

.1 Flush out new sewer system to ensure free running pipes. Supply all equipment and water required.

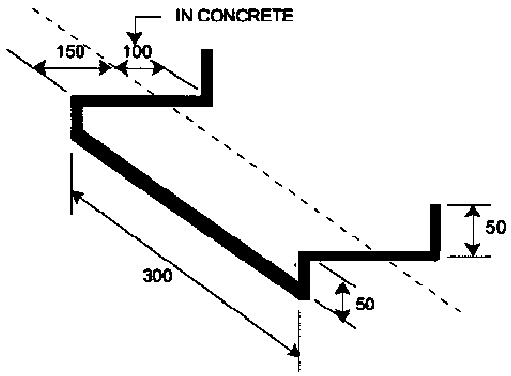
.2 Remove dirt and debris from manholes

END OF SECTION

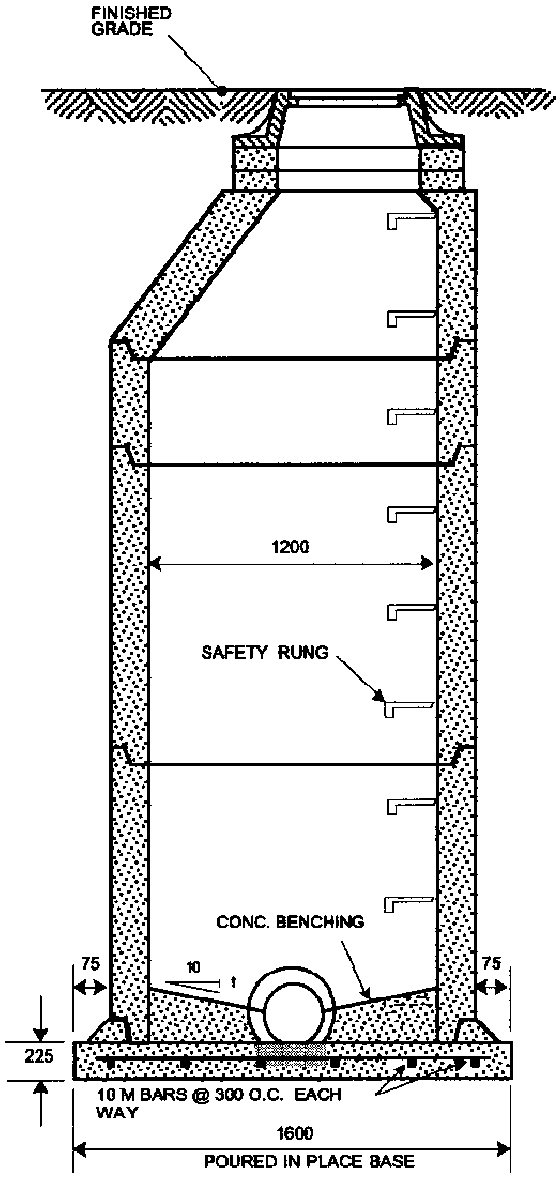


PLAN
SHOWING MATCHING OF INVERTS

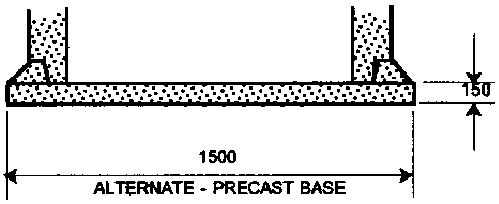
NOTE:

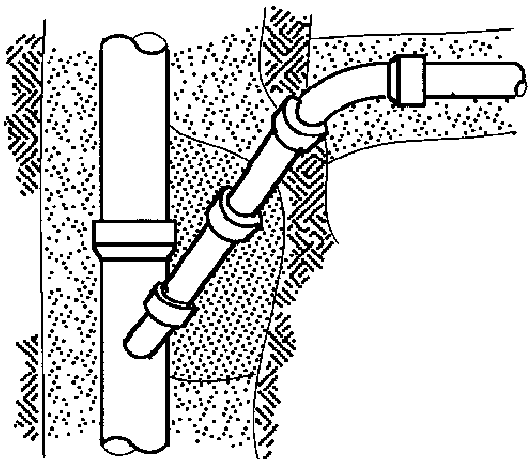


SAFETY MANHOLE RUNG



SECTION





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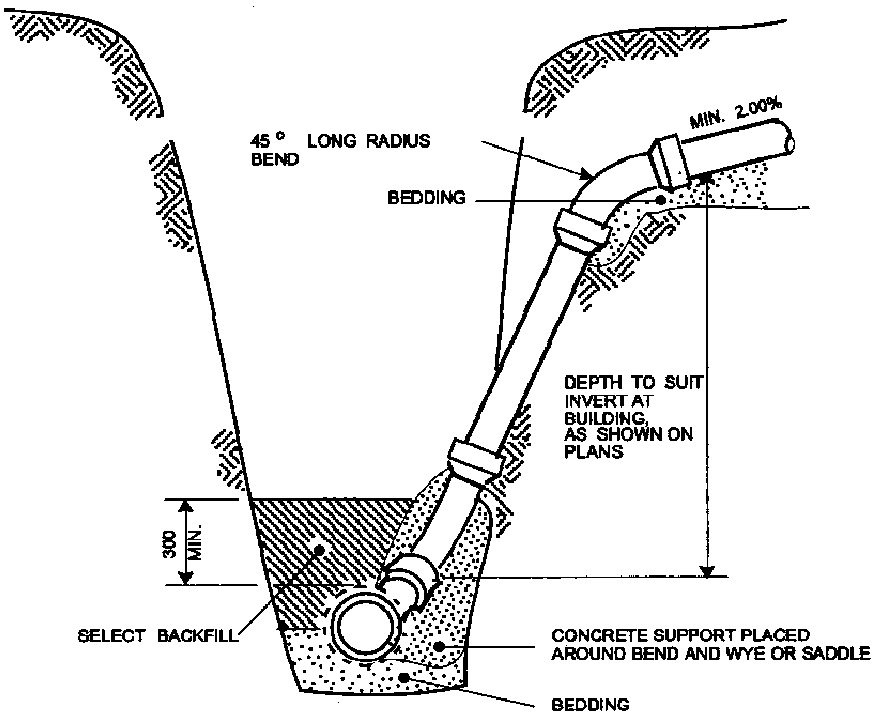

ELEVATION