

PART E
SPECIFICATIONS

PART E - SPECIFICATIONS

E1. APPLICABLE SPECIFICATIONS, STANDARD DETAILS AND DRAWINGS

- E1.1 *The City of Winnipeg Standard Construction Specifications* in its entirety, whether or not specifically listed on Form B: Prices, shall apply to the Work.
- E1.1.1 *The City of Winnipeg Standard Construction Specifications* is available in Adobe Acrobat (.pdf) format on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division internet site at <http://www.winnipeg.ca/matmgt>.
- E1.1.2 Further to GC:2.4(d), Specifications included in the Bid Opportunity shall govern over *The City of Winnipeg Standard Construction Specifications*.
- E1.2 The following Drawings are applicable to the Work:

Drawing Title	Drawing No.	File Name	Size
Cover sheet, Drawing List	00	9-2005_Drawing_00-R2.pdf	A1 (841mm x 594 mm)
Structural-Building Plan, Sections & Details	01	9-2005_Drawing_01-R2.pdf	A1
Structural-Building Elevations, Plans & Sections	02	9-2005_Drawing_02-R2.pdf	A1
Mechanical-Legend, General Notes, Schedules	03	9-2005_Drawing_03-R2.pdf	A1
Mechanical-Partial Site Plan and Flow Diagram	04	9-2005_Drawing_04-R2.pdf	A1

- E1.3 The following Drawings are issued for reference purposes only:

Drawing Title	Drawing No.	File Name	Size
Cover Sheet, Drawing List	05	9-2005_Drawing_05-R2.pdf	A1 (841 mm x 594 mm)
Pavement Plan	06	9-2005_Drawing_06-R2.pdf	A1
Sewer, Water and Ditching Plan	07	9-2005_Drawing_07-R2.pdf	A1
Landscape Plan	08	9-2005_Drawing_08-R2.pdf	A1
Electrical Site Plan & Schedule	09	9-2005_Drawing_09-R2.pdf	A1
Electrical Details	10	9-2005_Drawing_10-R2.pdf	A1
Electrical Power Distribution Enclosure and Schematic	11	9-2005_Drawing_11-R2.pdf	A1

E2. CODES AND STANDARDS

- E2.1 The entire project will conform to the National Building Code (NBC), the Manitoba Building Code (MBC), the Manitoba Fire Code (MFC), the Manitoba Electrical Code and all other applicable Federal, Provincial, and Municipal Codes, bylaws, and Regulations.
- E2.2 It is the Contractor's responsibility to ensure compliance.

E2.3 Materials, workmanship, and design must meet or exceed applicable requirements of Canadian General Standards Board (CGSB), Canadian Standards Association (CSA), American Concrete Institute (ACI), Canadian Sheet Steel Buildings Institute (CSSBI), American Society for Testing and Materials (ASTM), Underwriters Laboratory of Canada (ULC), Canadian Gas Association (CGA), Canadian Electrical Manufacturers Association (CEMA) or other referenced organizations.

E2.4 Compliance shall be with latest edition of the applicable code or standard.

E3. SITE INVESTIGATION REPORT

E3.1 Further to GC: 3.1, test hole logs are provided to aid in the Contractor's evaluation of the foundation structure. The test hole logs are tabulated and can be found in Appendix A.

E4. TRAFFIC MANAGEMENT

E4.1 Street and approach access shall be maintained at all times.

E4.2 Should the Contractor be unable to maintain pedestrian or vehicular access to a residence or business, he shall review the planned disruption with the business or residence and the Contract Administrator, and take reasonable measures to minimize the impact. The Contractor shall provide a minimum 24 hours notification to the affected residence or business and the Contract Administrator, prior to disruption of access.

E4.3 Pedestrian and ambulance/emergency vehicle access must be maintained at all times.

E5. WATER USED BY CONTRACTOR

E5.1 Further to clause 3.7 of CW 1120-R1, the Contractor shall arrange and pay for all costs associated with obtaining water in accordance with the Waterworks By-law. Sewer charges will not be assessed for water obtained from a hydrant.

E6. SITE PROTECTION AND CLEAN-UP

E6.1 The Contractor shall restrict himself to as small a work area as possible during all phases of the construction of the sand/salt storage building, as well as the storage and marshalling of materials associated with the construction.

E6.2 The Contractor shall protect all existing grounds and structures from damage at all times. The Contractor shall repair or remedy any damage to the Contract Administrator's satisfaction, at the Contractor's cost.

E6.3 The Contractor shall keep the work area free of waste materials and debris and on the completion of the Work shall clean up and remove all debris to the satisfaction of the Contract Administrator.

E7. CONSTRUCTION DOCUMENTS

E7.1 During the progress of the Work, the Contractor shall furnish to the Contract Administrator the Construction Documents that describe details of the design required by the Bid Opportunity. At the time of submission the Contractor shall notify the Contract Administrator of any significant deviations in the Construction Documents from the requirements of the Bid Opportunity.

E7.2 The Contract Administrator shall review the Construction Documents with reasonable promptness so as to cause no delay. The Contract Administrator's review is for conformity to

the intent of the Bid Opportunity and shall not relieve the Contractor of the responsibility for errors or omissions in the Construction Documents or for meeting all requirements of the Bid Opportunity unless the Contract Administrator expressly accepts a deviation from the Bid Opportunity.

- E7.3 No later than five (5) Business Days after completing the review, the Contract Administrator shall notify the Contractor in writing that the City has accepted the Construction Documents or shall notify the Contractor, giving reasons in writing, why the City rejects the Construction Documents. The Contractor shall revise and resubmit Construction Documents which the City has rejected.
- E7.4 When the Construction Documents are accepted by the City, the documents will be signed by the appropriate City Authorities and the Contractor, and the Construction Documents shall become part of the Contract.
- E7.5 Further to GC:2.4, in event of conflicts between portions of the Bid Opportunity and the Construction Documents, the Bid Opportunity shall govern unless these conflicts have been expressly overridden in writing by the Contract Administrator and accepted by the City.

E8. SHOP DRAWINGS

- E8.1 Shop Drawings shall be submitted to the Contract Administrator for the products, equipment or materials identified in the Bid Opportunity requiring Shop Drawings. In addition, provision of products, equipment or materials not identified in the Bid Submission or the Construction Documents must be to the satisfaction of the Contract Administrator, and must be approved by the Contract Administrator through submission of Shop Drawings prior to being manufactured.
- E8.2 Shop Drawings are to be originals prepared by Contractor, Subcontractor, Supplier or Distributor. Submit reproducible transparency and four (4) opaque prints of each shop drawing to the Contract Administrator for review. Sepia will be returned to Contractor following review.
- E8.3 Shop drawings for the following structural components shall bear the seal of a registered engineer of Manitoba:
- (a) Shoring
 - (b) Concrete reinforcement
 - (c) Structural steel/aluminium
 - (d) Structural connection details
- E8.4 The Contract Administrator's review is for conformity to the intent of the Bid Opportunity and Contract Documents and for general arrangement only. The Contract Administrator's review shall not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or for meeting all requirements of the Contract Documents unless the Contract Administrator expressly accepts a deviation from the Contract Documents in writing.

E9. RECORD DRAWINGS AND DOCUMENTS

- E9.1 The Contractor shall keep one record copy of all Specifications, Drawings, Addenda, Operation and Maintenance Manuals, Shop Drawings and samples at the Site in good order and shall record thereon all changes made during the construction of the Work as they occur. These record copies shall be made available to the Contract Administrator during construction and shall be delivered to the Contract Administrator on behalf of the City upon completion of the Work.

E10. OPERATION AND MAINTENANCE MANUALS AND WARRANTIES

- E10.1 The Contractor shall prepare and submit to the Contract Administrator three (3) copies of detailed operation and maintenance manuals. The operation and maintenance manuals shall include the following information:
- (a) Maintenance instructions for finished surfaces and materials.
 - (b) Copy of hardware and paint schedules.
 - (c) Description, operation, maintenance and lubrication instructions, including daily, weekly, monthly, semi-annual and annual checks for equipment and systems, including complete list of equipment. Indicate nameplate information such as make, size, capacity and serial number.
 - (d) General overall equipment layouts with details of each unit with parts list, complete with a list of recommended spare parts.
 - (e) Detailed instructions on adjustment of wear and replacement of parts.
 - (f) Names, addresses and telephone numbers of installing Contractors and local service representatives.
 - (g) Each section of the data book shall be listed in the Table of Contents by number, title as shown on divider tabs. Appendices shall be listed separately.
 - (h) Guarantees, warranties and bond showing:
 - (i) Name and address of project.
 - (ii) Guarantee commencement date (date of Total Performance of the work).
 - (iii) Duration of guarantees(s).
 - (iv) Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
 - (v) Signature and seal of Contractor.
 - (i) Manufacturer's literature shall show the name, address and telephone number of the local agent or supplier.
 - (j) Include final shop drawings in the appropriate sections, indicating corrections and changes made during fabrication and installation. Shop drawings shall be bound in manuals such that drawings may be used without dismantling manuals.
 - (k) Sheets larger than 280mm x 430mm shall be inserted in plastic sleeves complete with identification as to drawing title and number.

E11. BORED PILES

- E11.1 References – Canadian Standards Association (CSA)
- (a) CSA-A23.2-00 (June 2001), Methods of Test for Concrete.
 - (b) CAN/CSA-G30.18-M92 (R1998), Billet Steel Bars for Concrete Reinforcement.
- E11.2 Shop Drawings
- (a) Submit shop drawings.
- E11.3 Materials
- (a) Concrete mixes and materials: in accordance with Concrete Mix Design A in CW 2160-R6.
 - (b) Reinforcing steel to CAN/CSA – G30.18 and in accordance with CW 2160-R6.

E11.4 Source Quality Control

- (a) Concrete tests: to CSA-A23.2.

E11.5 Field Records

- (a) Maintain record for each pile, including tip elevation, and length of pile.
- (b) Provide Contract Administrator with three copies of records.

E11.6 Installation

- (a) Bore holes to diameters and depths as per accepted design.
- (b) Dispose of excavated materials off site.
- (c) Contract Administrator to inspect pile excavation prior to placing of concrete. Remove loose material, foreign matter and water.
- (d) Install steel reinforcement in accordance with accepted design.
- (e) Fill pile excavations with concrete to elevations as indicated. Place concrete in one continuous pour in accordance with CW 2160-R6.
- (f) Steel casing is to be removed. Withdraw casing in conjunction with concrete placing, keeping bottom of casing 600 mm below level of concrete.

E12. STEEL DOORS AND FRAMES

E12.1 Related Sections

- (a) E11: Door Hardware

E12.2 References:

- (a) American Society for Testing and Materials (ASTM International)
 - (i) ASTM A653/A653M-01a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- (b) Canadian General Standards Board
 - (i) CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - (ii) CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
 - (iii) CGSB 51-GP-21M, Thermal Insulation, Urethane and Isocyanurate, Unfaced.
- (c) Canadian Standards Association (CSA International)
 - (i) G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - (ii) CSA W59-M1989 (R2001), Welded Steel Construction (Metal Arc Welding) (Metric Version).
- (d) Canadian Steel Door Manufacturers' Association, (CSDMA).
 - (i) CSDMA, Specifications for Commercial Steel Doors and Frames, 1990.
 - (ii) CSDMA, Recommended Selection and Usage Guide for Commercial Steel Doors, 1990.

E12.3 Design Requirements

- (a) Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -40°C to 35°C.
- (b) Maximum deflection for exterior steel entrance doors under wind load of 1.2 kPa not to exceed 1/175th of span.

E12.4 Shop Drawings

- (a) Submit shop drawings.
- (b) Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, arrangement of hardware and finishes.
- (c) Indicate each type frame material, core thickness, reinforcements, location of anchors and exposed fastenings finishes.
- (d) Include schedule identifying each unit, with door marks and numbers.

E12.5 Materials

- (a) Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 – Thickness for Component Parts.
- (b) Reinforcement channel: to CSA G40.20/G40.21, Type 300W, coating designation to ASTM A653M, ZF75.
- (c) Composites: balance of core materials used in conjunction with lead: in accordance with manufacturers' proprietary design.

E12.6 Door Core Materials

- (a) Stiffened:
 - (i) Polyurethane: to CGSB 51-GP-21M rigid, modified poly/isocyanurate closed cell. Density 32 kg/m³.

E12.7 Adhesives

- (a) Polystyrene and polyurethane cores: water resistant, epoxy resin based, low viscosity, contact cement.
- (b) Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

E12.8 Primer

- (a) Touch-up primer: CAN/CGSB-1.181.

E12.9 Paint

- (a) Field paint steel doors and frames. Protect weatherstrips from paint. Final finish shall be free of scratches or other blemishes.

E12.10 Accessories

- (a) Door silencers: single stud rubber/neoprene type.
- (b) Exterior top and bottom steel caps.
- (c) Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections and counter-sunk oval head sheet metal screws.
- (d) Metallic paste filler: to manufacturer's standard.
- (e) Make provision for glazing as indicated and provide necessary glazing stops.
 - (i) Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.
 - (ii) Design exterior glazing stops to be tamperproof.

E12.11 Frames Fabrication General

- (a) Fabricate frames in accordance with CSDMA specifications.
- (b) Fabricate frames to profiles and maximum face sizes as indicated.
- (c) Exterior frames: 1.6 mm welded type construction.
- (d) Blank, reinforce, drill and tap frames for mortised, templated hardware, using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- (e) Protect mortised cutouts with steel guard boxes.
- (f) Prepare frame for doors silencers, 3 for single door, 2 at head for double door.
- (g) Manufacturer's nameplates on frames are not permitted.
- (h) Conceal fastenings except where exposed fastenings are indicated.
- (i) Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

E12.12 Frame Anchorage

- (a) Provide appropriate anchorage to floor and wall construction.
- (b) Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- (c) Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height of fraction thereof.
- (d) Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jamb and intermediate at 660 mm o.c. maximum.

E12.13 Frames: Welded Type

- (a) Welding in accordance with CSA W59.
- (b) Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- (c) Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- (d) Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- (e) Securely attach floor anchors to inside of each jamb profile.
- (f) Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

E12.14 Door Fabrication General

- (a) Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.
- (b) Exterior doors: insulated hollow steel construction.
- (c) Fabricate doors with longitudinal edges welded. Seams: visible grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- (d) Blank, reinforce, drill doors and tap for mortised, templated hardware.
- (e) Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- (f) Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors.

- (g) Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- (h) Manufacturer's nameplates on doors are not permitted.

E12.15 Hollow Steel Construction

- (a) Form each face sheet for exterior doors from 1.6 mm sheet steel.
- (b) Reinforce doors with vertical stiffeners, securely welded to each face sheet at 150 mm on centre maximum.
- (c) Fill voids between stiffeners of exterior doors with polyurethane core.

E12.16 Installation General

- (a) Install doors and frames to CSDMA Installation Guide.

E12.17 Frame Installation

- (a) Set frames plumb, square, level and at correct elevation.
- (b) Secure anchorages and connections to adjacent construction.
- (c) Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- (d) Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- (e) Caulk perimeter of frames between frame and adjacent material.
- (f) Maintain continuity of air barrier and vapour retarder.

E12.18 Door Installation

- (a) Install doors and hardware in accordance with hardware templates and manufacturer's instructions and E14 – Door Hardware.
- (b) Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:
 - (i) Hinge side: 1.0 mm
 - (ii) Latchside and head: 1.5 mm
 - (iii) Finished floor, and thresholds: 13 mm
- (c) Adjust operable parts for correct function.
- (d) Install louvres.

E12.19 Finish Repairs

- (a) Touch up with primer finishes damaged during installation.
- (b) Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

E13. **SECTIONAL METAL OVERHEAD DOORS**

E13.1 Related Sections

- (a) E26: Electrical power supply.

E13.2 References

- (a) The Aluminum Association Inc. (AA)
 - (i) Aluminum Association Designation System for Aluminum Finishes-1997.
- (b) American Society for Testing and Materials (ASTM)
 - (i) ASTM A 366M-97, Specification for Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
 - (ii) ASTM D 523-99, Test Method for Specular Gloss.
 - (iii) ASTM D 822-96, Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- (c) Canadian General Standards Board (CGSC)
 - (i) CAN/CGSB-1.105-M91, Quick-Drying Primer.
 - (ii) CGSB 1.121-93, Vinyl Pretreatment Coating for Metals (Vinyl Wash Primer).
 - (iii) CGSB 1.181-99, Coating, Zinc-Rich, Organic, Ready Mixed.
- (d) Canadian Standards Association (CSA)
 - (i) CSA G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles.

E13.3 Design Requirements

- (a) Design exterior door assembly to withstand windload of 1 kPa with a maximum horizontal deflection of 1/240 of opening width.
- (b) Design door assembly to withstand minimum 2000 cycles per annum, and 25 years total life cycle.

E13.4 Shop Drawings

- (a) Submit shop drawings.
- (b) Indicate sizes, service rating, types, materials, operating mechanisms, glazing locations and details, hardware and accessories, required clearances and electrical connections.

E13.5 Closeout Submittals

- (a) Provide operation and maintenance data for overhead door hardware for incorporation into manual.

E13.6 Extra Materials

- (a) Provide spare parts for overhead doors as follows:
 - (i) Door panels: 8.
 - (ii) Door rollers: 12.
 - (iii) Weatherstripping: 4 sets
 - (iv) Springs and cables: 2.
- (b) Spare parts will be delivered to location determined by the Contract Administrator. Store where directed. Identify each part and reference to appropriate door.

E13.7 Materials

- (a) Galvanized steel sheet: commercial quality Z275 zinc coating.
- (b) Steel sheet: commercial quality to ASTM A 366M exposed (E).
- (c) Primer: to CGSB1.181, for galvanized steel surfaces.
- (d) Cable: multi-strand stainless steel aircraft cable.

E13.8 Doors

- (a) Fabricate 42 mm thick flush panel doors of interlocking roll formed steel sections.
- (b) Fabricate panel frames in a continuous box frame with vertical stiffeners at 600 mm centres.
- (c) Assemble components by means of spot or arc welding or coated rivet system or adhesive and self tapping screws to manufacturer's recommendations.
- (d) Fabricate doors from prepainted steel stock.

E13.9 Heavy Duty Industrial Hardware

- (a) Track: high lift hardware with 75 mm size 2.6 mm core thickness galvanized steel track.
- (b) Track Supports: 2.3 mm core thickness continuous galvanized steel angle track supports.
- (c) Spring counter balance: heavy duty oil tempered torsion spring with manufacturer's standard brackets.
 - (i) Drum: 200 mm diameter die cast aluminium.
 - (ii) Shaft: 32 mm diameter galvanized steel.
- (d) Top roller carrier: galvanized steel 3.04 mm thick adjustable.
- (e) Rollers: sealed full floating grease packed hardened steel, ball bearing 75 mm diameter solid steel tire.
- (f) Roller brackets: adjustable, minimum 2.5 mm galvanized steel.
- (g) Hinges: heavy duty, 3.04 mm thick stainless steel.
- (h) Cable: 6 mm diameter stainless steel aircraft cable.

E13.10 Accessories

- (a) Overhead horizontal track and operator supports: galvanized steel, type and size to suit installation.
- (b) Pusher springs.
- (c) Handles
 - (i) Flat bar door latch.
 - (ii) Handles: key handle operated from outside, handle operated from inside.
- (d) Two horizontal sliding lock bolts on interior.
- (e) Weather stripping
 - (i) Sills: bulb type full width extruded neoprene weatherstrip.
 - (ii) Jambs and head: extruded aluminum and arctic grade vinyl weatherstrip to manufacturer's standard.
- (f) Finish ferrous hardware items with minimum zinc coating of 300 g/m² to CSA G164.

E13.11 Prefinished Steel Sheet

- (a) Prefinished steel with factory applied polyvinylidene fluoride.
 - (i) Class F1S.
 - (ii) Colour selected by Contract Administrator from manufacturer's standard range.
 - (iii) Specular gloss: 30 units +/- in accordance with ASTM D 523.
 - (iv) Coating thickness: not less than 22 micrometres.

- (v) Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20% to ASTM D 822 as follows:
 - (i) Outdoor exposure period 2500 hours.
 - (ii) Humidity resistance exposure period 5000 hours.

E13.12 Operators

- (a) Equip doors for operation by:
 - (i) Chain hoist with galvanized steel chain.
- (b) Cable fail safe device.
 - (i) Able to stop door immediately if cable breaks on door free fall. Braking capacity 500 kg.

E13.13 Electrical Operator

- (a) Electrical jack shaft side mounted type operator.
- (b) Electrical motors, controller units, remote pushbutton stations, relays and other electrical components: to CSA approval with CSA enclosure type 12.
- (c) Power supply: 208 V, 3 phase, 60 Hz.
 - (i) Motor: 746 W (1 hp), 208V, 3 phase.
- (d) Controller units with integral motor reversing starter, solenoid operated brake 3 heater elements for overload protection, including reset pushbuttons and control relays as applicable.
- (e) Operation:
 - (i) Remote pushbutton stations: surface mounted, in 1 location, with "OPEN-STOP-CLOSE" "SECURITY LOCKOUT" designations on pushbuttons in English.
- (f) Safety switch: combination roll rubber with limit switches for full length of bottom rail of bottom section of door, to reverse door to open position when coming in contact with object on closing cycle.
- (g) For jack shaft operators:
 - (i) Provide floor level disconnect device to allow for manual operation in event of power failure.
 - (ii) Equip Operator with:
 - (i) Electrical interlock switch to disconnect power to operator when in manual operation.
 - (ii) Built-in chain hoist for manual operation in event of power failure.
- (h) Automatic illumination complete with time delay, self extinguishing.
- (i) Door speed: 300 mm per second.
- (j) Control transformer: for 24 VAC control voltage.
- (k) Mounting brackets: galvanized steel, size and gauge to suit conditions.

E13.14 Installation

- (a) Install doors and hardware in accordance with manufacturer's instructions.
- (b) Rigidly support rail and operator and secure to supporting structure.
- (c) Touch-up steel doors with primer where galvanized finish damaged during fabrication.
- (d) Install operator including electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.

- (e) Lubricate and adjust door operating components to ensure smooth opening and closing of doors.
- (f) Adjust weatherstripping to form a weathertight seal.

E14. DOOR HARDWARE

E14.1 Related Sections

- (a) E12: Steel Doors and Frames
- (b) E13: Sectional Metal Overhead Doors

E14.2 Work Included

- (a) The following list generally describes the scope of this Section:
 - (i) Hardware for all Metal Doors and Frames.
 - (ii) Supply of Templates to Door Frame Manufacturers.
 - (iii) Master Keying System.
 - (iv) Temporary construction locksets on all exterior doors.

E14.3 Shop Drawings

- (a) Submit shop drawings.
- (b) Provide detailed list from hardware schedule including design, finish, catalogue identification, reference identification to specified standards.
- (c) Provide templates to door and frame manufacturer for accurate shop fabrication and sizing.

E14.4 Delivery/Storage

- (a) Package each item of hardware separately or in like groups.
- (b) Include installation templates, screws, keys and instructions.
- (c) Maintain inventory list with hardware schedule.

E14.5 Master Keying

- (a) Key door locks which are to be master keyed as noted in E14.10 Hardware Schedule.
- (b) Provide 2 keys for every lock cylinder supplied.
- (c) Review keying with the Contract Administrator and the City before placing order for locksets.

E14.6 Maintenance

- (a) Upon completion of work, provide the City with a manufacturer's parts list, manufacturer's instructions for door closers, locksets, door holders and panic hardware, and two (2) sets of wrenches for door closers and locksets.
- (b) Brief the building maintenance staff regarding the proper care of hardware such as lubrication of locksets, adjustments of door closers, cleaning and general maintenance.

E14.7 Materials

- (a) All items shall be supplied with ancillary brackets, shims, etc., to suit the door installation and operation as shown on the drawings.
- (b) Include with the hardware items, all necessary screws, bolts, expansion shields, etc. for proper installation.
- (c) All knobs, levers, locks and latches shall have temporary plastic covers.

E14.8 Manufacturers

- (a) Refer to E14.10 Hardware Schedule. Hardware as manufactured by the following manufacturers has been specified.

BUTTS	-	HAGER
LOCKSETS	-	SCHLAGE
PANIC HARDWARE	-	VON DUPRIN
DOOR CLOSERS	-	YALE
PULLS, PUSHES & KICK PLATES	-	HAGER
DOOR STOPS, HOLDERS	-	GLYNN JOHNSON
WEATHERSTRIPPING, THRESHOLDS	-	REESE

E14.9 Execution

- (a) Carry out work with proper templates supplied by manufacturer.
- (b) Clean and polish all hardware including adjacent affected work to the approval of the Contract Administrator.
- (c) Prepare hardware for installation to the following measurements from finished floor to centre line of component:
- | | |
|------------|---------|
| Door Pull | 1143 mm |
| Push Plate | 1143 mm |
| Door Bar | 1067 mm |
| Door Knob | 1024 mm |
| Dead Lock | 1524 mm |
| Panic Bolt | 1024 mm |

E14.10 Hardware Schedule

- (a) Exterior Single Doors:

Hardware/Quantity	Manufacturer's Number	Finish
3 Hinges	BB1191 – 114 x 114 N.R.P.	C26D
1 Lockset	D53PD x ORB x 127 mm B.S.	630
1 Deadbolt	B660 x 127 mm B.S.	626
1 Holder	GJ804MSHD	C26D
1 Kickplate	HA9550 250 x 860	C32D
1 Weather strip	DS79	AL
1 Sweep	DB469	AL
1 Threshold	CT-45	AL

E15. PREFABRICATED BUILDINGS

E15.1 Related Sections

- (a) E2: Codes and Standards
- (b) E11: Bored Piles
- (c) CW 2160-R6: Reinforced Concrete
- (d) E12: Steel Doors and Frames
- (e) E13: Sectional Metal Overhead Doors
- (f) E14: Door Hardware

E15.2 System Description

- (a) Provide building structure and enclosure to physical dimensions shown on drawings.
- (b) Building occupancy as defined by National Building Code of Canada 1995 is Group F, Division 3.
- (c) Generally, building is intended to enclose sand and salt storage.
- (d) The building shall be a clear span, stressed membrane structure approximately 30.5 m (100 ft.) wide by 67 m (220 ft.) long with a 2.5 m (8 ft.) high concrete stub wall and foundation.
- (e) The centre line interior height of the building shall be 13.9 m (45 3/4 ft.) or greater with a minimum 5.26 m (17 1/4 ft.) clearance within 0.9 m (3 ft.) of the side of the building.
- (f) The structure shall be constructed with flat end walls to maximize space usage.
- (g) The building shall be a clear span, totally enclosed weather-tight building, with no exterior horizontal purlins or exterior guy ropes or cables for anchoring the structure.

E15.3 Design Requirements

- (a) Design building to allow for thermal movement of component materials caused by ambient temperature range of 80 deg. C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- (b) Building shall be watertight.
- (c) Provide for positive drainage of water entering at joints, to exterior face in accordance with NRC "Rain Screen Principles".
- (d) Design for hourly velocity pressure of 0.42 kPa for 1/30 probability. In addition to uniform live load, design for full live load on leeward half of building frame and zero live load on windward half.
- (e) Design members to withstand, within acceptable deflection limitations:
 - (i) Snow load based on ground snow level $S_s = 1.7$ kPa plus $S_r = 0.2$ kPa.
 - (ii) Lateral load of wind based on design hourly velocity pressure of 0.42 kPa.
- (f) Design building enclosure elements to accommodate movement in wall and structural movements without permanent distortion, damage to infills, racking of joints, breakage of seals or water penetration.
- (g) Design deep foundations in accordance with NBC requirements to permissible soil loads listed in soils report.
- (h) Design, assemble and secure building elements to building frame to ensure stresses in sealants and seals are within manufacturer's recommended maximum.
- (i) Design building assembly to permit easy replacement of components.
- (j) Allow for ventilators and vents per E24, conduit and lighting per E27 and E31 and other interior dead loads imposed on this structure.
- (k) Building interior ventilation as per E24.
- (l) Building lighting shall maintain measured lighting level of 110 lux (10 f.c.) at 1500 mm above finished floor, after building finishes and painting complete.
- (m) Access units and doors to sizes and locations indicated on Bid Document Drawings. Access units and doors shall be weather resistant and weatherstripped.

E15.4 Performance Requirements

- (a) Maximum deflection for roofing under full specified live load: 1/180 of clear span.

- (b) Maximum deflection for exterior cladding under full specified exterior wind induced loads: 1/90 of clear span.
- (c) Maintain following tolerances for building structure and enclosure elements.
 - (i) Maximum variation from plane or location shown on shop drawings: 1 mm/1 m of length and up to 1 mm/5 m maximum.
 - (ii) Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.75 mm.

E15.5 Shop Drawings

- (a) Submit shop drawings.
- (b) Submitted drawings to bear signature and seal of professional Engineer registered in Province of Manitoba for fabricator designed assemblies, components and connections including foundations and stub walls.
- (c) Indicate plans and grid lines, structural members and connection details, bearing and anchorage details, stressed membrane, framed openings, accessories, schedule of materials and finished, camber and loadings, fasteners and welds.
- (d) Indicate detailed description of mechanical, electrical and other systems in work.
- (e) Submit erection drawings for approval, before construction.
- (f) Indicate erection dimensions and methods.

E15.6 Warranty

- (a) For work of this section – Prefabricated Buildings the warranty period is 3 years.

E15.7 Materials

- (a) Building materials: non-combustible or combustible construction in accordance with the National Building Code of Canada for use and occupancy specified.
- (b) Fire resistive building elements: in accordance with the National Building code of Canada for use and occupancy specified.
- (c) The main structural components shall be coated steel or aluminum.
 - (i) The main steel structural components shall be “Gatorshield” coated Viper steel (or approved equal) coated on the exterior with a gloss finish providing a minimum corrosion resistance of 2000 hours – as per ASTM B117-90. A 100% zinc based organic coating shall be applied to the interior. All welded components shall be finished with a coating of hot molten zinc, applied to a minimum of 3 mils thick. All welded surfaces must be prepared/sandblasted prior to the application of the molten zinc. As per the National Building Code, all welds shall maintain a minimum standard as determined by the Canadian welding Bureau sections W47.1 and W59. All bolts used shall be a minimum of Grade 5 – A325 galvanized specification.
An acceptable alternative is to have the steel structural components sand blasted and powder coated using DuraCoat Powder applied to a minimum thickness of 5.3 mils with all tube members seal welded prior to sand blasting. All connection bolts for this alternative shall be Type 316 stainless steel and anchor bolts shall be powder coated or Type 316 stainless steel.
 - (ii) The main aluminum components shall be extruded aluminum utilizing the 6061 structural aluminum alloy. All other components shall be extruded or cast aluminum utilizing the 6061 structural aluminum alloy. All connections in areas of high stress shall be bolted using Type 316 stainless steel bolts. Connections in areas of low stress may be bolted using Type 316 stainless steel bolts or welded using 4043 or

5356 filler alloy. All aluminum shall be isolated from contact with concrete by coating with 2 coats of bituminous paint.

- (d) The fabric membrane shall be Duraweave II FR fire retardant, Polyethylene (or approved equal) white in colour with a weight of 12.5 oz. per square yard and a minimum thickness of 2.3 mm, including a minimum .4 mm ultraviolet protective coating. The fabric shall have a minimum 10 year pro-rated warranty with workmanship guarantee for a minimum of 2 years. An acceptable alternative is Nova-Shield II Membrane Structure Fabric RU88X-6 fire retardant, polyethylene white in colour with a weight of 12.5 oz. per square yard, a minimum thickness of 2.3 mm, including a minimum .4 mm ultraviolet protective coating. The fabric shall have a minimum 10 year pro-rated warranty with a workmanship guarantee for a minimum of 2 years.
- (e) Man Doors – 3'-0" x 7'-0" hollow metal doors and frames per E12 located as shown on the drawings complete with hardware as per E14.
- (f) Overhead Doors – 20'-0" x 20'-0" sectional metal overhead doors for base bid and 18'-0" x 18'-0" sectional metal overhead doors for optional bid. Provide in accordance with E13.

E15.8 Fabrication

- (a) Maintain air and vapour barrier throughout building enclosure elements.
- (b) Enclosure assembly shall be complete including exterior skin and access units, doors, etc.
- (c) Accurately fit and rigidly frame together joints, corners and mitres. Match components carefully to produce continuity of line and design. Make joints and connections toward exterior weathertight. Coordinate location of visible joints.

E15.9 Erection

- (a) Erect building structure and enclosure elements.
- (b) The Duraweave membrane (or approval equal) shall be installed and tensioned both vertically and horizontally to prevent wear and abrasion. The horizontal stretch-warp direction (min pre-stress of 40 lbs. PLF) shall be maintained mechanically with horizontal purlins and cabling that requires no ongoing maintenance. The vertical stretch-fill direction (min. pre-stress of 40 lbs. PLF) shall be maintained mechanically with winch lock fastening system that requires no ongoing maintenance. The membrane shall be assembled and tensioned in a manner to eliminate wrinkles in hot and cold temperatures. The membrane-welded seams shall maintain a minimum of 175 lbs. per lineal inch (PLI).

E15.10 Cleaning

- (a) Clean all surfaces of structure and membrane.

E15.11 Protection

- (a) Provide protection to finished surfaces with strippable coatings, strippable wrappers, plywood or sheet materials as required before acceptance of work.

E16. MECHANICAL GENERAL REQUIREMENTS

E16.1 General

- E16.1.1 All systems shall be corrosion-proof and storm-proof, suitable for the applications.
- E16.1.2 Provide complete code compliant, fully functional systems.
- E16.1.3 Reference: Transportation Association of Canada – Synthesis of Best practices Road Salt Management – 7.0 Design and Operation of Road Maintenance Yards.
- E16.1.4 ASHRAE Standard 62 – latest edition.

E16.2 Equipment List

E16.2.1 Complete list of equipment and materials to be used on this project and forming part of Bid Documents by adding manufacturer's name, model number and details of materials, and submit for approval.

E16.3 Equipment Installation

E16.3.1 Unions or flanges: provide for ease of maintenance and disassembly.

E16.3.2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.

E16.3.3 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

E16.4 Waste Management and Disposal

E16.4.1 Separate and recycle waste materials in accordance with good practice and with the Waste Reduction Workplan.

E16.4.2 Place materials defined as hazardous or toxic waste in designated containers.

E16.4.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

E16.5 Anchor Bolts and Templates

E16.5.1 Supply anchor bolts and templates for installation by other divisions.

E16.6 Trial Usage

E16.6.1 The Contract Administrator or the City may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

E16.6.2 Trial usage to apply to following equipment and systems:

- (a) All ventilation systems
- (b) All plumbing systems.
- (c) Control systems.

E16.7 Protection of Openings

E16.7.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

E16.8 Electrical

E16.8.1 Electrical work to conform to E26 Electrical including the following:

- (a) Unless noted otherwise, control wiring under 50 V to be supplied and installed by the Mechanical Control Subcontractor in accordance with E26 Electrical.
- (b) Control wiring over 120 V is to be installed by Electrical Contractor.

E16.8.2 Motors to be provided with mechanical equipment.

E16.9 Motors

E16.9.1 Provide motors for mechanical equipment.

E16.9.2 If delivery of indicated motor will delay delivery or installation of any equipment, install motor approved by the Contract Administrator for temporary use. Final acceptance of equipment will not occur until indicated motor is installed.

E16.9.3 Motors under 373 W (½ HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120V, unless otherwise specified or indicated.

E16.9.4 Motors 373 W (½ HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated, unless otherwise specified or indicated.

E16.10 Drive Guards

E16.10.1 Provide guards for unprotected drives.

E16.10.2 Provide means to permit lubrication and use of test instruments with guards in place.

E16.10.3 Guard for flexible coupling:

- (a) "U" shaped, minimum 1.6 mm thick (16 gauge) galvanized mild steel.
- (b) Securely fasten in place.
- (c) Removable for servicing.

E16.11 Equipment Supports

E16.11.1 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of CAN/CSA-G40.20/G40.21-M92 "General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels" unless otherwise noted. Submit structural calculations with shop drawings. Provide corrosion protection.

E16.11.2 Storage tanks shall be mounted on concrete pads

E16.11.3 Supports for the equipment and above ground piping of the deicing liquid system shall be designed to be mounted on the concrete short wall near the building's overhead door. All supports shall be made of stainless steel suitable for the salt and sand handling environment in the building.

E16.11.4 Design and provide support systems to mechanical systems and to suit the applications. All vibration, thermal expansion and contraction, suitable spacing, size shall be accounted for in the support systems.

E16.11.5 Unless otherwise noted, installation and fabrication shall be in accordance with ANSI/ASME, ASTM, MSS, Canadian Plumbing Code, Provincial Code and authority having jurisdiction.

E16.12 Preparation for Firestopping

E16.12.1 Firestopping material within annular space between pipes and adjacent fire separation shall be in accordance with ASTM E-814 (UL1479) fire test.

E16.12.2 The material shall be installed in accordance with UL through penetration firestop system #161 where pipes penetrate any rated floors.

E16.13 Tests

E16.13.1 Give 24 h written notice of date for tests.

E16.13.2 Insulate or conceal work only after testing and approval by the Contract Administrator.

E16.13.3 Conduct tests in presence of the Contract Administrator.

E16.13.4 Bear costs including retesting and making good.

E16.13.5 Piping:

- (a) General: maintain test pressure without loss for 4 h unless otherwise specified.
- (b) Hydrostatically test double containment piping in accordance with the double containment piping system manufacturer's recommendations.
- (c) Single walled above ground piping shall be hydrostatically tested in accordance to the carrier pipe of the containment piping system.
- (d) Equipment: test as specified in relevant sections.
- (e) Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

E16.14 Painting

- E16.14.1 Stainless steel material to remain bare. Any metallic items that are not stainless steel shall receive a minimum of two coats of corrosion resistant primer and two finish coats of colour specified for service. Any galvanized parts will receive a minimum of one coat of primer and one coat of colour. Provide zinc rich paint to galvanized steel material where it was being cut.
- E16.14.2 Prime and touch up marred finished paintwork to match original.
- E16.14.3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

E16.15 Special Tools

- E16.15.1 Provide one set of special tools required to service equipment as recommended by manufacturers.
- E16.15.2 Furnish one commercial quality grease gun and adaptor to suit different types of grease fittings. Provide grease to suit manufacturer's recommendations for all greasable systems.
- E16.15.3 Spare parts are to be provided to an identified City representative complete with transmittal documents showing all materials provided and date of supply. City's representative to sign for all materials received.

E16.16 Drain Valves

- E16.16.1 Locate where indicated on the drawings or as required to suit application.
- E16.16.2 Minimum NPS 3/4 unless otherwise specified: with hose end male thread and complete with cap and chain.

E16.17 Demonstration and Operating and Maintenance Instructions

- E16.17.1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- E16.17.2 Where indicated elsewhere in Mechanical Division, manufacturers to provide demonstrations and instructions.
- E16.17.3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- E16.17.4 Instruction duration time requirements as specified in appropriate sections.
- E16.17.5 Where deemed necessary, the Contract Administrator may record these demonstrations on video tape for future reference.

E16.18 Operation and Maintenance Manual

- E16.18.1 Provide operation and maintenance data for incorporation into manual specified in the appropriate sections.
- E16.18.2 Operation and maintenance manual to be approved by, and final copies deposited with, the Contract Administrator before final inspection.
- E16.18.3 Operation data to include:
- (a) Control schematics for each system including environmental controls.
 - (b) Description of each system and its controls.
 - (c) Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - (d) Operation instruction for each system and each component.
 - (e) Description of actions to be taken in event of equipment failure.
 - (f) Valves schedule and flow diagram.
 - (g) Colour coding chart.
- E16.18.4 Maintenance data shall include:
- (a) Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - (b) Data to include schedules of tasks, frequency, tools required and task time.
- E16.18.5 Performance data to include:
- (a) Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - (b) Equipment performance verification test results.
 - (c) Special performance data as specified elsewhere.
 - (d) Testing, adjusting and balancing reports as specified in the appropriate sections.
- E16.18.6 Approvals:
- (a) Submit three (3) copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless so directed by the Contract Administrator.
 - (b) Make changes as required and re-submit as directed by the Contract Administrator.
- E16.18.7 Additional data:
- (a) Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.
- E16.19 Shop Drawings and Product Data
- E16.19.1 Submit shop drawings and product data in accordance with requirements described in E8 Shop Drawings.
- E16.19.2 Shop drawings and product data shall show:
- (a) Mounting arrangements.
 - (b) Operating and maintenance clearances. e.g., access door swing spaces.
- E16.19.3 Shop drawings and product data shall be accompanied by:
- (a) Detailed drawings of bases, supports, and anchor bolts.

- (b) Acoustical sound power data, where applicable.
- (c) Points of operation on performance curves.
- (d) Manufacturer to certify as to current model production.
- (e) Certification of compliance to applicable codes.

E16.19.4 Use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

E16.20 Cleaning

E16.20.1 Clean mechanical systems in accordance with manufacturer's recommendations.

E16.20.2 Clean interior and exterior of all systems.

E16.20.3 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

E16.21 As-Built Drawings/Record Drawings

E16.21.1 Site records:

- (a) Design-Build Consultant will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to any existing mechanical systems, control systems and low voltage control wiring.
- (b) On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
- (c) Use different colour waterproof ink for each service.
- (d) Make available for reference purposes and inspection at all times.

E16.21.2 As-Built Drawings:

- (a) Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
- (b) Identify each drawing in lower right hand corner in letters at least 12 mm (1/2") high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
- (c) Submit to Contract Administrator for approval and make corrections as directed.
- (d) TAB to be performed using as-built drawings.
- (e) Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

E16.21.3 Submit copies of as-built drawings for inclusion in final TAB report.

E16.22 Breakdown of Costs and Progress Claims

E16.22.1 Price to be broken down at the time of Bid in accordance with Contract Documents.

E16.22.2 Following award of contract, each section of this Division is to provide breakdown of bid prices into categories required for submission of Progress Claim. Sufficient categories to be provided to permit evaluation of the claim and approval of payment. Modify or add categories as requested.

E16.22.3 Progress claims to indicate for each category:

- (a) Total
- (b) Total to date

(c) Monthly claim

E16.22.4 Categories to include or as appropriate for the project:

- (a) Ventilation
- (b) Plumbing
- (c) Controls

E17. PIPE WELDING

E17.1 References

E17.1.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)

- (a) ANSI/ASME B31.1-2000, Power Piping.
- (b) ANSI/ASME B31.3-1999, Process Piping.
- (c) ANSI/ASME Boiler and Pressure Vessel Code-1998:
 - (i) Section 1: Power Boilers.
 - (ii) Section V: Nondestructive Examination.
 - (iii) Section IX: Welding and Brazing Qualifications.

E17.1.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

- (a) ANSI/AWWA C206-88, Field Welding of Steel Water Pipe.

E17.1.3 American Welding Society (AWS)

- (a) AWS C1.1-66, Recommended Practices for Resistance Welding.
- (b) AWS Z49.1-1999, Safety Welding, Cutting and Allied Process.
- (c) AWS W1-1980, Welding Inspection.

E17.1.4 Canadian General Standards Board (CGSB)

- (a) CAN/CGSB-48.2-92, Spot Radiography of Welded Butt Joints in Ferrous Materials.

E17.1.5 Canadian Standards Association (CSA)

- (a) CSA W47.2-M1987(R1998), Certification of Companies for Fusion Welding of Aluminum.
- (b) CSA W48 series-M1980(R1998), Electrodes.
- (c) CSA B51-M1991(R1997), Boiler, Pressure Vessel and Pressure Piping Code.
- (d) CAN/CSA-W117.2-94, Safety in Welding, Cutting and Allied Processes.
- (e) CSA W178.1-1996, Certification of Welding Inspection Organizations.
- (f) CSA W178.2-1996, Certification of Welding Inspectors.

E17.1.6 Manitoba Labour – Certificate of Authorization Program.

E17.1.7 Manitoba Regulation 108/87R “Steam and Pressure Plants Regulation”

E17.1.8 Stainless steel piping is used in the deicing liquid distribution system.

E17.2 Welders Qualifications

E17.2.1 Welding qualifications to be in accordance with CSA B51.

- E17.2.2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction in the province of application.
- E17.2.3 Furnish welder's qualifications to Contract Administrator and authority having jurisdiction.
- E17.2.4 Each welder to possess identification symbol issued by authority having jurisdiction.
- E17.3 Inspectors Qualifications
 - E17.3.1 Inspectors to be qualified to CSA W178.2.
- E17.4 Welding Procedures
 - E17.4.1 Registration of welding procedures in accordance with CSA B51.
 - E17.4.2 Copy of welding procedures to be available for inspection at all times.
 - E17.4.3 Safety in welding, cutting and allied processes to be in accordance with CAN/CSA-W117.2.
- E17.5 Waste Management and Disposal
 - E17.5.1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.
 - E17.5.2 Place materials defined as hazardous or toxic waste in designated containers.
 - E17.5.3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- E17.6 Electrodes
 - E17.6.1 Electrodes: in accordance with CSA W48 Series.
- E17.7 Workmanship
 - E17.7.1 Welding to be in accordance with ANSI/ASME B31.1, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.
- E17.8 Installation Requirements
 - E17.8.1 Identify each weld with welder's identification symbol.
 - E17.8.2 Backing rings:
 - (a) Where used, fit to minimize gaps between ring and pipe bore.
 - (b) Do not install at orifice flanges.
 - E17.8.3 Fittings:
 - (a) NPS 2 and smaller: install welding type sockets.
 - (b) Branch connections: according to the following schedule:
 - E17.8.4 Schedule:
 - (a) T: Forged tee or reducing tee
 - (b) S: Socolet
 - (c) W: Weldolet

HEADER	13(1/2")	T												
	20(3/4")	T	T											
	25(1")	T	T	T										
	32(1-1/4")	T	T	T	T									
	38(1-1/2")	T	T	T	T	T								
	50(2")	S	S	S	T	T	T							
	65(2-1/2")	S	S	S	S	T	T	T						
	75(3")	S	S	S	S	S	T	T	T					
	100(4")	S	S	S	S	S	T	T	T	T				
	150(6")	S	S	S	S	S	W	T	T	T	T			
	200(8")	S	S	S	S	S	W	W	W	T	T	T		
	250(10")	S	S	S	S	S	W	W	W	W	T	T	T	
	300(12")	S	S	S	S	S	W	W	W	W	W	T	T	T
			13(1/2")	20(3/4")	25(1")	32(1-1/4")	38(1-1/2")	50(2")	65(2-1/2")	75(3")	100(4")	150(6")	200(8")	250(10")
BRANCH														

E17.9 Inspection and Tests - General Requirements

- E17.9.1 Review all weld quality requirements and defect limits of applicable codes and standards with Contract Administrator before any work is started.
- E17.9.2 Formulate "Inspection and Test Plan" in co-operation with Contract Administrator.
- E17.9.3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- E17.9.4 Provide for inspector to visually inspect all welds during early stages of welding procedures in accordance with AWS W1. Repair or replace all defects as required by codes and as specified herein.

E17.10 Specialist Examinations and Tests

E17.10.1 General

- (a) Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Contract Administrator.
- (b) To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
- (c) Inspect and test all welds in accordance with "Inspection and Test Plan" by non-destructive visual examination.

E17.10.2 Hydrostatically test all welds to requirements of ANSI/ASME B31.1.

E17.10.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

E17.10.4 Failure of visual examinations:

- (a) Upon failure of any weld by visual examination, perform additional testing as directed by Contract Administrator of a total of up to 10% of all welds, selected at random by Contract Administrator by radiographic tests.

- E17.10.5 Radiographic testing of piping systems following failure of visual examination:
- (a) Spot radiography to CAN/CGSB-48.2:
 - (i) Conduct spot radiographic tests of welds, selected at random by Contract Administrator from all welds which would be most difficult to repair in event of failure after system is operational.
 - (b) Radiographic film:
 - (i) Identify each radiographic film with date, location, name of welder, and submit to Contract Administrator. Replace film if rejected because of poor quality.
 - (c) Interpretation of radiographic films:
 - (i) To be by qualified radiographer.
 - (d) Failure of radiographic tests:
 - (i) If any weld fails tests, tests will be extended to all welds made by welder responsible.
- E17.10.6 Defects Causing Rejection
- (a) As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
- E17.10.7 Repair of Welds Which Failed Tests
- (a) Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

E18. TESTING

E18.1 General Conditions

E18.1.1 E16 Mechanical General Requirements shall be part of this section.

E18.1.2 Work Included

- (a) The work described in this section includes testing work for the following systems:
 - (i) Plumbing

E18.2 Products

E18.2.1 Refer to relevant sections of specification for materials by system.

E18.3 Execution

E18.3.1 Test Requirements

- (a) Plumbing shall be tested in full conformance with the requirements of the National Plumbing Code of Canada, and as required by local inspection authority.
- (b) De-icing liquid piping shall be hydrostatically tested at 1 ½ times system operating pressure or 350 kPa (whichever is greater) as recommended by the piping manufacturer's recommendations.
- (c) In addition, the double containment piping system may be tested during the installation at intervals to be determined by the system manufacturer. Cleaning and testing for the double containment piping system shall be performed in strict accordance with the recommendations of the piping system manufacturer.
- (d) Single walled piping above ground shall be hydrostatically tested in accordance with the carrier pipe of the double containment piping system manufacturer's recommendations.

E18.3.2 Procedures

- (a) The testing of the individual systems shall be completed by the trade responsible for installing the system.
- (b) Provide all necessary equipment and perform all work required to field test all piping systems, including all remedial and re-testing work.
- (c) Clean all piping systems by flushing with water or blowing with air with all valves wide open prior to testing and before installing any primary element instrumentation on the piping systems.
- (d) Timely notification shall be given to the Contract Administrator of the schedule for all tests. A minimum of three working days is required to schedule witnessing of tests.
- (e) All piping must pass all field tests in the presence of the Contract Administrator.
- (f) Completion of tests is not evidence of acceptance of tested part of Contract.
- (g) No claim for damage will be made for injury or breakage of parts due to tests.
- (h) Piping, which has to be concealed prior to the completion of the service as a whole, shall be tested in sections to the pressures and for the periods specified, prior to the piping being concealed.

E19. THERMOMETERS AND GAUGES

E19.1 General Conditions

E19.1.1 E16 Mechanical General Requirements shall be part of this Section.

E19.2 Scope

E19.2.1 Provide meters and gauges and taps as requested.

E19.2.2 Submit shop drawings of proposed products for review.

E19.2.3 Submit data sheets on gauges indicating service or pressure ranges for review.

E19.3 Products

E19.3.1 Pressure Gauges

- (a) Suitable for liquid calcium chloride and salt and sand (corrosive) environment.
- (b) Stainless steel material, 1% midscale accuracy, calibration adjustment, black figures on white background, diaphragm seal, suitable for measuring pressure at inlet and outlet of a pump, isolation valve.
- (c) Acceptable material: Winters diaphragm seals pressure gauge or approved equal.

E19.3.2 Pressure Gauge Taps

- (a) Provide stainless steel valve.

E19.4 Execution

E19.4.1 Installation

- (a) Provide piping to gauge as required.
- (b) Select gauges so that normal operating point is approximately mid-point of instrument range.
- (c) On pipes 65 mm (2 1/2") and smaller, place well in tee used in lieu of an elbow to accommodate well.

- (d) Provide gauges and gauge taps where required.
- (e) Coordinate with system balancing requirements.

E20. MECHANICAL IDENTIFICATION

E20.1 Product Data

E20.1.1 Product data to include paint colour chips, all other products specified in this section.

E20.2 Samples

E20.2.1 Samples to include nameplates, labels, tags, lists of proposed legends.

E20.3 Products

E20.3.1 Manufacturer's Equipment Nameplates

- (a) Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- (b) Lettering and numbers to be raised or recessed.
- (c) Information to include, as appropriate:
 - (i) Equipment: Manufacturer's name, model, size, serial number, capacity.
 - (ii) Motor: voltage, Hz, phase, power factor, duty, frame size.

E20.3.2 System Nameplates

- (a) Colours:
 - (i) Hazardous: red letters, white background.
 - (ii) Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- (b) Construction:
 - (i) 3mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- (c) Sizes:
 - (i) Conform to following table:

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

- (ii) Use maximum of 25 letters/numbers per line.
- (d) Locations:
 - (i) Terminal cabinets, control panels: Use size # 5.
 - (ii) Equipment in Mechanical Rooms: Use size # 9.

E20.3.3 Identification of Piping Systems

- (a) Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- (b) Pictograms:
 - (i) Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.
- (c) Legend:
 - (i) Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- (d) Arrows showing direction of flow:
 - (i) Outside diameter of pipe or insulation less than 75mm (3"): 100mm (4") long x 50mm (2") high.
 - (ii) Outside diameter of pipe or insulation 75mm (3") and greater: 150mm (6") long x 50mm (2") high.
 - (iii) Use double-headed arrows where flow is reversible.
- (e) Extent of background colour marking:
 - (i) To full circumference of pipe or insulation.
 - (ii) Length to accommodate pictogram, full length of legend and arrows.
- (f) Materials for background colour marking, legend, arrows:
 - (i) Pipes and tubing 20mm (3/4") and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - (ii) All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (392°F).
 - (iii) Suitable for winter/summer design outdoor temperature and salt and sand handling environment.
- (g) Colours and Legends:
 - (i) Contractor shall verify with authority having jurisdiction.
 - (ii) Colours for legends, arrows: To following table:

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

- (iii) Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
Contractor shall verify with authority having jurisdiction	To Codes	Calcium Chloride
Conduit for low voltage control wiring	To Section 15950	

E20.3.4 Valves, Controllers

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

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

E20.3.5 Controls Components Identification

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

E20.3.6 Language

- (a) Identification to be in English.

E20.4 Execution

E20.4.1 Timing

- (a) Provide identification only after all painting has been completed.

E20.4.2 Installation

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

E20.4.3 Nameplates

- (a) Locations:
 - (i) In conspicuous location to facilitate easy reading and identification from operating floor.
- (b) Standoffs:
 - (i) Provide for nameplates on hot and/or insulated surfaces.
- (c) Protection
 - (i) Do not paint, insulate or cover in any way.

E20.4.4 Location of Identification on Piping Systems

- (a) Ensure that identification is visible from any one viewpoint in operating areas.
- (b) Adjacent to each change in direction.
- (c) On both sides of visual obstruction or where run is difficult to follow.
- (d) Where system is installed in pipe chases, galleries, other confined spaces, at entry and exit points, and at each access opening.
- (e) At beginning and end points of each run and at each piece of equipment in run.
- (f) At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- (g) Identification to be easily and accurately readable from usual operating areas and from access points.
 - (i) Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.
- (h) Provide identifications to all system devices.

E20.4.5 Valves, Controllers

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

E21. VALVES AND STRAINERS

E21.1 General Conditions

E21.1.1 Mechanical General Conditions shall be part of this Section.

E21.2 Scope

E21.2.1 Provide valves and strainers for deicing liquid system.

E21.2.2 All equipment shall be suitable for salt and sand handling environment.

E21.3 Manufacturer

E21.3.1 Provide valves of the same type by the same manufacturer throughout.

E21.3.2 Provide valves with manufacturer's name and pressure rating clearly marked on the outside of the body.

E21.4 Shop Drawings

E21.4.1 Submit detailed shop drawings clearly indicating make, model, size, pressure rating, materials of constructed and intended applications.

E21.5 Products

E21.5.1 Deicing Liquid Service

- (a) Ball valves up to 75 mm (3")
 - (i) 316 stainless steel 3 piece body, blow out proof stem, PTFE seats, PTFE seal, 316 stainless steel ball, stainless steel ball lever handle operator, FNPT connections, full port, stainless steel stem. Size to be same as pipe size to minimize friction loss.
 - (ii) minimum 6895 kPa (1000 psig) rating.
 - (iii) Acceptable material: M.A. Stewart & Sons Ltd. Model G-3 or Flow-Tek or approved equal.
- (b) Check valves (horizontal) 65 mm (2 ½") and larger
 - (i) Swing check valve, stainless steel material, stainless steel disc, Teflon seal.
 - (ii) 150 ANSI.
 - (iii) Horizontal operation.
 - (iv) Material to be suitable for liquid calcium chloride and salt and sand (corrosive) environment.
 - (v) Size to be same as pipe size to minimize friction loss.
 - (vi) Acceptable material: Check Rite or approved equal.

- (c) Butterfly valves 65 mm (2 ½") and larger
 - (i) Threaded lug style cast iron body
 - (ii) EPDM seat liner
 - (iii) 316 S.S. disc
 - (iv) 316 SS Stem
 - (v) 10 position lever lock handle operator 150 mm and smaller
 - (vi) Minimum 1034 kPa (150 psi) rating
 - (vii) Material to be suitable for liquid calcium chloride and salt and sand (corrosive) environment and outdoor application.
 - (viii) Size to be same as pipe size to minimize friction loss.
 - (ix) Acceptable material: Kitz or approved equal.

E21.6 Execution

E21.6.1 Installation and Application-Valves

- (a) Install valves with stem upright or horizontal, not inverted.
- (b) Provide valves for isolation of all equipment and flow balancing and as shown. Valve type to suit line size.
- (c) Provide drain valves as required.

E22. PUMPS

E22.1 Scope

- E22.1.1 Contractor shall verify pump size, capacity and selection to suit applications.
- E22.1.2 Coordinate requirements with Electrical and all other trades.
- E22.1.3 Contractor shall verify deicing liquid distribution and supply operation procedure and requirements with the City's representative.

E22.2 Shop Drawings and Product Data

- E22.2.1 Submit shop drawings and product data in accordance with E8 Shop Drawings.
- E22.2.2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- E22.2.3 Submit product data of pump curves for review showing point of operation. Submit information, calculation on pump sizing.
- E22.2.4 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

E22.3 Closeout Submittals

- E22.3.1 Provide maintenance data for incorporation into Operation and Maintenance Manual.

E22.4 Products

E22.4.1 Self-Priming Pump

- (a) Suitable for liquid calcium chloride.
- (b) Suitable for salt and sand handling environment, truck filling, suction from truck.

- (c) Suitable for winter/summer design outdoor air temperature.
- (d) Impeller: cast iron or stainless steel.
- (e) Casing: Rugged cast iron or stainless steel, self-cleaning and facilitates long life.
- (f) Seal assembly: made of stainless steel with viton bellows or better.
- (g) Motor: 230 V, single phase, suitable for application.
- (h) Pressure and temperature rating: 107°C (225°F) and 1200 kPa (175 psi).
- (i) Pump shown in the equipment schedule is for reference purposes, based on valve size same as the pipe size for minimizing friction loss.

E22.5 Execution

E22.5.1 Installation

- (a) Installation shall be as per manufacturer's recommendations.
- (b) Check rotation prior to start-up.
- (c) Provide supports to the pump. Pump supports shall be secured to the concrete short wall. Provide vibration isolation for the pump.

E23. PLUMBING

E23.1 Scope Of Work

- E23.1.1 Piping, piping containment, fittings, hose connections fittings to trucks and vehicles.
- E23.1.2 Deicing liquid storage tanks and accessories. Contractor to verify with the City on required connection fitting size for connecting to trucks.
- E23.1.3 Plumbing specialties and accessories for the deicing liquid (calcium chloride) system.
- E23.1.4 Provide complete functional, operational, and code compliant plumbing systems and associated services for deicing liquid (calcium chloride) distribution and storage.
- E23.1.5 All materials shall be suitable for liquid calcium chloride and be suitable for salt and sand handling environment (corrosive).
- E23.1.6 Systems shall be designed for winter/summer design outdoor temperature.
- E23.1.7 Provide systems in accordance to Transportation Association of Canada - "Syntheses of Best Practices Road Salt Management – 7.0 Design and Operation of Road Maintenance Yards".
- E23.1.8 Coordinate with all other trades for buried pipes installation requirements, such as trenching, dewatering, backfilling, bedding, etc.
- E23.1.9 Provide non-metallic portable containers, approximately 22 L in volume each, at locations where underneath fill hoses, pumps.
- E23.1.10 Provide flange connection and fittings to equipment for easy equipment removal and service.
- E23.1.11 Contractor shall verify deicing liquid distribution and supply operation procedure and requirements with the City's representative.
- E23.1.12 Provide testing to system and its operations.

E23.2 Related Work

- E23.2.1 Refer to E26 Electrical for general electrical requirements.

E23.3 Shop Drawings and Product Data

E23.3.1 Refer to E8, E9 and E10 for general submission requirements.

E23.3.2 Submit shop drawings and product data on the following:

- (a) Valves
- (b) Flow meter
- (c) Specialties and accessories
- (d) Piping and containment systems
- (e) Storage tanks and accessories
- (f) Hoses
- (g) Rotatable piping/hose arms

E23.3.3 Shop drawings of the double containment piping system shall include details of pipe fabrications (including supporting devices, method of attachment, spacing, etc.), prefabricated double containment fitting dimensions, starting and terminating connections, high-point vent and low-point drain details for the secondary containment as required, valves and accessories. Submit joint details, methods and location of supports, and all other pertinent technical data for all piping to be furnished. Manufacturer shall submit mill certs for all metal piping used.

E23.4 Operation and Maintenance Data

E23.4.1 Refer to E10 Operation and Maintenance Manuals and Warranties for general submission requirements.

E23.5 Pressure Testing

E23.5.1 Test all piping systems in accordance with the National Plumbing Code, E16 Mechanical General Requirements, and authority having jurisdiction.

E23.5.2 Refer to E18 Testing for further information.

E23.6 Start-Up and Commissioning

E23.6.1 Flushing

E23.6.2 Venting

E23.6.3 Flow rate adjustment and balancing of valves.

E23.7 Products

E23.7.1 General

- (a) Code conformance: All equipment, pipe, fittings and valves are to comply with the requirements of the National Building Code 1995, CSA Standards, ANSI Standards and ASTM Standards as referenced in these Specifications, listed in E16 General Mechanical Requirements or as applicable by their scope.
- (b) All material shall be suitable for the applications.

E23.7.2 Pipe, Tube, Fittings and Joints

- (a) Stainless steel piping (above ground): sizes up to and including 75 diameter, seamless.
 - (i) Pressure piping, suitable for deicing liquid (calcium chloride) systems.
 - (ii) T304 stainless steel, to ASTM312.

- (iii) Size 75 mm (3") and under: Schedule 40 wall, unless otherwise noted.
- (iv) Provide welding or flanges (ASTM 182) for connection.
- (v) T304 stainless steel 90° elbow to ASTM 403, all fittings shall be in accordance with ANSI, ASTM.

(b) Piping (Underground)

- (i) Pressure piping, suitable for deicing liquid (calcium chloride).
- (ii) Provide complete double containment piping system, carrier pipe shall be T304 stainless steel pipe, as listed by ASTM and ANSI, Schedule 40 for size 75 mm (3") and under, containment pipe to be PVC, Schedule 80, as listed by ASTM and ANSI. Provide all required pipe elbows, fittings, closure coupling, piping supports, system termination assembly and appurtenances. All listed pressure fittings shall be in accordance to piping listed standards. All other unlisted components intended for use as pressure retaining components shall have sufficient thickness and reinforcement so as to be able to maintain the same pressure ratings as the piping.
- (iii) Provide welding to carrier pipe. Provide solvent-based cement for PVC piping as per manufacturer's recommendations.
- (iv) Provide inspection port with removable cover for piping containment inspection.
- (v) Provide testings, inspections to the piping system as per manufacturer's recommendations.
- (vi) Each system shall be provided with suitable drains and vents and be designed to provide complete drainage of both the primary and secondary containment piping. Interstitial supporting devices shall be provided within the secondary containment pipe, manufactured by the piping manufacturer, and shall be designed to allow continuous drainage in annular space the drain points. Drain fittings shall be designed to allow a valve attachment to be made so that the secondary containment compartment may be readily drained and manually checked for leaks. All fittings shall be pre-assembled and pretested by the double containment piping system manufacturer.
- (vii) Acceptable material: IPEX double containment piping system or approved equal.

(c) Flexible rubber hose:

- (i) Heavy duty, flexible, suitable for all season application.
- (ii) Temperature range: -50°C to 90°C.
- (iii) Size to suit deicing liquid supply and distribute trucks.
- (iv) Deicing liquid calcium chloride suitable for discharge and suction service.
- (v) Acceptable material: Goodall Model N2675 or approved equal.

E23.7.3 Gaskets

- (a) For flanged joints: 3 mm thick type SBR red rubber, die cut to ASA Class 125 flange pattern (or ANSI Class 150).
 - (i) Acceptable material: Garlock No. 22, Polar Bear Rubber Model S012RRS or Argus Industries.

E23.7.4 Fasteners

- (a) Fasteners: T304 stainless steel studs, plate washers and heavy hex nuts.

E23.7.5 Valves

- (a) For valves, refer to E21 Valves and Strainers

E23.7.6 Deicing Liquid Storage Tank (T-1, T-2)

- (a) Storage tank shall be suitable for deicing liquid (calcium chloride). Tank shall be of double wall construction. The capacity of the primary tank shall be 24605 L (6500 USgal). The secondary containment capacity shall be 110% of the primary tank. Each storage tank shall be c/w two 75 mm diameter flange connections for piping connections on the side of the tank, one close to the tank bottom (c/w long 90° elbow inside the tank), one close to the tank top, required transition fitting, 600 mm diameter (24") manway at the top of the tank, fitting for liquid level sensor (coordinate location and connection fitting requirements with sensor manufacturer), vent piping assemblies, assemblies for tank transport/lifting. Tank venting location shall be furthest away from piping connection inlets/outlets. Tank to be 3.05 minimum diameter, 5.1 m at top of the lid.
- (b) Provide gooseneck and bird screen at vent piping assemblies termination.
- (c) Acceptable manufacturer: Polywest 6500 US gal captor tanks.

E23.7.7 Deicing Liquid System Flow Meter

- (a) Suitable for liquid calcium chloride.
- (b) UL, CSA approval.
- (c) Metric unit, in litre.
- (d) 4.5 digit instantaneous flow indication and a 6 digit accumulative total indication. The flow monitor device shall have a NEMA 4 enclosure and be powered by battery. The totalizer number shall be memorized in the device in case battery power runs out and until battery replacement. The flow monitor device shall be directly mounted and connected to the flow sensing device.
- (e) Suitable for salt and sand handling environment.
- (f) Pressure drop through the meter: should not exceed 8.3 kPa at 151 LPM (1.2 psig rate at 40 gpm).
- (g) Accuracy: +/- 1%.
- (h) Flow range: 57 LPM to 681 LPM (15 to 180 USgpm).
- (i) Rated for 34474 kPa (5000 psig).
- (j) 50 mm size
- (k) Flow meter body and all components subject to deicing liquid (calcium chloride) to be stainless steel. Rated for -73°C to 163°C. Turbine rotor and rotor support to be stainless steel, Tungsten Carbide rotor shaft.
- (l) Acceptable material: Hedland Model 1100 flow meter with HB2200 flow monitor or approved equal.

E23.7.8 Flexible Pipe Connector

- (a) Suitable for liquid calcium chloride.
- (b) Location: outdoor.
- (c) Stainless steel corrugated flexible metal hose with annular corrugations, single stainless steel overbraid, flange piping connection ends. The flexible pipe connectors shall be suitable for minimum 50 mm (2") lateral movement.
- (d) Acceptable manufacturer: Senior Flexonics, Hydroflex, Flexpressions.

E23.8 Execution

E23.8.1 General

- (a) Perform all work in full compliance with all codes, standards, bylaws and recommended practices referenced. Codes, standards and bylaws are minimum requirements, contractors shall provide fully functional and reliable systems to suit applications, which may exceed codes, standards, minimum requirements.
- (b) Only first quality workmanship will be accepted, all deficient and inferior work will be corrected at no additional cost to the City.
- (c) Provide top quality industrial sealant suitable for applications.
- (d) Layout and installation is to consider access for maintenance, repair, inspection and replacement. Provide sufficient clearances from the building structure, access through finishes, clearance from electrical cables and communication wiring as will be required for these tasks.
- (e) Provide all sketches, drawings and product information required for permit applications and pay all fees levied for the issuance of permits, inspections, reports, testing and penalties.
- (f) Install equipment in accordance with manufacturer's recommendations.

E23.8.2 Piping and Fittings

- (a) All references to tubing are to include pipe, tube, hose and conduits of other shapes and descriptions.
- (b) Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- (c) Assemble all piping using fittings manufactured to ANSI standards.
- (d) Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- (e) Buried piping:
 - (i) Provide double containment piping systems.
 - (ii) Install buried pipe on a minimum 100 mm bed of washed clean sand, shaped to accommodate fittings, to line and grade as indicated. Backfill with washed clean sand. Compact to Class 2 standards as specified in –CW2020-R6 Excavation, Bedding and Backfill. Piping installation shall also be conducted in accordance to piping and containment manufacturer's recommendations, Reference: IPEX.
- (f) Install piping with slopes and grades to promote effective venting, drainage and suitable for inspection.
- (g) Provide unions, flanges or other means of quick disconnection of piping from connections at pumps and equipment.
- (h) Unless otherwise noted, support piping at intervals in accordance with the National Plumbing Code.
- (i) Provide the means to accommodate piping expansion, contraction and shock loadings without damage to the piping system, equipment.
- (j) Provide drain valves as required.
- (k) Provide supports to above ground piping and valves located outdoor and inside the building.
- (l) Provide expansion compensators for vertical piping passing through floor slab.

- (m) Provide suitable transition couplings when joining pipe of differing materials.
- (n) Use liquid pipe sealant on any threaded connections to PVC pipe.
- (o) Provide KamLok connections and required joints for easy connections to filling trucks.
- (p) Installation procedures shall be in accordance with the double containment piping system manufacturer's specific recommendations. All secondary containment joints shall be solvent-cemented joints using heavy body-slow set PVC cement ASTM D-2564, made in accordance with ASTM D-2855 procedure. The splitting and rewelding of fittings shall not be permitted. All personnel who prepare solvent cemented joints shall be qualified for such bonding practices according to the ASTM E B31.3 bonding qualification procedures.

E23.8.3 Valves

- (a) Indelibly mark the position of the operator after setting in a throttling position.
- (b) Where valves are required to be closed more than once per year for service or operating reasons, provide a memory stop feature to allow the reliable repositioning of the valve to its design position.
- (c) Install check valves in lines where reverse flow would have a detrimental effect on system safety, function or performance.
- (d) Valve stems are to be oriented in the vertical "upright" position where possible. Position above horizontal to full upright will be acceptable in vertical lines and horizontal lines where space is limited.

E23.8.4 Flushing

- (a) Conduct all pressure tests, test all backflow preventors, and flush all piping and tanks to remove foreign objects and all loose materials.
- (b) Flushing and cleaning shall be conducted in accordance to the equipment manufacturer's recommendations.

E23.8.5 Flow Rate Adjustment

- (a) Adjust, measure and balance deicing liquid system so that the amount of liquid supply and return to/from each tank is the same. Provide system balancing and adjustment to suit applications.
- (b) Flow meter shall be installed in accordance to manufacturer's recommendations.

E24. AIR OUTLETS

E24.1 General

- E24.1.1 For additional information, refer to E16 Mechanical General Requirements.
- E24.1.2 The mechanical contractor shall be responsible for coordinating all aspects of this work.
- E24.1.3 The positions indicated on the drawings are approximate only. Check the location of the outlets and make any necessary adjustments in positions to conform to the building features, symmetry and lighting arrangement.
- E24.1.4 Reference: ANSI/ASHRAE Standard 62.

E24.2 Scope of Work

E24.2.1 The scope of work for this section includes, but is not limited to, the following:

- (a) Design and provide complete functional ventilation system suitable and adequate for the application. Salt and sand are stored and handled in the building. All items shall be corrosion-proof, suitable for use in this environment.
- (b) Material loading and unloading onto vehicles are conducted in the building. Building is not mechanically heated nor cooled. Natural ventilation method to be used.
- (c) Provide exterior louvers and ventilators.

E24.3 Shop Drawings

E24.3.1 Shop drawings shall be submitted for the following items:

- (a) Exhaust air ventilator.
- (b) Exterior louvres.

E24.3.2 Shop drawings shall indicate the following:

- (a) Size and free area.
- (b) Noise level and throw characteristics at the specified air volumes.
- (c) Mounting methods.
- (d) Finish.
- (e) Accessories.

E24.4 Products

E24.4.1 General

- (a) Air outlets shall be based on a noise level of NC30 maximum unless otherwise specified.
- (b) All items shall be corrosion-proof, suitable for the applications.
- (c) Refer to Equipment Schedule.

E24.4.2 Air Intake/Exhaust Louvers

- (a) Construction:
 - (i) Stainless Steel: 1.6 mm thick (16 gauge) stainless steel frames and blade, welded construction with exposed joints ground flush and smooth.
- (b) Louver Depth: 100 mm (4")
- (c) Blade Configuration: storm-proof blades on 45° slope with vertical/horizontal top and bottom margins, horizontal middle "ridge" over entire length on each blade for water protection.
- (d) Mounting: shall be suitable for the building system.
- (e) Accessories: intake birdscreen in frames; middle mullions at maximum 1,500 mm (60") on centre, stainless steel.
- (f) Louver Free Area: 45% face area.
- (g) Air Intake Louver Water Penetration: not to exceed 0.01 oz/ft² of free area when tested to AMCA Standard 511.

E24.4.3 Exhaust Air Ventilator

- (a) Construction:
 - (i) Steel: galvanized, minimum 22 gauge, with baked polyester finish.
 - (ii) Entire unit shall be built in one piece. The base of the ventilator shall be reinforced for more solidity.
 - (iii) The ventilator shall be complete with epoxy coating on all surfaces (inside and outside), suitable for salt and sand handling environment (corrosive) in the buildings.
- (b) Colour: Grey
- (c) Storm-proof deflectors well protected against rain or snow infiltrations. Stainless steel mesh shall be equipped at the ventilator openings exposed to outdoor.
- (d) Static ventilation with no moving parts.

E24.5 Execution

E24.5.1 Installation

- (a) Make airtight connections between louvers and building.
- (b) Sizes indicated are nominal. Provide the correct standard product nearest to nominal, which delivers the capacity required without an increase in noise level or pressure drop.
- (c) Confirm all air outlet/inlet and louver dimensions. Coordinate mounting details, finish and colours with building construction prior to submitting shop drawings.
- (d) Contractor shall integrate mounting of intake air louvers and exhaust air ventilators to the building structural system so that they are firmly secured in place. Contractor shall coordinate equipment installations with all other trades. Equipment installations shall be in accordance to equipment manufacturer's recommendations.
- (e) All materials used for securing the equipment shall be corrosion-proof and weather-proof. Provide top quality industrial grade silicone for sealing. Eliminate any sharp edges or corners of the equipment and all the equipment supporting system so that building's wall/fabric will not be damaged. Provide framing for equipment penetrating building wall/fabric. Special attention must be given to exhaust air ventilator installation. Each ventilator shall be firmly secured to the building's structural system as per ventilator manufacturer's recommendations.

E25. CONTROLS

E25.1 Scope

E25.1.1 The following generally describes the scope of work covered by this section:

- (a) Provide design and all control components to achieve the sequence of operation and design conditions shown on the Contract Documents and to provide fully functional systems to suit application.
- (b) Coordinate sensor/device installation requirement (fittings), electrical requirements with all other trades.
- (c) Provide control transformers, relays, control wiring, corrosion proof and water proof controls enclosure and switches, control valves, valve actuators, indicators, conduit, starters, etc.
- (d) Salt and sand are stored inside the building. Liquid de-icer (calcium chloride) is used in the truck/tank fill systems. Building is not mechanically heated nor cooled. Liquid

de-icer is not mechanically heated nor cooled. All control system equipment shall be suitable for the applications.

- (e) Electrical wiring shall be installed in conformance with CSA, ULC, Manitoba Building Code, and standards described in E26 Electrical.
- (f) Provide liquid level sensor.

E25.2 Related Work

- (a) Section E16: Mechanical General Requirements.
- (b) Section E20: Mechanical Identification
- (c) Section E23: Plumbing
- (d) Section E18: Testing
- (e) Section E26: Electrical

E25.3 Work By Other Sections

E25.3.1 Electrical to supply and install all conduit wire and connections from the distribution panels to the line side of magnetic starters and thermal overload switches and from load side of starters and switches to motors.

E25.4 Shop Drawings and Product Data

E25.4.1 Submit shop drawings and product data in accordance with E8: Shop Drawings.

E25.4.2 Provide diagrams showing normal positions, model numbers and wiring layouts.

E25.4.3 Provide a valve schedule indicating size, configuration, CV and mounting locations.

E25.4.4 Provide technical literature on all components.

E25.4.5 Provide wiring diagrams including loads, voltage, minimum or maximum conductor size, conductor counts and wire grade requirements.

E25.4.6 Provide description on sequence of operations.

E25.5 Maintenance Data

E25.5.1 Provide maintenance data for incorporation into manual specified in E10 Operation and Maintenance Manuals and Warranties.

E25.6 Certification

E25.6.1 All components to be CSA certified.

E25.7 General

E25.7.1 All materials shall be suitable for the application environment.

E25.7.2 All materials to be commercial/industrial grade and from one manufacturer or supplier, where available.

E25.8 Identification

E25.8.1 Provide in accordance with E20 Mechanical Identification.

E25.8.2 Provide laminated plastic nameplate for control devices.

E25.9 Control Valve CV-1, CV-2, CV-3

E25.9.1 Full port ball valve, 316 stainless steel body with FNPT connection, 316 stainless steel ball and stem, PTFE seats and PTFE seal, size to be the same as pipe size minimizing friction loss, three piece body. Minimum 6895 kPa (1000 psi) w.o.g. rated, suitable for liquid calcium chloride, and design winter and summer ambient outdoor air temperatures and salt and sand handling environment, low friction loss for fluid flow through.

E25.9.2 Valve actuator shall be electric on/off actuator, NEMA 414X for use with 120 VAC power supply with heater and thermostat and manual override mounted and tested. Suitable for design winter and summer ambient outdoor air temperatures and salt and sand handling environment.

E25.9.3 Acceptable material: M.A. Stewart & Sons Ltd. Model G-3 or Flow Tek or approved equal for the stainless steel ball valve; Apollo Model AE-1000-ID electric valve actuator or approved equal.

E25.10 Adjustable Timer

E25.10.1 Time setting shall be adjustable. Unit shall be in "minutes", suitable for installing inside the control enclosure.

E25.11 Adjustable Time Clock for Periodic Liquid Circulation

E25.11.1 Periodic de-icer liquid automatic circulation schedule shall be able to set, memorized, and adjust at this time clock. Unit for pump and valve activation period shall be adjustable in "minutes". Time clock to be suitable for installing inside the control enclosure.

E25.12 Controls Enclosure, Hand Switches

E25.12.1 Any hand switches or pushbuttons, conduits, shall be corrosion proof, dust-proof and water-tight.

E25.12.2 Controls enclosure shall be high quality industrial grade, corrosion and waterproof, size to suit applications, minimum NEMA 3. Controls enclosure door shall be hinged and be lockable.

E25.12.3 Suitable for design winter and summer ambient outdoor air temperatures, and salt and sand handling environment.

E25.12.4 Deicing liquid level sensing and display system:

- (a) Ultrasonic liquid level sensor and level display system. Liquid level sensor to be mounted on outdoor liquid storage tank. Level display will be located inside a non-mechanical heat/cool building. Sensor operation temperature rated for -40°C to 95°C, to be c/w flange connection fitting as required. Contractor shall coordinate sensor location, connection fittings requirement, sensor blocking distance between sensor supplier and liquid storage tanks manufacturer. The liquid level display shall have a NEMA 4X enclosure, able to display % of tank full or liquid volume inside the tanks. The two storage tanks are connected to each other by common piping. Measurement unit to be in metric.
- (b) Suitable for deicing liquid (calcium chloride), salt and sand (corrosive) handling environment.
- (c) Suitable for design outdoor/indoor temperature.
- (d) Provide complete functional system with all required accessories to suit application.
- (e) Acceptable material: Endress + Hauser FDU series sensor and FMU series transmitter or approved equal.

E25.13 Installation

- E25.13.1 Fasteners used shall be corrosion-proof.
- E25.13.2 Provide junction box adaptor plates where electrical wiring is in conduit with junction box terminations.
- E25.13.3 Hand switches or pushbuttons shall be located approximately 1.5 m above the finished floor surface.

E25.14 Sequence of Operations

E25.14.1 Truck fill system:

- (a) Control valve CV-1 shall be normally "close" and pump P-1 shall be normally "off".
- (b) Control valve CV-1 shall be activated to "open" when hand switch is put to "on" position. When CV-1 is fully open, pump P-1 shall be activated. The timer will allow the CV-1 and P-1 to remain activated during the activation period (adjustable, initially set at 20 minutes).
- (c) Pump P-1 and Control Valve CV-1 shall be deactivated when either the hand switch is put to "off" position or the timer system activation period expires.
- (d) Timer activation period shall be restarted automatically every time the hand switch is put to "on" position.
- (e) CV-3 shall remain fully closed during truck fill operation.

E25.14.2 Storage Tanks Fill System (through Pump P-2 operation)

- (a) Control valve CV-2 shall be normally "closed" and pump P-2 shall be normally "off".
- (b) Control valve CV-2 shall be activated to "open" when hand switch is put to "on" position. When CV-2 is fully open, pump P-2 shall be activated. The timer will allow the CV-2 and P-2 to remain activated during the activation period (adjustable, initially set at 30 minutes).
- (c) Pump P-2 and control valve CV-2 shall be de-activated when either the hand switch is put to "off" position, or the timer system activation period expires.
- (d) Timer activation period shall be restarted automatically every time the hand switch is put to "on" position.
- (e) CV-3 shall remain fully closed during storage tanks fill operation.

E25.14.3 Liquid Deicer Periodic Circulation System

- (a) Control valve CV-3 shall be normally "closed" and pump P-2 shall be normally "off".
- (b) The liquid deicer periodic circulation time clock shall automatically activate control valve CV-3 to "open" in accordance to user defined time schedule (adjustable). When CV-3 is fully open, pump P-2 shall be activated. The time clock shall allow the CV-3 and P-2 to remain activated during the user defined activation period (adjustable) provided that truck filling operation and storage tank filling operation have not taken place. If truck filling or storage tank filling is to be take place or in process, priority shall be given to these activities (truck filling or storage tank filling), any liquid periodic circulation in process shall be stopped and wait for the next automatic circulation period available.
- (c) Pump P-2 and CV-3 shall be deactivated when the timer activation period expires provided that all other operating conditions are satisfied.
- (d) CV-3 is allowed to be activated to open provided that CV-1, CV-2 are in fully closed positions.

E25.14.4 Provide hand on/auto/off switches on the control panel for manual override truck filling operation, storage tank filling operation, and periodic liquid circulation operation. Normally set at "auto".

E25.14.5 Provide signage indicating periodic liquid circulation operation system shall be manually set to "off" position for the time period when the user is conducting storage tanks filling without using pump P-2 and CV-2. user may use a liquid deicer supply truck with pump and hose to fill the storage tanks. When this tanks filling activity is complete, the manual override switch on the liquid circulation operation shall be set back to "auto" position.

E25.15 General

E25.15.1 Provide complete functional systems of control and instrumentation to control operation of the identified systems.

E25.15.2 Provision of adjustments to the control systems to suit system balancing and testing.

E25.15.3 In addition to requirements of operation and maintenance manual described in other sections of the contract document, the O&M manual shall include list of equipment supplied, including its make, model number, tag number, and normal set point. Control/wiring diagrams and description of operations sequence shall also be included.

E25.15.4 Coordinate installation and system requirements with all other trades.

E26. ELECTRICAL

E26.1 Codes and Standards

- (a) Do complete installation in accordance with CSA C22.1-2002 except where specified otherwise.
- (b) Do overhead and underground systems in accordance with CSA C22.3 No.1-M1987 except where specified otherwise.

E26.2 Care, Operation and Start-up

- (a) Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.

E26.3 Voltage Ratings

- (a) Operating voltages: to CAN3-C235-83.
- (b) Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

E26.4 Permits, Fees and Inspection

- (a) Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- (b) Pay associated fees.
- (c) Notify Contract Administrator of changes required by Electrical Inspection Department prior to making changes.
- (d) Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Contract Administrator.

E26.5 Materials and Equipment

- (a) Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.
- (b) Factory assemble control panels and component assemblies in CSA certified facility.

E26.6 Electric Motors, Equipment and Controls

- (a) Control wiring and conduit is specified in Sections E30 and E31 except for conduit, wiring and connections below 50 V which are related to control systems shown on mechanical drawings.

E26.7 Finishes

- (a) Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - (a) Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.
 - (b) Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.
- (b) Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- (c) Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

E26.8 Equipment Identification

- (a) Identify electrical equipment with nameplates as follows:
- (b) Nameplates:
 - (a) Lamicoid 3 mm thick plastic engraving sheet, black face, black white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- (c) Labels:
 - (a) Embossed plastic labels with 6 mm high letters unless specified otherwise.
- (d) Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.
- (e) Allow for average of twenty-five (25) letters per nameplate and label.
- (f) Identification to be English.
- (g) Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- (h) Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- (i) Terminal cabinets and pull boxes: indicate system and voltage.
- (j) Transformers: indicate capacity, primary and secondary voltages.

E26.9 Wiring Identification

- (a) Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- (b) Maintain phase sequence and colour coding throughout.
- (c) Colour code: to CSA C22.1.
- (d) Use colour coded wires in communication cables, matched throughout system.

E26.10 Conduit and Cable Identification

- (a) Colour code conduits, boxes and metallic sheathed cables.
- (b) Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- (c) Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Telephone	Green	
Other	Green	Blue
Communication Systems		
Fire Alarm	Red	
Emergency	Red	Blue
Voice		
Other	Red	Yellow
Security Systems		

E26.11 Wiring Terminations

- (a) Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

E26.12 Manufacturers and CSA Labels

- (a) Visible and legible, after equipment is installed.

E26.13 Warning Signs

- (a) As specified and to meet requirements of Electrical Inspection Department and Contract Administrator.
- (b) Decal signs, minimum size 175 x 250 mm.

E26.14 Location of Outlets

- (a) Locate outlets in accordance with Section E30.
- (b) Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- (c) Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- (d) Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

E26.15 Mounting Heights

- (a) Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- (b) If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- (c) Install electrical equipment at following heights unless indicated otherwise.
 - (i) Local switches: 1400 mm.
 - (ii) Wall receptacles: 1400 mm.
 - (i) General: 1200 mm.
 - (iii) Panelboards: as required by Code or as indicated.

E26.16 Load Balance

- (a) Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- (b) Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- (c) Forward, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

E26.17 Conduit and Cable Installation

- (a) Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- (b) Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

E26.18 Field Quality Control

- (a) All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- (b) The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province that the work is being constructed.
- (c) Conduct and pay for following tests:
 - (i) Power distribution system including phasing, voltage, grounding and load balancing.
 - (ii) Circuits originating from branch distribution panels.
 - (iii) Lighting and its control.
- (d) Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- (e) Insulation resistance testing.
 - (i) Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - (ii) Check resistance to ground before energizing.
- (f) Carry out tests in presence of Contract Administrator.

- (g) Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- (h) Submit test results for Contract Administrator's review within seven (7) Working Days after completion of test.

E26.19 Co-ordination of Protective Devices

- (a) Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

E27. BUILDING LIGHTING

E27.1 Related Sections

- (a) E13: Sectional Metal Overhead Doors
- (b) E15: Prefabricated Buildings
- (c) Reference Drawings as identified in E1.3:
 - (i) Electrical Site Plans & Schedule-Drawing No. 9-2005_Drawing_09-R1.pdf
 - (ii) Electrical Details-Drawing No. 9-2005_Drawing_10-R1.pdf
 - (iii) Electrical Power Distribution, Enclosure and Schematic-Drawing No. 9-2005_Drawing_11-R1.pdf

E27.2 References

- (a) ANSI C82.4-92, Ballasts for High-intensity discharge and low pressure sodium lamps.
- (b) American National Standards Institute of Electrical and Electronics Engineers (ANSI/IEEE).
 - (i) ANSI/IEEE C62.41-1991, Surge voltages in low-voltage AC power circuits.
- (c) American Society for Testing and Materials (ASTM)
 - (i) ASTM F 1137-1193, Specification for phosphate/oil and Phosphate/organic corrosion protective coatings for fasteners.
- (d) United States of America, Federal Communications Commission (FCC)
 - (i) FCC (CFR47) EM and RF interference suppression.

E27.3 Performance Requirements

- E27.3.1 Building interior to be illuminated to a minimum of 10 FC average at 1500 mm above finished floor with a maximum to minimum ratio of 1.5:1 or better.
- E27.3.2 Building exterior lighting to be mounted and aimed to minimize glare for approaching sand-salt trucks or service vehicles entering and leaving the storage facility.

E27.4 Shop Drawings

- E27.4.1 Submit shop drawings.
- E27.4.2 Submit complete photometric data for luminaries. Photometric data to include VCP table and spacing criterion.

E27.5 Warranty

- E27.5.1 Guarantee luminaries and lighting system three years from date of completion. Replace burned out lamps or faulty ballasts during this time at no cost to the client.

E27.6 Design Requirements

- (a) Luminaries to be 400 watt high pressure sodium with a dropped acrylic lens. Lighting unit to be sealed from entry of dirt and dust.
- (b) Install 400W HPS luminaries. Bottom of luminaries lens to be at an elevation no lower than the building structural frame elevation.
- (c) The luminaries over east-west access overhead door/corridor to have additional 100W quartz re-strike lamps.
- (d) Acceptable luminaries: Lithonia TXC 400S series or equal.
- (e) Interior HID lighting to be installed on U-channel support system to maintain even spacing of luminaries.
- (f) Building exterior at east and west overhead doors each to have one 250 watt weatherproof wall pack style luminaries mounted on the exterior door frame.
- (g) Acceptable manufacturer for exterior luminaries: Lithonia TWH series 250 watt high pressure sodium.
- (h) Available power for luminaries is 120 volt AC.
- (i) Lighting control as per Section E29.

E28. EMERGENCY LIGHTING AND EXIT SIGNS

E28.1 Related Sections

- (a) E1.2: Drawings
- (b) Structural Building Plans, Sections and Details

E28.2 References

- (a) Canadian Standards Association (CSA)
 - (i) CSA C22.2 No. 141- 1992, Unit equipment for emergency lighting.
 - (ii) CSA C860-96, Performance of internally lighted exit signs.
- (b) National Fire Protection Association (NFPA) requirements.

E28.3 Design Requirements

- (a) Each man door to have an exit sign.
- (b) Exit sign lamps to be LED type.
- (c) Exit sign to be complete with two tungsten emergency lighting heads complete with internal battery, battery charging unit and battery heating element.
- (d) Exit signs to be rust proof, constructed of PVC.
- (e) Exit signs / emergency light units to be connected to non-switched lighting circuit.
- (f) Emergency lighting to be installed in accordance with Manitoba Building Code to illuminate egress routes.
- (g) Exit sign / emergency lighting unit: Ready-Lite LDX-6-72-IF-L061- 2-WSR-HTR model or approved equal.

E28.4 Shop Drawings

- (a) Submit shop drawings.

E29. LIGHTING CONTROL EQUIPMENT

E29.1 Related Sections

- (a) E27: Building Lighting

E29.2 References

- (a) CSA 22.1-2002, Canadian Electrical Code Part 1

E29.3 Design Requirements

- (a) Indoor lighting control to be automatic. Control to be both by motion sensors and manually controlled by an automatic control switch.
- (b) Motion sensors to be installed. Sensors to be installed to cover 3 separate zones, north, center and south.
- (c) Luminaries control is via contactors located in the Watt Stopper control panel located in the distribution enclosure.
- (d) Sequence of operation:
 - (i) Main lighting control is by photoelectric control installed on the outdoor electrical distribution enclosure. Lighting power to be activated if outdoor light level falls below 5 foot candles and turned off if outdoor light level rises above 15 foot candles.
 - (ii) Outdoor overhead door mounted wall pack luminaries to be controlled by photocell only.
 - (iii) Indoor luminaries to be controlled by motion detectors and or automatic control switch in addition to the photocell control.
 - (iv) When personal or equipment enter the building via the east/west O/H doors or man doors the north group of luminaries are powered on. The row of luminaries over the doorway to have re-strike lamps installed to provide instant light.
 - (v) When personal or equipment approaches the center of the building the center group of luminaries are powered on.
 - (vi) When personal or equipment approaches the south end of the building the south group of luminaries are powered on.
 - (vii) Lighting to remain on for a minimum of ½ hour if no motion is detected, then to shut off.
 - (viii) Automatic light switch – Watt Stopper AC-100 to be programmed to have overrides to enable continuous lighting if required.
 - (ix) Building interior and exterior lighting to be connected to distribution
 - (x) Panel Watt Stopper LP8 (installed as part of Phase I construction). Contractor to program panel LP8 to function as per sequence of operation.
 - (xi) Motion sensors to be Watt Stopper EN-200-120-G or equal.
 - (xii) Install light control equipment to manufacturer's instructions.
 - (xiii) Program Watt Stopper control panel (LP8) to operate as per the sequence of operation.

E29.4 Shop Drawings

- (a) Submit shop drawings.

E29.5 Warranty

- (a) Replace any defective device or system to three years from date of commissioning

E30. WIRING DEVICES, MOTORS

E30.1 Related Sections

- (a) E15: Prefabricated Buildings
- (b) E25: Controls
- (c) E16: Mechanical

E30.2 References

- (a) CSA 22.1-2002, Canadian Electrical Code Part 1.
- (b) EEMAC M1-7, 1992, Motors and Generators.

E30.3 Design Requirements

- (a) All device boxes to be PVC, suitable for surface mounting.
- (b) Receptacles – 15A, 125V rated straight blade NEMA configuration No. 5-15R Specification grade. Pass & Seymour 5252-GRYCN or equal.
- (c) Receptacle covers – thermoplastic duplex vertical self-closing flip lids.
- (d) Support boxes independently of conduit.
- (e) Install one duplex receptacle inside building adjacent to each man door. At south man door install receptacle on stub wall between man door and stop logs. Refer to Structural Building Plan, Sections & Details-Drawing No. 9-2005_Drawing_01-R2.pdf and Structural Building Elevations, Plans & Sections-Drawing No. 9-2005_Drawing-02-R2.pdf.
- (f) Install Lighting control automatic switch AS-100 adjacent to east man door.
- (g) Pushbuttons to be weatherproof.
- (h) Raceways for calcium chloride tank control devices and motors to be PVC jacketed flexible metal conduit.
- (i) Provide non-fused disconnect switches at motor locations, disconnect enclosure to suit environment, NEMA 12 indoors, NEMA 3 outdoors.
- (j) Connections to motors to be with PVC jacketed flexible metal conduit.
- (k) Connect overhead door operators as per manufacturer's instructions.

E30.4 Shop Drawings

- (a) Submit shop drawings for control devices, include schematic, wiring and interconnection diagrams.

E31. WIRE, CABLE, CONDUIT AND CONDUIT FITTINGS

E31.1 Related Sections

- (a) Drawings: Phase I (Reference Drawings)
 - (i) Drawing 05 Electrical Details
 - (ii) Drawing 06 Electrical Power Distribution Enclosure and Schematic

E31.2 References

- (a) Canadian Standards Association (CSA) C22.2 No. 18 – 98, Outlet boxes, Conduit boxes, fittings and associated hardware.
- (b) CSA C22.2 No. 83-R1999, Electrical metallic tubing.
- (c) CSA C22.2 No. 211.2-R1999, Rigid PVC.

- (d) CSA C22.2 No. 0.3-96, Test methods for electrical wire and cables.
- (e) CAN/CSA-C22.2 No. 131-1994, type TECK 90 cable.

E31.3 Design Requirements

- (a) Conduit buried below grade to be PVC.
- (b) Install sleeves where conduits pass through concrete.
- (c) Conduit in the Sand / Salt storage building to be surface mounted PVC, complete with PVC fittings or TECK cabling may be used for wiring that is 120 volt or higher voltage.
- (d) Motor connections to be PVC jacketed watertight flexible metal conduit.
- (e) Lighting control wiring to be minimum #12 AWG in separate conduit system.
- (f) Wiring and raceway system for exterior calcium chloride storage tanks to be TECK cabling for power, PVC jacketed flexible metal conduit for multi conductor control wiring system.

E31.4 Existing Electrical Equipment

- (a) Phase I installation included a electrical enclosure located 3.5 m north of the north side of the building structure, west of the overhead door location. Access to enclosure is through PVC conduit installed in Phase 1. Conduits terminate 1000mm from edge of pad. Refer to Phase 1 drawings No. 05 and 06.
- (b) Installed in the enclosure is a 120/240 volt, 100 amp, 24 circuit panelboard, photocell, Watt Stopper LP8 panel.