Part 1 Structural

Part 2 Mechanical

Part 3 Electrical

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Submit to Engineer submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, and samples in imperial units with metric units noted below.

.4 Where items or information is not produced in imperial units converted values are acceptable. Review submittals prior to submission to Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.5 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.6 Verify field measurements and affected adjacent Work are co-ordinated.

.7 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer's review of submittals.

.8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer’s review.

.9 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Nova Scotia, Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 7 days for Engineer's review of each submission.

.5 Adjustments made on shop drawings by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.

.6 Make changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.8 Submissions include:

- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Relationship to adjacent work.

.9 After Engineer's review, distribute copies.

.10 Submit number of prints Engineer requires for distribution plus 3 copies of shop drawings which will be retained by Engineer for each requirement requested in specification Sections and as Engineer may reasonably request.

.11 Submit 2 copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Engineer where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit 2 copies of test reports for requirements requested in specification Sections and as requested by Engineer.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.13 Submit 2 copies of certificates for requirements requested in specification Sections and as requested by Engineer.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit 2 copies of manufacturers instructions for requirements requested in specification Sections and as requested by Engineer.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit 2 copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Engineer.

.1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.16 Delete information not applicable to project.

.17 Supplement standard information to provide details applicable to project.

.18 Shop drawings, product data, test reports and certificates may be submitted electronically in PDF format in lieu of the above requirements for hard copies.

.19 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.20 The review of shop drawings by the Engineer is for the sole purpose of ascertaining conformance with the general concept. This review shall not mean that the Engineer approves the detail inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting the same, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for

meeting all requirements of the construction and contract documents. Without restricting the generality of the foregoing, the Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.

1.3 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Engineer's business address.

.3 Notify Engineer in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

.5 Adjustments made on samples by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.

.6 Make changes in samples which Engineer may require, consistent with Contract Documents.

.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 03 30 00 – Cast-in-Place Concrete.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CAN/CSA-O86-09, Engineering Design in Wood.
- .3 CSA O121-08, Douglas Fir Plywood.
- .4 CSA O151-09, Canadian Softwood Plywood.
- .5 CSA O153-13, Poplar Plywood.
- .6 CAN/CSA-O325-07(R2012), Construction Sheathing.
- .7 CAN/CSA-S269.3-M92(R2008), Concrete Formwork.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

- .1 Separate waste materials for reuse and recycling.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Divert wood materials from landfill to a recycling facility.
- .4 Divert plastic materials from landfill to a recycling facility.
- .5 Divert unused form release material from landfill to an official hazardous material collections site.

Part 2 Products

2.1 MATERIALS

.1 Formwork materials:

- .1 Use wood and wood product formwork materials to CSA-O121 and CAN/CSA-O86.

.2 Form ties:

- .1 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface. Holes to be plugged with approved material.

.3 Form liner:

- .1 Plywood: medium density overlay Douglas Fir to CSA O121 or Canadian Softwood Plywood to CSA O151, square edge, 19 mm thick.

.4 Form release agent: non-toxic, biodegradable, low VOC.

.5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110s Saybolt Universal 15 to 24 mm^2/s at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

Part 3 Execution

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork and ensure dimensions agree with drawings.

.2 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.3 Align form joints and make watertight.

.1 Keep form joints to minimum.

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

.5 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.6 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 2 days for curbs.

.2 Re-use formwork subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 03 10 00 - Concrete Forming

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

- .1 ASTM C260/260M-10a, Specification for Air-Entraining Admixtures for Concrete.
- .2 ASTM C494/C494M-13, Specification for Chemical Admixtures for Concrete.
- .3 ASTM C827/C827M-10, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- .4 ASTM C939-10, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
- .5 ASTM F593-13, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

.3 Canadian Standards Association (CSA)

- .1 CAN/CSA-A3001-08 - Cementitious Materials for Use in Concrete.
- .2 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.
- .3 CAN/CSA-A23.2-09, Methods of Test for Concrete.

.4 Society for Protective Coatings (SSPC)

- .1 SSPC-SP12, Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra High Pressure Water Jetting Prior to Recoating.

1.3 DESIGN REQUIREMENTS

.1 Alternative 1 - Performance: in accordance with CSA-A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittals.

.2 Submit testing results and reports for review by Engineer and do not proceed without written approval when deviations from mix design or parameters are found.

.3 Concrete pours: submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.

1.5 QUALITY ASSURANCE

.1 Submit to Engineer, minimum 4 weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.

.1 When plant does not hold valid certification, provide test data and certification by qualified independent inspection and testing laboratory that materials used in concrete mixture will meet specified requirements.

.2 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for review by Engineer on following items:

.1 Curing.

.2 Finishes.

.3 Formwork removal.

.4 Joints.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.

.1 Modifications to maximum time limit must be agreed to by Engineer and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by Engineer.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

.3 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling.

.2 Divert unused concrete materials from landfill to local facility.

.3 Provide an appropriate area on the job site where concrete trucks can be safely washed. Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site.

.4 Unused admixtures and additive materials must not be disposed of into sewer systems, into ocean, onto ground or in other location where it will pose health or environmental hazard.

.5 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

Part 2 Products

2.1 MATERIALS

.1 Cement: to CAN/CSA-A3001, Type 10 Portland Cement.

.2 Supplementary cementing materials: with minimum 15% to maximum 25% fly ash, by mass of total cementitious materials to CAN/CSA-A3001.

.3 Water: to CSA-A23.1.

.4 Aggregates: to CAN/CSA-A23.1/A23.2.

.5 Admixtures:

.1 Chemical admixtures: to ASTM C494/C494M.

.6 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA-A23.1/A23.2.

.1 Compressive strength: 50 MPa at 28 days.

.2 Net shrinkage at 28 days: maximum 2 %.

.7 Drilled in concrete chemical anchors: Stainless Steel HAS Rods to ASTM F593 (AISI 316) with Hilti HIT-RE 500 adhesive.

.9 Joint sealant: Sikaflex 2c NS/SL or approved equal.

2.2 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet performance criteria in accordance with CAN/CSA-A23.1/A23.2.

.1 Provide concrete mix to meet following hard state requirements:

.1 Durability and class of exposure: F-2.

.2 Minimum compressive strength at 28 days: 25 MPa for curbs.

.3 Nominal size of coarse aggregate: 20 mm.

.4 Slump at time and point of discharge: 180 mm (+/- 30 mm) with the aid of superplasticizer, 60 mm before superplasticizer.

.5 Air content: 4 to 7 %.

.2 Concrete supplier's certification.

Part 3 Execution

3.1 PREPARATION

.1 Obtain Engineer's approval before placing concrete.

.1 Provide 24 hours notice prior to placing of concrete.

.2 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.3 Pumping of concrete is permitted only after approval of equipment and mix.

.4 Ensure inserts are not disturbed during concrete placement.

3.2 CONSTRUCTION

.1 Do cast-in-place concrete work in accordance with CSA-A23.1/A23.2.

.2 Finishing and curing:

.1 Finish concrete in accordance with CSA-A23.1/A23.2.

.2 Use procedures as reviewed by Engineer to remove excess bleed water. Ensure surface is not damaged.

.3 Moist cure for 3 days. Completely cover concrete to be cured with burlap or other approved material and keep wet for entire curing period. Use of sprinklers is not permitted.

.4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.

.3 Joint fillers:

.1 Locate and form construction joints as indicated.

.2 Install backer rod and joint sealant in accordance with manufacturer's written instructions.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance in accordance with CSA-A23.1/A23.2 straightedge method.

3.4 FIELD QUALITY CONTROL

.1 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Engineer for review in accordance with CSA-A23.1/A23.2.

.2 Owner will pay for costs of tests.

.3 Engineer will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.4 Non-Destructive Methods for Testing Concrete: in accordance with CSA-A23.1/A23.2.

.5 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

END OF SECTION

1.0 GENERAL

1.2 REFERENCES

.1 ASTM A307- 14, Specification for Carbon Steel Bolts and Studs, 60000 psi Tensile.

.2 ASTM A325-14, Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength

.3 CAN/CSA- G40.20-13, General Requirements for Rolled or Welded Structural Quality Steel.

.4 CAN/CSA- G40.21- 13, Structural Quality Steels.

.5 CAN/CSA - S16-14, Limit States Design of Steel Structures.

1.3 SOURCE QUALITY CONTROL

.1 At least 2 weeks prior to fabrication of structural steel, submit 2 copies of mill test reports showing chemical and physical properties and other details of steel to be incorporated into work. Such mill test reports shall be certified by qualified metallurgists confirming that tests conform to requirements of CAN/CSA G40.20 and CAN/CSA G40.21.

1.4 DESIGN OF DETAILS AND CONNECTIONS

.1 Design details and connections in accordance with requirements of CAN/CSA-S16 to resist forces, moments and shears indicated.

.2 If connection for shear only (standard connection) is required:

.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction".

.2 If shears are not indicated, select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam.

.3 For non standard connections, submit sketches and design calculations stamped and signed by qualified professional engineer registered or licensed in Province of Nova Scotia in Canada.

1.3 SHOP DRAWINGS

.1 Submit shop detail, erection drawings and materials list in accordance with Section 01 33 00 – Submittals.

.2 On erection drawings, indicate all details and information necessary for assembly and erection purposes such as, description of methods, sequence of erection, type of equipment used in erection and temporary bracings.

.3 Reproduction of contract drawings for use as erection drawings is not permitted unless approved in writing by Engineer.

.4 Each drawing submission shall bear signature and stamp of qualified professional engineer registered or licensed in the province of Nova Scotia in Canada for all fabricator designed assemblies, components and connections.

2.0 PRODUCTS

2.1 MATERIALS

.1 Structural steel: to CAN/CSA-G40.21 Grade 350W for rolled sections and Grade W300 for plates, angles and channels.

.2 Bolts, nuts and washers: to ASTM A325M.

.3 Threaded rods: to CAN/CSA-G40.21 Grade 300W.

.4 Adhesive anchors for concrete: Hilti HIT-RE 500 adhesive anchors to sizes indicated complete with HAS-E Standard rods to ISO 898 Class 5.8, or HAS stainless steel rods where indicated on drawings.

.5 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.

2.2 FABRICATION

.1 Fabricate structural steel, as indicated, in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.

.2 Continuously seal members by continuous welds where indicated.

3.0 EXECUTION

3.1 GENERAL

.1 Do structural steel work in accordance with CAN/CSA S16.

.2 Do welding in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 CONNECTION TO EXISTING WORK

.1 Verify elevations, dimensions and condition of existing work before commencing preparation of shop drawings and fabrication and report any discrepancy and potential problem areas to Engineer and await instructions.

.2 Where new steel is to be welded to existing steel, remove paint and clean existing steel to SSPC SP3.

3.3 MARKING

.1 Mark materials in accordance with CAN/CSA-G40.20. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

.2 Match marking: shop mark splices for fit and match.

3.4 ERECTION

.1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and in accordance with reviewed erection drawings.

.2 Obtain written approval of Engineer prior to field cutting or altering of structural members.

.3 Install adhesive anchors in accordance with manufacturer's written instructions.

3.5 QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Engineer.

.2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Engineer.

.3 If requested, submit test reports to Engineer one week of completion of inspection.

.4 Owner will pay costs of tests.

3.6 FIELD PAINTING

.1 Refer to section 09 90 00: Painting.

END OF SECTION

Part 1 General

1.1 DESCRIPTION OF WORK

.1 Work under this section is for painting of structural steel and miscellaneous metals for the cooler ceiling support.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittals.

.2 Section 05 12 23 – Structural Steel.

1.3 REFERENCES

.1 Architectural Painting Specifications Manual, Master Painters Institute (MPI).

.2 Systems and Specifications Manual, SSPC Painting Manual, Volume Two, Society for Protective Coatings (SSPC).

.3 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings) of the Environmental Protection Agency (EPA).

1.4 SUBMITTALS

.1 Submit product data and manufacturer's installation/application instructions for paints and coating products to be used in accordance with Section 01 33 00 – Submittals.

.2 Submit WHMIS MSDS - Material Safety Data Sheets as requested by Consultant.

.3 Upon completion, submit records of products used. List products in relation to finish system and include the following:

- .1 Product name, type and use.
- .2 Manufacturer's product number.
- .3 Colour numbers.
- .4 MPI Environmentally Friendly classification system rating.
- .5 Manufacturer's Material Safety Data Sheets (MSDS).

1.5 SITE REQUIREMENTS

.1 Temperature, Humidity and Substrate Moisture Content Levels:

- .1 Unless specifically pre-approved by applied product manufacturer, perform no painting work when:
  - .1 ambient air and substrate temperatures are below 10^0C.

.2 substrate temperature is over 32 ^{0}C unless paint is specifically formulated for application at high temperatures.

.3 substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.

.4 the relative humidity is above 85% or when dew point is less than 3 ^{0}C variance between air/surface temperature.

.2 Surface and Environmental Conditions:

.1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint only to adequately prepared surfaces.

.3 Apply paint only when previous coat of paint is dry or adequately cured.

.4 Apply paint finishes only when conditions forecast for entire period of application fall within manufacturer's recommendations.

.5 Do not apply paint when:

.1 Temperature is expected to drop below 10^{0}C before paint has thoroughly cured.

.2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.

.3 Surface to be painted is wet, damp or frosted.

.6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.

.7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.

.8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.2 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.3 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.4 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground the following procedures shall be strictly adhered to:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.5 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

.6 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection by organizations for verifiable re-use or re-manufacturing.

.7 Close and seal tightly partly used sealant and adhesive containers and store protected in well ventilated fire-safe area at moderate temperature.

Part 2 Products

2.1 COATING SYSTEMS

.1 Coating system shall be Amerlock 400.

.1 First coat: ANSI 70 Grey, 100 – 200 µm (DFT).

.2 Top coat: Black to match existing, 100 – 200 µm (DFT).

Part 3 Execution

3.1 GENERAL

.1 Apply coating materials in accordance with manufacturer's written application instructions.

3.2 EXISTING CONDITIONS

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Engineer damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

3.3 PROTECTION

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Engineer.

.2 Protect factory finished products and equipment.

.3 As painting operations progress, place "WET PAINT" signs in pedestrian traffic areas to approval of Engineer.

3.4 CLEANING AND PREPARATION

.1 Clean and prepare surfaces in accordance with coating manufacturer's written specifications.

3.5 APPLICATION

.1 Method of application to be as approved by Engineer. Apply paint by brush, roller, air sprayer, airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

- .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
- .2 Work paint into cracks, crevices and corners.
- .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
- .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by Consultant
- .5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray Application:

- .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
- .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
- .3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
- .4 Brush out immediately runs and sags.
- .5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Consultant.

.5 Apply coats of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.

.9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 RESTORATION

.1 Remove protective coverings and warning signs as soon as practical after operations cease.

.2 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.3 Protect freshly completed surfaces from paint droppings and dust to approval of Engineer. Avoid scuffing newly applied paint.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB).

.2 Canadian Standards Association (CSA International).

.3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as Of: May 14, 2004.

1.2 HOARDING

.1 Install temporary plastic sheet wall along back end of walk-in refrigerator to allow continued operation during work. Do not remove any panels from existing walk-in refrigerator until new panels have been received locally (either on site or at Contractor’s premises).

1.3 DUST TIGHT SCREENS

.1 Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

1.4 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.5 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.6 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Consultant the locations and installation schedule 3 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Federal Regulations.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 This section includes all work pertaining to the fabrication and installation required to expand the existing "Foster" walk-in cooler by approximately 4.15 metres to fully enclose all 4 metres of existing ActivRAC tracking in the floor. The expanded walk-in cooler must be fully functional and maintain a temperature of 4 degrees Celcius.

1.2 RELATED WORK

.1 Section 21 05 01 - Common Work Results - Mechanical

1.3 GENERAL

.1 Walk-in cooler to maintain a temperature set point of 4°C with a temperature control variance of +/- 0.5°C.

1.4 MECHANICAL SYSTEMS

.1 The expanded walk-in cooler shall consist of the four (4) existing evaporator units (EV.1, EV.2, EV.3, and EV.4), two (2) new rooftop air cooled scroll compressor condensing units (C1 and C2), and new refrigeration piping to suit the new equipment layout. Evaporator EV.1 shall be relocated as indicated on the drawings.

.2 Electrical: As indicated on the drawings.

1.5 SERVICE

.1 Type required: Standard response - within 4 hours. The Walk-in Cooler supplier shall demonstrate local, first party, service response capability in the HRM area.

1.6 DIMENSIONS

.1 Refer to the drawings for the expanded walk-in cooler dimensions. All dimensions shall be confirmed on-site prior to submitting shop drawings. A minimum of 25mm clearance is required between the walls of the expanded cooler and the existing walls of the Building.

1.7 REFERENCES

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

.2 American Society for Testing and Materials (ASTM):
  .1 ASTM A 167, Specification for Stainless Steel and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip.
  .2 ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.

.3 ASTM E 162, Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

.4 ASTM A 653/A 653M, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.

.3 Canadian General Standards Board (CGSB):

.1 CGSB 51 GP 23M, Thermal Insulation, Urethane, Spray in Place.

.2 CAN/CGSB 51.26M, Thermal Insulation, Urethane and Isocynanrate, Boards, Faced.

.3 CAN/CGSB 52.28M, Refrigerators and Freezers, Prefabricated, Mechanical, Commercial, Walk-in.

.4 Underwriters Laboratories of Canada:

.1 CAN/ULC 101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

.5 When provisions of pertinent codes and standards conflict with these specifications, the more stringent provisions shall govern.

1.8 SUBMITTALS

.1 Provide submittals in accordance with the requirements of Section 21 05 01 - Common Work Results - Mechanical.

.2 The manufacturer shall submit a complete design/ install package for the expanded walk-in cooler. The information shall include dimensions, weights, attachment details, electrical requirements, wiring schematics, etc.

.3 Shop Drawings:

.1 Indicate the installation details and panel identification numbering for erection.

.2 Indicate rough-in requirements for mechanical and electrical services.

.3 Indicate features including but not limited to the following: switches, light fixtures, services, utility connection points, closure trim. Items shall be dimensioned for both size and location. Shop drawings shall note work provided by others. Coordinate services with mechanical, electrical, and other subcontractors.

.4 Drawing submission shall include cover sheet, plan view of the cooler and equipment, elevation view with equipment, electrical power requirements, and equipment list.

.5 All measurements shall be confirmed on site prior to submitting shop drawings.

.6 Operations and Maintenance Data: Provide operation and maintenance data for incorporation into the manual specified in Section 21 05 01 - Common Work Results - Mechanical.

.7 Upon completion of the project, submit “As-Built” drawings for record keeping purposes.

1.9 QUALITY ASSURANCE

.1 The equipment manufacturer and installer shall have personnel skilled in the manufacturing and installation of walk-in coolers and have continuous proven experience within the last five (5) years. The company must be able to provide first-party warranty and local support. Provide technicians for equipment start-up commissioning and training.

1.10 DELIVERY AND STORAGE

.1 Remove the existing end wall panel of the existing walk-in cooler and save on-site for reuse. Store at location directed by Departmental Representative.

.2 Deliver, store, and handle materials in a manner to prevent damage and deterioration.

.3 Protect all factory finished panel surfaces subject to damage while in transit and after installation.

.4 Do not deliver materials or assemblies to site until installation spaces are ready for construction. Cover the rooms with protective material to prevent damage during construction.

1.11 SITE CONDITIONS

.1 Examine and verify project conditions on site to assure acceptable access, dimensions, and general conditions. Notify Consultant in writing of any conditions, which are unacceptable to complete the required work.

1.12 SEQUENCING AND SCHEDULING

.1 Expand the walk-in cooler in close coordination with the work of other trades. During construction, cooler downtime must be minimized as much as possible, therefore the Contractor must adhere to the sequencing of work below:

- .1 Do not remove any panels from the existing walk-in cooler until new panels have been received locally (either on-site or at th local Contractor's premises).
- .2 Install new rooftop condenser units prior to removing the existing refrigeration unit on the roof of the existing walk-in cooler and the existing rooftop condenser unit.
- .3 As indicated in Section 01 56 00 - Temporary Barriers and Enclosures, install a temporary plastic sheet wall on the back end of the walk-in cooler to allow for continued operation while the new wall and roof panels are being installed.

1.13 WARRANTY

.1 The manufacturer shall provide a written Warranty to the end user stating the product is free from defects in material or workmanship under normal use and service. The Warranty shall become effective on the date of Interim Completion as accepted by the Consultant. The Warranty shall cover the following items for the noted duration:

- .1 Ten (10) year insulated panel Warranty.
- .2 Five (5) year compressor Warranty.

.3 One (1) year parts and labour Warranty; except as specified in 1.13.1.1.
.4 Service and Warranty to be provided directly by the supplier.

Part 2 Products

2.1 GENERAL

.1 In order to define the minimum acceptable standard of quality, this specification names the manufacturers whose published products are acceptable.
.1 Master-Bilt
.2 Norbec Inc.
.3 Hussmann

.2 Materials:

.1 Galvanized sheet steel: commercial grade to ASTM A653M, with zinc coating (galvanized) designation Z275.

.3 Sealant: Type 2 (silicone), colour to match panels.

.4 Isolating coating: to manufacturer's recommendations.

.5 Panel finish: to match existing

.6 Insulation for panels: to CGSB 51 GP 23M, Class 3, poured type foam in place polyurethane (urethane) using chlorine free blowing agent, 100mm thick (RSI 4.22). Certified to have a flame spread rating of 25 or less, and pass one or more of the following standard test methods for Fire Hazard Classification of Building Materials:
.1 CAN 4-S101, CAN/ULC S102, ASTM E84, ASTM E162, or NFPA 255 and be labelled by ULC or FM.

2.2 FABRICATION

.1 Manufacture to CAN/CGSB 52.28.

.2 Wall and ceiling panel sections:100mm thick, precision die formed metal pans accurately spaced and insulated. Panel edges and corners to have tongue and grooves, formed in place, to assure airtight, vapour proof joints using silicone sealant. Do not use structural metal, wood, or fibreglass material between interior and exterior skins.

.3 Corner panels: 300mm X 300mm wide external preformed 90° angles.

.4 Ceiling panels: reinforced internally or externally as required to support the weight of the ceiling panels and refrigeration systems and lights. Where external reinforcement is needed and through-fasteners used, fasteners to be of low heat conducting material such as Teflon. Insert fasteners in Teflon sleeves to prevent compressing of insulation. Cover all exposed rods and nuts with a decorative panel material to match the ceiling panels to conceal the fasteners.

.5 Panel thicknesses and finishes for exterior and interior panels exposed to normal view: minimum 24 gauge galvanized steel skin.

.6 Locking devices: panel sections to have cam action locking devices, spaced at maximum 900mm vertically, 600mm horizontally. Male and female lock pockets.

.7 Accessories:

.1 Lighting for the walk-in cooler expansion: Install new vapour-tight fluorescent fixtures to match existing. Housing constructed of corrosion resistant fibreglass or ABS plastic, complete with clear prismatic acrylic lens with closed cell neoprene gasketing bonded to housing to form a continuous seal from the lens. Provide lighting so as to provide uniform distribution of light. Lighting to be controlled by the existing walk-in cooler lighting circuit.

2.3 CONTROL PANEL

.1 Relocate existing electrical panel and associated circuits located above the walk-in cooler to allow for the new expansion. New electrical panel location must be confirmed with the Departmental Representative.

2.4 REFRIGERATION EQUIPMENT

.1 Refrigeration equipment: specifically designed, engineered, manufactured and of adequate capacity to fulfill required walk-in cooler operating temperature and performance. The equipment shall operate using R-404a refrigerant, be fully automatic in operation, operate continuously and conform to the following minimum requirements:

.1 The compressors shall be furnished to operate on 208V, 3 phase service. Provide a non-fused disconnect for each rooftop condensing unit. Provide new insulated refrigeration piping from the new condensing units to the existing evaporator coils with liquid line and suction line. Provide adjustable thermostatic expansion valves, with strainers, hot gas inlet tees, and be externally equalized. Entire packaged refrigeration assembly readily accessible for cleaning.

2.5 SERVICES

.1 Coordinate design and installation of walk-in cooler expansion to accommodate services described. Provide reinforcement for wall penetrations as recommended by wall system manufacturer. Seal penetrations air-tight after installation of services by other trades.

.2 Electrical wiring and components shall meet CSA standards.

.3 Electrical Contractor shall provide a single point of service to the control panel circuit breaker panel with disconnect switch. The walk-in cooler manufacturer shall wire their equipment from the control panel.

Part 3 Execution

3.1 EXAMINATION

.1 Examine and verify areas and work of other trades for conditions that affect the work of this section.

.2 Report unsatisfactory conditions to the Consultant in writing.

.3 Do not begin installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

.1 Supply and Install new prefabricated refrigeration wall and ceiling panels to match existing and reinstall existing end panel. Complete all seams.

.2 Installation shall be performed by manufacturer's personnel or manufacturer's representative. Manufacturer shall supply factory trained, on-site supervision at all times when work of this section is performed.

.3 Provide appropriate protection of materials on site.

.4 Install in accordance with CAN/CGSB 52.28.

.5 Erect work true to line, plumb, square and level with all joints aligned. Fit joints and intersecting members accurately and in true planes adequately fastened.

.6 Cut or drill holes in panels, as required, to accommodate electrical and mechanical services, runs, or connections. Insert Teflon sleeves into holes and seal air-tight. After installation of services, fill remaining space with insulation and seal air-tight.

.7 Cap wrench access holes with an in fitting, flush, stainless steel removable plug.

3.3 CLEANING AND ADJUSTING

.1 Upon completion of work, clean equipment and apparatus, remove protective coverings, test and adjust operating equipment. Re-finish damaged coatings and finishes.

3.4 TESTING AND TRAINING

.1 Manufacturer shall provide field test results for the complete packaged refrigeration systems prior to completion. The test shall include a 24 hour run test of the complete refrigeration system to simulate actual operating conditions. The test shall include the following:

.1 Run test of 24 hour duration at the desired set point of 4 degrees C. Demonstrate that the system has operated at the desired set point for the full 24 hours.

.2 Provide a temperature recording from a reliable source instrument of the actual temperature readings at 10 minute intervals over the full 24 hour period.

.3 Provide evidence that the room refrigeration system maintained the temperature and tolerance to meet the specification.

.4 The Consultant will be given the option to witness and confirm the test results. Notify the Consultant prior to test in writing.

.5 Should the systems fail this test, then it will be the full responsibility of the manufacturer to correct the system and resubmit for a new test to the Owner.

.2 The manufacturer shall instruct/ provide training to the Owner on the complete operation of the expanded walk-in cooler, including controls, after the completion of the room start-up.

.1 Provide demonstration and instruction of the walk-in cooler.

.2 Provide operation and maintenance manual indicating sequential operation, start-up and shut down and preventative maintenance, with all pertinent control data, schematics, test results and drawings.

END OF SECTION

Part 1 General

1.1 PROTECTION OF OPENINGS

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

1.2 PAINTING

.1 Prime and touch up marred finished paint work to match original.

.2 Restore to new condition, finishes which have been damaged too extensively to be primed and touched up.

1.3 SPARE PARTS

.1 Contractor to provide spare sprinkler heads to the Departmental Representative as outlined in Section 21 13 13.

1.4 SPECIAL TOOLS

.1 Contractor to supply sprinkler wrenches and keys for emergency repair work as outlined in Section 21 13 13.

1.5 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel how to operate, control, adjust, trouble-shoot and service all systems and equipment during regular work hours, prior to acceptance.

.2 Manufacturer’s representative shall provide instructional demonstrations.

.3 Use Operation and Maintenance (O&M) Manual, As-Built or Record Drawings, audio visual aids, etc. as part of instruction materials.

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

.5 Where deemed necessary, the Consultant and/or the Departmental Representative may record these demonstrations on video tape for future reference.

1.6 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into O&M Manual specified herein.

.2 Operation and Maintenance (O&M) Manual to be approved by, and final copies deposited with the Departmental Representative before final inspection.

.3 Operation data to include:
- .1 Description of each system and its controls.
- .2 Description of operation of each system at various loads together with reset schedules and seasonal variances.
- .3 Operation instruction for each system and each component.
- .4 Description of actions to be taken in event of equipment failure.
- .5 Valves schedule and flow diagram.
- .6 Colour coding chart.
- .7 Legend of above ceiling identifiers.

.4 Maintenance data shall include:
- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:
- .1 Equipment manufacturer's performance data sheets with point of operation.
- .2 Equipment performance verification test results.
- .3 Special performance data as specified elsewhere.

.6 Approvals:
- .1 Submit three (3) hard copies (ringed binders) and one (1) electronic (PDF) copy of the draft Operation and Maintenance Manual to the Consultant for approval. Submission of individual data will not be accepted unless so directed by the Consultant.
- .2 Make changes as required and resubmit as directed by the Consultant.

.7 Additional data:
- .1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.
- .2 MSDS for all hazardous material installed and left stored on site or with the Owner.

1.7 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for all equipment provided/installed.

.2 Shop drawings and product data shall show:
- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.
- .3 Wiring diagrams showing field wiring connections and field wiring between related components.

.3 Shop drawings and product data shall be accompanied by:
- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Manufacturer to certify as to current model production.
- .4 Certification of compliance to applicable codes.

.4 Use the "Shop Drawing Submittal Form" included within this Specification Section. Identify section and paragraph number.

.5 Provide three (3) hard copies and one (1) electronic (PDF) copy of the shop drawings for all equipment specified and/or indicated, including but not limited to the following items:

.1 General:
  .1 Caulking and/or Fire-Stopping Materials.

.2 Plumbing:
  .1 Refrigerant piping, valves and fittings.

.3 Refrigeration Equipment:
  .1 Evaporator units and condensing units.

.4 Insulation:
  .1 Pipe insulation.

.5 Fire Protection:
  .1 Sprinkler heads.

1.8 CLEANING

.1 Clean the job site daily. If the job site is not cleaned to the Client's satisfaction, then the Client shall make arrangements for cleaning and charge the cost against the Contract.

1.9 AS-BUILT AND RECORD DRAWINGS

.1 Site records:
  .1 The Consultant will provide one set of reproducible Drawings for use by the Contractor. The Contractor shall mark thereon all changes as the work progresses and as changes occur.
  .2 On a daily basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
  .3 Use different colour waterproof ink for each service.
  .4 Make available for reference purposes and inspection at all times.

.2 As-Built Drawings:
  .1 Identify each Drawing in lower right hand corner in letters at least ½" high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
  .2 Submit to the Consultant for approval and make corrections as directed.
  .3 Submit completed reproducible As-Built Drawings with each of the three (3) Operating and Maintenance Manuals.

.3 The Consultant shall use the Contractor's As-Built Drawings to prepare Record Drawings for the Client.

1.10 DEFINITIONS

.1 The word "provide" shall mean "supply and install" unless otherwise indicated.

.2 Provide new materials, equipment and plan of proven design and quality and of current models with published ratings for which replacement parts are readily available.

.3 Conform to the requirements of the "General Conditions.

1.11 DRAWINGS AND SPECIFICATIONS

.1 The Consultant’s Drawings and the Consultant’s Specifications are not intended to show Structural details or Architectural features.

.2 Except where dimensioned, they indicate general Mechanical layouts only. Do not scale.

.3 The Contractor shall check the content of the Drawings, Specifications and equipment dimensions, and before proceeding, report to the Consultant any error or omission between the Mechanical, Electrical and/or the Structural Drawings.

.4 These Specifications are to be considered as an integral part of the Drawings which accompany them. Neither the Drawings nor the Specifications shall be used alone. Any item which is omitted in one, but which is reasonably implied in the other, shall be considered properly and sufficiently specified and must, therefore, be provided under the Contract. The Consultant’s decision shall be final, if document interpretation is required.

.5 Misinterpretation of the Drawings and/or the Specifications shall not relieve the Contractor of responsibility.

.6 The Contractor shall make himself/herself familiar with the overall intended operation of the Mechanical systems prior to installation, so that all necessary accessories such as valves, controls, etc., can be installed during the normal progress of the work. Failure to do so will result in the Contractor's responsibility in providing such devices, at his/her expense when the need of such devices becomes apparent during start-up.

1.12 SITE VISITS

.1 Before commencing work, visit site and verify that the requirements of the Drawings and the Specifications are consistent with the on-site conditions.

.2 Advise the Consultant, in writing, of any discrepancies or conflicts encountered.

.3 No allowance shall be made for failure to include items which a thorough investigation would have shown to be required.

1.13 GUARANTEES

.1 The Contractor shall guarantee the installed scope of work free from defects for a period of one year, unless specifically noted otherwise, after final acceptance of such work by the Client; and shall make good all defects other than normal wear and tear during the life of the Warranty/Guarantee period.

.2 The Contractor shall guarantee all work and equipment supplied by him/her to work

quietly and satisfactorily and to accomplish the work for which it was installed during the life of the above noted Warranty/Guarantee.

.3 At any time during this period, he/she shall make the necessary changes and adjustments or replacements, to accomplish this at his/her own expense.

.4 Submit the manufacturers' written guarantees to the Consultant for review.

.5 Bind guarantees in hard cover report binder suitable for 8½" x 11" sheets. Label cover "Guarantees" and show project name. Provide a title sheet and a table of contents.

.6 Each Warranty/Guarantee shall include the:
- .1 Project name and address.
- .2 Guarantee time period (commencement date shall be as date shown on Project Final Certificate of Completion unless otherwise indicated).
- .3 Clear and concise definition of what is guaranteed and remedial action provided.
- .4 Signatures of the Contractor.

1.14 PERMITS AND REGULATIONS

.1 The Contractor shall comply with all Codes, Standards, Regulations and Bylaws issued by the Authorities Having Jurisdiction (AHJ), where applicable, including but not limited to the following:
- Provincial Department of Labour
- Federal Fire Commissioner
- Plumbing Inspector
- Provincial Board of Insurance Underwriters
- Provincial Department of Health

.2 The Contractor shall obtain and pay for any and all permits required by local Codes, Statutes and/or Regulations; and shall make arrangements for inspections by the AHJ.

.3 Any additional materials or labour required to conform to any of these rules and regulations will be furnished under the Contract with no additional cost to the Client.

1.15 REFERENCE STANDARDS

.1 Use following latest editions and amendments in effect on date of Tender call:

ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
CEMA	Canadian Electrical Manufacturers Association
CFUA	Canadian Fire Underwriters' Association
CGSB	Canadian Government Specification Board
CSA	Canadian Standards Association
CUA	Canadian Underwriters' Association

HRA	Heating, Refrigeration and Air Conditioning Institute of Canada
NACE	National Association of Corrosion Engineers
NBC	National Building Code of Canada
NBFU	National Board of Fire Underwriters'
NBS	National Bureau of Standards
NFPA	National Fire Protection Association
NSC	National Standards of Canada
TIMA	Thermal Insulation Manufacturers Association
UL	Underwriters' Laboratories
ULC	Underwriters' Laboratories of Canada

1.16 CO-ORDINATION

.1 The Contractor shall coordinate work with all Trades, to avoid conflict, prior to installation of systems and/or equipment.

.2 Locate distribution systems, equipment and materials to provide minimum interference and maximum useable space.

.3 Co-ordinate location of duct drops, pipe drops and risers with existing walls and ceilings to ensure that all pipes and ducts can be easily boxed in by the relevant trades.

.4 The Contractor shall meet regularly with the relevant Trades during the construction for coordination to obtain physical dimensions, access requirements and preferred locations for the services.

.5 In the event that conflicts arise, the Contractor shall work with all other relevant Contractor(s) to ensure that the necessary adjustments are made so that all components fit in the space available with adequate clearance for servicing and removal. If after a thorough effort to fit equipment in a space and provide adequate space for servicing and removal, the Contractor determines that additional space is required, he/she may request assistance to resolve the issue through the General Contractor.

.6 All adjustments or re-routing of the Mechanical, Electrical and Sprinkler systems required to avoid conflict and provide adequate space for servicing and removal of equipment shall be made at the expense of the relevant trade contractor.

1.17 ALTERNATES

.1 Wherever an item or class of material is specified exclusively by trade name of maker or by catalogue reference or under "Acceptable Materials", only such item shall be used unless the Consultant's approval for an alternative is secured in writing.

.2 Should the Contractor desire to substitute another material for one or more specified by name, he/she shall apply in writing for such permission at least ten (10) calendar days before closing date of the Tender package. He/she shall also provide data and/or samples for the Consultant’s consideration. The Contractor shall be fully responsible for any additional costs that might result due to equipment substitution.

.3 Equipment submitted as an "Alternate" to that specified on the Drawings or named in the Specifications by model number or catalogue reference, must be capable of meeting the full range of operating parameters as the specified equipment. It must also be configured and set to meet the specific design point parameters as called for on the Drawings or in the Specifications.

.4 The Contractor shall note that all layouts on the Drawings are based on the specified equipment and any changes necessitated in service connections, etc., will be done at the Contractor's expense. Furthermore, if it is found that the provisions made regarding space conditions are not met, the right is reserved by the Consultant to require installation of the equipment used preparing the layout.

.5 Definitions:

.1 Acceptable Materials - Any product mentioned may be used provided it meets or exceeds the quality, performance capability, and space requirements of the equipment shown and called for on the plans and in the specifications. Alternates, other than those specified, must be submitted for approval prior to Tender closing.

.2 Standard of Acceptance - Only the product mentioned may be used unless alternate products are approved in the Addenda.

1.18 CUTTING AND PATCHING

.1 All cutting and patching to be performed by this Contractor. The Contractor shall provide sleeves for all services penetrating the concrete floors, roofs and shear walls.

.2 Make every effort to minimize cutting and patching.

1.19 TESTS

.1 Notice of Tests: Give written notice for a minimum of five (5) working days prior to date when tests will be made.

.2 Prior Tests: Concealed or insulated work shall remain uncovered until completely tested and approved, but if construction schedule requires, arrange for prior tests on parts of system as approved.

.3 Acceptance Tests: Conduct in presence of the Consultant's representative or a representative of the Authorities Having Jurisdiction (AHJ).

.4 Costs: Bear all costs in connection with tests conducted.

.5 Certificates: Obtain acceptance certificates from the authorities having jurisdiction. Work is not considered complete until certificates have been delivered to the Consultant.

1.20 SLEEVES

.1 Sleeves:
- .1 Unless otherwise specified, supply pipe sleeves for all points where pipe passes through masonry or concrete walls or floors. Sleeves shall be supplied by the Contractor and built-in by the appropriate Contractor.
- .2 Where concrete walls or floors are core drilled to accommodate pipe, sleeves are not required except where indicated in Paragraph 1.20.1.5 below.
- .3 Unless otherwise specified, construct sleeve of galvanized sheet steel with lock seam joints of minimum 22 gauge.
- .4 Use cast iron or galvanized steel pipe sleeves with perimeter fin continuously welded at mid point.
  - .1 Where sleeve extends above finished floor.
- .5 In wet areas where water from spills or leaks may penetrate the floor slab, extend sleeves 6 mm above the finished floor. This does not apply to concrete slabs on grade. In all other areas, sleeves shall be flush with the finished floor.

.2 Sizes:
- .1 Provide approximately 13 mm clearance, all around, between sleeve and pipes or between sleeve and insulation.
- .2 Unless otherwise specified, terminate sleeves flush with walls and ceilings.
- .3 Sleeves shall be sized to accommodate the insulated pipe diameter.

.3 Unless otherwise indicated for pipes passing through roofs, use galvanized or cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make watertight durable joint.

.4 Caulking:
- .1 Caulk sleeves below grade floors with oakum and lead between sleeve and pipe.
- .2 Ensure no contact between copper tube or pipe and ferrous sleeve.

.5 Penetrations of Fire Separations:
- .1 Where pipes or ducts pass through walls or floors which provide fire separations, seal around openings with ULC or cUL classified fire stop system. Material shall be installed to manufacturers' recommendations by factory trained installers and shall provide a fire rating equal to that of the separation which has been penetrated.
- .2 The Consultant reserves the opportunity for destructive testing of a sample of the installation in order to examine the thickness of sealant and installation of the backing material.
- .3 Provide shop drawings for all products supplied. The Contractor shall be responsible for his/her own fire-stopping.
- .4 Acceptable Materials:
  - .1 Dow Corning Fire Stop System.
  - .2 3M Fire Barrier Penetration Sealing System.
  - .3 Hilti Fire Stop System.
  - .4 Royal Quickstop.

1.21 DI-ELECTRIC UNIONS

.1 All connections between steel and copper or brass for pipe 50 mm and smaller shall be made of di-electric unions, except for closed loop systems (where this is not a requirement). On pipe 63 mm and larger, use flanged connections with non-metallic gasket and plastic sleeves for bolts.

1.22 COMPLETION

.1 Nothing herein contained can be constructed to relieve the Contractor from making good and perfect work in all usual details of construction and in accordance with best standard practice and in strict compliance with provisions of any and all laws and ordinances, and the rules and regulations of any duly constituted public body having jurisdiction over this work.

.2 This Contractor shall be held responsible to provide and furnish all necessary labour and to bear all expenses incidental to the satisfactory completion of the work.

1.23 MANUFACTURER'S REVIEW

.1 It shall be the responsibility of the Contractor to have the equipment supplier or his representative review all proposed connections, clearances, sizes, valves, breakers, etc. including wire and pipe sizes to his equipment before installation commences. At that time, he shall inform the Consultant of any changes required to make the equipment function satisfactorily.

.2 Provide the Contractor with a letter accepting all connections as proposed and where required, recommend necessary changes.

.3 If any changes or additional material and labour are required to make the equipment function properly to capacity and the manufacturer has not pointed out this work prior to commencement of work, the additional and/or corrective work shall then be done at the expense of the equipment supplier.

1.24 WARRANTIES

.1 Make good all defects other than normal wear and tear during the life of the warranty period specified in the General Conditions of the contract. Warrant all work and installed equipment to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the warranty. At any time during this period, make any necessary changes and adjustments, or replacements, to accomplish this at no additional cost to the Owner.

.2 Submit the one year Warranty letters in the O&M Manuals.

1.25 CONTROLS

.1 The Contractor may elect to obtain the services of a Controls Contractor to perform the Controls wiring and/or EMT conduit scope of work identified.

.2 The Contractor shall verify the wiring requirements with the equipment manufacturer's prior to installation. All controls wiring shall be run in EMT conduit between the indoor refrigeration evaporators and the outdoor refrigeration condenser units. This scope of work is the responsibility of this Contractor. All wiring shall conform to the Electrical Specifications and all wiring shall be clearly labelled/identified.

1.26 EQUIPMENT/SYSTEM START-UP, COMMISSIONING AND TRAINING

.1 The Contractor shall make arrangements with the equipment manufacturer's representative to provide on-site start-up, commissioning and training for the refrigeration equipment and systems installed. The Contractor is responsible for all costs related there-to.

1.27 DEMOLITION AND REMOVALS

.1 The Contractor shall be responsible for carefully removing materials designated to be removed, capped off and/or turned over to the Client.

.2 Scope of Work:

- .1 Remove end wall panel on existing refrigerator and save onsite for reuse. Store at location directed by departmental representative.
- .2 Remove and dispose of concrete curb used to support panels and ensure steel tracking underneath is not damaged.
- .3 Remove existing compressor located on top of the existing walk-in refrigerator and dispose.

.2 Be responsible for all damage caused by the scope of work. Make good, repair and/or replace to the Client's and the Consultant's satisfaction.

1.28 **APPENDIX A** 15-218

SHOP DRAWINGS

MECHANICAL CONTRACTOR'S REVIEW CONFIRMATION

The Shop Drawings Have Been Reviewed by the Mechanical Contractor and All Items Are In Conformance with the Plans and Specifications? ☐ **Yes** ☐ **No**

Are Specified Model Numbers and/or Options Indicated? ☐ **Yes** ☐ **No**

If No, Explain:

Confirmed by Contractor:

Print Name

Contractor's Signature:

Date:

Item:

Specification Section and Item Number:

Drawing Reference:

General Contractor:

Mechanical Contractor:

Mechanical Contractor's Project Representative:

Phone Number: Fax Number: E-mail:

Part 1 General

1.1 SUMMARY

.1 The General Conditions outlined in Section 21 05 01 - Common Work Results -Mechanical apply to work performed under this section.

.2 Scope of Work:
- .1 Modifications to and extension of the existing wet pipe sprinkler system affected by the scope of work indicated.
- .2 Install new wet pipe sprinkler branch off existing sprinkler main to service the expanded 4 deg.C Walk-in Cooler.

1.2 REFERENCES

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

.2 National Building Code of Canada - 2010.

.3 Authority Having Jurisdiction:
- .1 Conform to the requirements of the Authority having Jurisdiction. The Authority having Jurisdiction for this project is the Dominion Fire Marshall/Federal Fire Commissioner.

.4 Approvals:
- .1 Obtain approval from the Authority having Jurisdiction before beginning installation.
- .2 Contractor to provide shop drawings and piping layout drawings to the Authority having Jurisdiction.
- .3 Pay all costs associated with such approvals and checking.

1.3 DESIGN PARAMETERS

.1 Automatic wet pipe fire suppression sprinkler system designed in accordance with required and advisory provisions of NFPA 13, Installation of Sprinkler Systems, in accordance with the drawings for uniform distribution of water over the design area.

.2 Include with each system all materials, accessories and equipment inside the Building.

.3 Provide each system with equipment to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.

.4 Location of Sprinkler Heads:
- .1 Locate sprinkler heads bearing in mind the location of light fixtures and the refrigeration evaporators, etc.
- .2 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13.

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

1.4 SUBMITTALS

.1 Submit manufacturer's printed product literature, specifications and datasheets.

.2 Field Test Reports:
- .1 Piping system pressure test is required to validate piping integrity and workmanship.

.3 As-Built Drawings:
- .1 After completion, but before final acceptance, submit complete set of As-Built drawings of each system, showing deviation from the contract drawings clearly marked in red.
- .2 Submit Drawings on reproducible bond paper with title block similar to full size contract drawings.

.4 Submit Operation, Maintenance c/w Engineering data for incorporation into the O&M Manuals.

1.5 QUALITY ASSURANCE

.1 Qualifications:
- .1 Installer: company or person specializing in wet sprinkler systems with documented experience.

1.6 MAINTENANCE

.1 Extra Materials:
- .1 Provide maintenance materials as noted below,
- .2 Turn over spare sprinklers of each type and melting point temperature to the Client. Include sprinkler wrenches and keys, for emergency repair work. Quantities of spare sprinklers of each type to be as follows:

Installed Sprinklers	Spare Sprinklers
Up to 100	2

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions. Store materials indoors and protect materials from exposure to harmful weather conditions.

1.8 PROTECTION

.1 Fire safety protection in accordance with NBC requirements during construction to be provided by this Contractor.

Part 2 Products

2.1 PIPE, FITTINGS AND VALVES

.1 Above-ground Pipe:
- .1 Pipe - Welded, Threaded or Cut Grooved: Sch. 40 steel for sizes less than 100 mm diam.

.2 Above-ground Fittings and joints:
- .1 Fittings: 860 kPa cast iron screwed or 860 kPa cast iron flanged.
- .2 Bolts: Square or hex head to ASTM A307-00.
- .3 Flange Gaskets: 1.6 mm thick cloth inserted red rubber.
- .4 Grooved Products:
  - .1 Rubber gasketted grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
  - .2 All grooved products for systems to be ULC listed.
  - .3 All grooved couplings to be complete with angle bolt pads to provide a rigid joint, equal to Victaulic Style 005 Firelock, Anvilstar G-4 or Gruvlok 7400.
  - .4 All grooved products provided for this work and work covered under related sections to be provided by only one manufacturer.
  - .5 Side outlet tees using rubber gasketted fittings are not permitted.
  - .6 Fittings to ASTM A47-99 and A536-84.
  - .7 Acceptable Materials: Anvilstart, Gruvlok, Shurjoint, Victaulic.

.3 Rubber Gasket for Pipe Connection:
- .1 Gaskets shall be moulded SBR rubber per ANSI/AWWA C111/A21.11.

.4 Bolt and Nut for Flange:
- .1 Bolts shall be high-strength, low-alloy steel per AWWA C111.

.5 Valves:
- .1 In accordance with ANSI/NFPA 24.
- .2 Gate valves: ULC listed and opened by counterclockwise rotation.
- .3 Up to 50 mm:

	Gate	Check	Ball
Jenkins	820	4475	30
Crane	459	141	9302
M.A. Stewart	——	——	Fig. 5044V
Victaulic	——	——	Series 727

Anvil	——	——	F171

.4 63 mm and Larger:

	Gate/Butterfly	Check
Jenkins	825-A	477
Crane	10269	6435
M.A. Stewart	Fig. 423	——
Victaulic	Series 708	Series 717
NIC		
NIBCO		
Gruvlok	Series 7700	Series 7800

.5 Valves to be ULC listed for fire protection service.
.6 Valves not controlling water supply shall be globe type with renewable discs.
.7 Check valves: flanged clear opening swing-check type with flanged inspection and access cover plate for sizes 100 mm and larger.

.6 Pipe Hangers:
.1 ULC listed for fire protection services in accordance with NFPA.

2.2 SPRINKLER HEADS

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

.2 Hemispherical spray pattern. 15 mm thread size. Max. Working pressure: 1.2 MPa. Minimum operating pressure: 48 kPa.

.3 Sprinkler head types:
.1 Dry pendent type for walk-in coolers and walk-in freezers. K 11.5 (imperial K8); quick response. Corrosion resistant SS or Teflon coated.

.4 Provide 13 mm nominal orifice size sprinkler heads.
.1 Release element of each head to be of ordinary rated temperature rating or higher as suitable for specific application and as required by ANSI/NFPA 13.
.2 Provide ULC corrosion-resistant sprinkler heads/sprinkler head guards.
.3 Sprinklers in light hazard occupancies shall be the quick response type.
.4 Bronze deflector construction (pendent and upright heads).
.5 Glass bulb type (pendent and upright heads).

.5 Acceptable Materials: Victaulic; Globe Fire Sprinkler Corporation; Reliable; Viking; Tyco.

2.3 PIPE SLEEVES

.1 Provide pipe sleeves where piping passes through walls and floors.

.2 Secure sleeves in position and location during construction.

.3 Provide sleeves of sufficient length to pass through entire thickness of walls and floors.

.4 Provide 25 mm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
- .1 Firmly pack space with mineral wool insulation.
- .2 Seal space at both ends of sleeve or core-drilled hole with mechanically adjustable segmented elastomeric seal.
- .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.

.5 Sleeves in Masonry and Concrete Walls, Floors and Roofs:
- .1 Provide cast-iron sleeves.
- .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.

.6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
- .1 Provide 24 ga thick galvanized steel sheet.

Part 3 Execution

3.1 INSTALLATION

.1 All installation work to be in accordance with the rules and regulations of the Authority having Jurisdiction, and the Client's Insurer.

.2 All piping to be kept as high and neat as possible.

.3 Pipe to run parallel to building lines unless noted otherwise.

.4 All piping shall be securely hung from the building structure using approved hangers.

.5 Install gate and check valves as required to complete the system and as required by the drawings.

.6 Co-ordinate locations of all holes required for pipes with the work of other trades and provide pipe sleeves where pipes pass through walls and floors. Pack voids between pipes and sleeves with fibreglass and between pipes and existing walls and floors. Piping may be grouted solid at walls, without the use of sleeves. Installation of sleeves by appropriate trade contractor. Provide fire-stopping where pipes penetrate fire walls or floors.

.7 Install system in accordance with the reviewed shop drawings and manufacturers' recommendations.

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

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

.10 Inspect piping before placing into position.

.11 Protect exposed steel pipe and fittings.

.12 Provide ULC listed SS wire guards for sprinkler heads in the Walk-in Cooler.

3.2 FIELD QUALITY CONTROL

.1 Site Test, Inspection:
- .1 Test systems in accordance with the appropriate NFPA code and requirements of the Authority Having Jurisdiction.
- .2 Test, inspect, and approve piping before covering or concealing.
- .3 Preliminary Tests:
  - .1 Hydrostatically test each system at 1.4 MPa for a 2 hour period with no leakage or reduction in pressure.
  - .2 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Scope of Work:
- .1 Modifications to existing evaporator condensate piping to suit new evaporator layout.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):
- .1 ASTM B 32, Specification for Solder Metal.
- .2 ASTM B 306, Specification for Copper Drainage Tube (DWV).
- .3 ASTM C 564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.2 Canadian Standards Association (CSA).

.3 CSA B67, Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.

.4 CAN/CSA-B125, Plumbing Fittings.

1.3 RELATED SECTIONS

.1 Section 21 05 01 – Common Work Results - Mechanical.

.2 Section 23 05 05 - Installation of Pipework.

.3 Section 23 07 15 – Thermal Insulation for Piping.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary and vent (50 mm and smaller) Type DWV to: ASTM B 306.
- .1 Fittings.
  - .1 Cast brass: to CAN/CSA-B125.
  - .2 Wrought copper: to CAN/CSA-B125.
- .2 Solder: lead free, tin- Antimony 95:5 to ASTM B32, Type 50A.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with the 2010 National Plumbing Code of Canada and the local Authorities Having Jurisdiction (AHJ).

.2 Run sloped (min. 1:100) insulated DWV copper piping as indicated to floor drains or other designated places. Co-ordinate scope of work with other trades. Pipe insulation as per Section 23 07 15.

.3 Install piping parallel and close to walls to conserve headroom and ceiling space; grade as indicated.

3.2 TESTING

.1 Hydraulically test to verify quality of workmanship, grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

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

.2 Affix applicable label condensate, etc. complete with directional arrows every floor or 5 meters, whichever is less.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 21 05 01 - Common Work Results - Mechanical.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB).

.2 National Plumbing Code of Canada - 2010.

.3 National Building Code of Canada - 2010.

.4 National Fire Code - 2010.

1.3 SCOPE OF WORK

.1 This section applies to installation of piping for each of the following systems:
- .1 Refrigerant Piping.
- .2 Condensate Drainage Piping.

Part 2 Products

.1 Not Used.

Part 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

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

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

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

3.2 CLEARANCES

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

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

3.3 DRAINS

.1 Install drain valve at low points in piping systems, at equipment and so that each section of piping can be drained.

.2 Drain valves: 19 mm gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.4 DI-ELECTRIC COUPLINGS

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

.2 Locations: Where dissimilar metals are joined.

.3 50 mm and under: Isolating unions or bronze valves.

.4 Over 50 mm: Isolating flanges.

3.5 PIPEWORK INSTALLATION

.1 Screwed fittings to be jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install so that equipment can be isolated and removed without interruption to operation of any other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of the main. Hole saw (or drill) and ream main so as to maintain full inside diameter of branch line prior to welding saddle.

.6 Install piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines unless stated otherwise.

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

.8 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.

.9 Except where indicated, install so as to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible (and as indicated).

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

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

.13 Provide for thermal expansion as indicated and specified.

.14 Install copper pipe/tube so that it is not in contact with dissimilar metal and will not be kinked or collapsed.

.15 Clean all excess flux and solder from joints.

3.6 VALVES

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above the horizontal position unless otherwise indicated.

.4 Valves to be accessible for maintenance without removing adjacent piping.

.5 Use 1/4 turn ball valves at branch take-offs for isolating purposes except where otherwise specified. Provide isolation valves at all branch take-offs from mains, and at each take-off from risers on each floor.

3.7 PREPARATION FOR FIRE-STOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 21 05 01 - Common Work Results - Mechanical.

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

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

3.8 FLUSHING OUT OF PIPING SYSTEMS

.1 Purge, flush out and clean all piping systems installed.

3.9 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise the Consultant 48 hours minimum prior to performance of pressure tests.

.2 Maintain specified test pressure without loss for four (4) hours minimum unless specified for longer period of time in relevant sections of Division 21 and 23.

.3 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.4 Conduct tests in presence of the Consultant.

.5 Bear costs for repairs or replacement, retesting, and making good. Consultant to determine whether repair or replacement is appropriate.

.6 Insulate or conceal work only after approval and certification of tests by the Consultant.

3.10 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by the Departmental Representative.

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

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

.4 Ensure daily clean-up of existing areas.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 21 13 13 - Wet Pipe Sprinkler System.

.2 Section 22 13 17 - Drainage, Waste and Vent Piping - Cast Iron and Copper.

.3 Section 23 05 05 - Installation of Pipework.

.4 Section 23 23 00 - Copper Tubing and Fittings - Refrigerant.

1.2 REFERENCES

.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME):
- .1 ANSI/ASME B31.1-07, Power Piping.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM A 307-07b, Specification for Carbon Steel Bolts and Studs, 8.7 MPa Tensile Strength.
- .2 ASTM A 563-07a, Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):
- .1 MSS SP-58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .2 MSS SP-69-2003, Pipe Hangers and Supports - Erection and Application.
- .3 MSS SP-89-2003, Pipe Hangers and Supports - Fabrication and Installation.

.4 Underwriter’s Laboratories of Canada (ULC).

1.3 DESIGN REQUIREMENTS

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

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

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

.4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 21 05 01 - Common Work Results - Mechanical.

.2 Submit shop drawings and product data for following items:
- .4 All bases, hangers and supports.
- .5 Connections to equipment and structure.

1.5 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into Manuals specified in Section 21 05 01 - Common Work Results - Mechanical.

Part 2 Products

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58.

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

2.2 PIPE HANGERS

.1 Finishes:
- .1 Pipe hangers and supports used outside the building: galvanized after manufacture with hot dipped galvanizing process; or stainless steel.
- .2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .3 Apply to hangers, supports and equipment fabricated from ferrous metals at least one (1) coat of corrosion resistant paint before shipment to job site. Touch-up damaged finish surfaces to satisfaction of the Consultant.

.2 Upper attachment structural: Suspension from lower flange of I-Beam.
- .1 Cold piping 50 mm maximum: Malleable iron C-clamp with hardened steel cup point setscrew, locknut.
  - .1 Rod: 13 mm FM approved.
  - .2 Acceptable Materials: Myatt Fig. 586; Grinnell Fig. 131, Hunt, Cooper B-Line.
- .2 Cold piping 63 mm or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, ULC listed to MSS-SP-58 and MSS-SP-69.
  - .1 Acceptable Materials: Myatt Fig. 514; Grinnell Fig. 131, Hunt, Cooper B-Line.

.3 Upper attachment structural: Suspension from upper flange of I-Beam.
- .1 Cold piping 50 mm maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS-SP-69.
  - .1 Acceptable Materials: Myatt; Grinnell Fig. 62, Anvil, Taylor, Hunt, Cooper B-Line.
- .2 Cold piping 63 mm or greater; all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut ULC listed.
  - .1 Acceptable Materials: Myatt Fig. 506; Grinnell Fig. 267, Anvil, Taylor, Hunt, Cooper B-Line.

.4 Upper attachment to concrete.
- .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
- .2 Concrete inserts: wedge shaped body with knockout protector plate ULC listed to MSS-SP-69.

.5 Hanger rods: threaded rod material to MSS SP-58.
- .1 Ensure that hanger rods are subject to tensile loading only.
- .2 Provide linkages where lateral or axial movement of pipework is anticipated.
- .3 Use 22 mm hanger rod for 150 mm piping, 16 mm hanger rod for 100 mm piping, and 10 mm hanger rod for smaller piping.
- .4 Plumbing piping may be supported as per the pipe hanger sizes noted in the National Plumbing Code of Canada - 2010.

.6 Pipe attachments: material to MSS SP-58.
- .1 Attachments for steel piping: carbon steel black.
  - .1 Acceptable Materials: Myatt Fig. 124; Grinnell Fig. 260, Anvil, Taylor, Hunt.
- .2 Attachments for copper piping: copper plated or epoxy coated black steel.
  - .1 Acceptable Materials: Myatt Fig. 124; Grinnell Fig. 260, Anvil, Taylor, Hunt.

.7 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A 563.
- .1 Finishes for steel pipework: black.
- .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated, epoxy coated.

.8 Wall brackets: carbon steel prime coated.
- .1 Acceptable Materials: Myatt Fig. 321; Grinnell Fig. 195, Anvil, Taylor, Hunt, Cooper B-Line.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS-SP-58, type 42, ULC listed.
- .1 Acceptable Materials: Anvil Fig. 261, Cooper B-Line.

.2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42 or epoxy coated.

.1 Acceptable Materials: Anvil Fig. CT-121, Cooper B-Line.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

2.4 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel.

2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with Manufacturer's instructions and recommendations.

.2 All pipes shall be hung securely from structure.

.3 Clamps on riser piping:
- .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
- .1 Bolt-tightening torques to be to industry standards.
- .2 Steel pipes: Install below coupling or shear lugs welded to pipe.
- .3 Cast iron pipes: Install below joint.

.4 Clevis plates:
- .1 Attach to concrete with four minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 HANGER SPACING

.1 Hangers shall be spaced as far apart as economically possible. Maximum spacing shall be as follows:

Material/Service	Pipe Size (mm)	Horizontal Maximum Spacing (mm)
Sanitary Pipes	All Sizes	1500
Hard Temper Copper Pipes	Less than 32	2100
	32 and Larger	3000
Soft Temper Copper Pipes	All Sizes	2400
Copper Water Pipe	Up to 13	1500
Steel Water Pipe	25	2100
	32 and over	3000

.2 Vertical sanitary pipes shall be supported at each floor by means of iron hooks or straps placed directly below hub or fittings. Maximum distance between vertical pipe hangers to be 7500 mm. Vertical drops to fixture shall be supported at top of riser to prevent strain on fixture connection.

.3 Sprinkler/Fire Protection: to NFPA 13.

3.3 HANGER INSTALLATION

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

.2 Adjust hangers to equalize load.

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

3.4 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 100 mm from vertical.

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

3.5 FINAL ADJUSTMENT

.1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.

.2 Adjustable clevis:
  .1 Tighten hanger load nut securely to ensure proper hanger performance.
  .2 Tighten upper nut after adjustment.

.3 C-clamps:
  .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:
  .1 Hammer jaw firmly against underside of beam.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Scope of Work:
  .1 Provide neoprene vibration isolation pad between relocated evaporator (EV.1) mounting bracket and the walk-in cooler ceiling panel as indicated on the Drawings.

Part 2 Products

2.1 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thickness; 50 durometer; maximum loading 345 kPa.

.2 Acceptable Materials: Vibron, Vibro-Acoustics, Mason, Korfund, Vibra-Sil Inc., Vimco.

Part 3 Execution

3.1 INSTALLATION

.1 Install vibration isolation equipment in accordance with the manufacturer's instructions and adjust mountings to level equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 21 05 01 - Common Work Results - Mechanical.

.2 Section 21 13 13 - Wet Pipe Sprinkler System.

.3 Section 22 13 17 - Drainage, Waste and Vent Piping - Cast Iron and Copper.

.4 Section 23 05 05 - Installation of Pipework.

.5 Section 23 23 00 - Copper Tubing and Fittings - Refrigerant.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
  - .1 CAN/CGSB-24.3, Identification of Piping Systems.

.2 National Fire Protection Association:
- .1 NFPA 13 - Installation of Sprinkler Systems.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Section 21 05 01 - Common Work Results-Mechanical.

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

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal nameplate with raised or recessed letters mechanically fastened to each piece of equipment by manufacturer.

.2 Information to include, as appropriate:
- .1 Equipment: Manufacturer's name, model, size, serial number, capacity, registration plates where specified or required (eg pressure vessel, ULC, CSA).
- .2 Motor: voltage, Hz, phase, power, power factor, duty, frame size, rpm.

2.2 SYSTEM NAMEPLATES

.1 Colours:
- .1 Hazardous: red letters, white background.
- .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:
- .1 1/8" thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:
- .1 Conform to following table:

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

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

.4 Locations:
- .1 Terminal cabinets, control panels: Use size # 5.
- .2 Equipment in Mechanical Rooms: Use size # 9.

2.3 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:
- .1 Sprinkler Piping: to NFPA 13.

2.4 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, stencils, and/or pictogram (as necessary) showing name and service including temperature and pressure and directional flow arrows where relevant. To CAN/CGSB 24.3 except where specified otherwise.

.2 On P.V.C. jacket use the following material:
- .1 Legend Markers, Arrows and Colour Bands: Pressure sensitive plastic coated cloth vinyl with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 149°C and intermittent temperature of 204°C. Apply to dry, clean prepared surfaces. Wrap 1" colour band around pipe or pipe covering with ends overlapping one pipe diameter.

.2 Waterproof and Heat Resistant Pressure Sensitive Plastic Marker Tags: for pipes and tubing 19 mm nominal and smaller.

.3 Acceptable Materials: SMS Coilmark, W.H. Brady Inc., Seton Name Plate Corp., and Top Tape and Label Ltd..

.3 Stencilled Identification:

.1 As an alternate to manufactured pipe markers identification may be stencilled on pipe except P.V.C. piping using a first quality oil base paint and colour bands. Letters shall be a minimum of 19 mm high. Text to be black.

.4 Identification of pipe to include Pictograms where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

.5 Use block capital letters 50 mm high for pipes of 75 mm nominal and larger o.d. including insulation and not less than 19 mm high for smaller diameters.

.6 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

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

.7 Background colour marking to be full circumference of pipe or insulation, length to accommodate pictogram, full length of legend and arrows.

.8 Colours and Legends:

.1 Where not listed, obtain direction from Engineer.

.2 Colours for legends, arrows: To following table:

Background Colour	Legend, Arrows
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background Colour Marking	Legend
Refrigeration Liquid	Yellow	REFRIG. (R#) LIQUID
Refrigeration Suction	Yellow	REFRIG. (®#) SUCTION
Fire Protection Water	Red	FIRE
Sanitary	Green	SAN

.9 Exposed pipe in areas to be painted out with the ceiling.

2.5 VALVES AND CONTROLLERS

.1 Brass tags with 13 mm stamped identification data filled with black paint.

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

.3 Valve identifiers for Fire Protection System to correspond with that used by Fire Alarm System.

2.6 CONTROLS COMPONENTS IDENTIFICATION

.1 Provide plastic lamicoid label (black background, white lettering) affixed to the device or secured to the wall.

2.7 EQUIPMENT

.1 Identify Mechanical equipment (Evaporators, Condensers, etc.) with black lamicoid plates with white letters attached to equipment. Letters to be a minimum of 19 mm high.

.2 Identification to be visible by an individual standing on the floor.

2.8 ABOVE CEILING EQUIPMENT IDENTIFICATION

.1 Pull and junction boxes for control wiring to be coloured inside and out (red and white).

.2 Where valves, and balancing dampers and are installed above accessible ceilings, adhesive discs coloured in accordance with the table below shall be installed on the ceiling spline directly below the valves and boxes. Discs shall be 19 mm diameter, white or black disc to be 6 mm diameter. In no case shall a valve or box be installed in a ceiling space that is not considered accessible unless a proper access hatch is provided by the Contractor. Discs shall be similarly applied to access hatches.

.3 Provide framed legend of colour coding used and mount in the main mechanical room or other location as directed by the Client. Include a copy of legend in the Operation and Maintenance Manuals.

.4 Boxes, valves and dampers shall be colour coded as follows:

Service	Colour of Disc
Plumbing System Valves	Green
Fire Protection Valves	Red/White
Control Panels/Junction Boxes	Red/White

2.9 LANGUAGE

.1 Identification to be in English.

Part 3 Execution

3.1 TIMING

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

3.2 INSTALLATION

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

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

.3 Identify all equipment and piping

3.3 NAMEPLATES

.1 Locate nameplates in conspicuous location to facilitate easy reading and identification from operating floor.

.2 Provide standoffs for nameplates on hot and/or insulated surfaces.

.3 Do not paint, insulate or cover in any way.

3.4 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 7.5 meter intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

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

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

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, other confined spaces, at entry and exit points, and at each access opening.

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

.8 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.

.9 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

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

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

.3 Number valves in each system consecutively.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Scope of Work:
- .1 Provide new thermal insulation for all refrigerant and condensate drainage piping.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
- .1 ASHRAE Standard 90.1.

.2 American Society for Testing and Materials (ASTM):
- .1 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
- .2 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .3 ASTM C 449M, Standard Specification for Mineral Fibre-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .4 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-51.9, Mineral Fibre Thermal Insulation for Piping and Round Ducting.
- .2 CAN/CGSB-51.12, Cement, Thermal Insulating and Finishing.
- .3 CAN/CGSB-51.40, Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
- .4 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 CGSB 51-GP-53M, Jacketing, Polyvinyl Chloride (PVC) Sheet, for Insulating Pipes, Vessels and Round Ducts.

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

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

.6 National Building Code of Canada - 2010.

.7 National Plumbing Code of Canada - 2010.

.8 National Fire Code of Canada - 2010.

.9 National Energy Code of Canada for Buildings - 2011.

1.3 DEFINITIONS

.1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible, chases and furred-in spaces.
- .2 "EXPOSED" - will mean "not concealed" as defined herein.

.2 TIAC:
- .1 CRF: Code Rectangular Finish.
- .2 CPF: Code Piping Finish.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 21 05 01 – Common Work Results - Mechanical.

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

.3 Submit shop drawings for pipe insulation and covering.

1.5 MANUFACTURER'S INSTRUCTIONS

.1 Submit manufacturer's installation instructions for insertion in the Operation & Maintenance Manuals.

1.6 QUALIFICATIONS

.1 Installer to be specialist in performing work of this section, and have at least three years successful experience in this size and type of project.

.2 Acceptable Contractors: Guildfords Inc., Scotia Insulators Ltd., Twin City Insulation, Pro-Insul Ltd., Zink’s Mechanical Insulation, Parker Kaefer Inc., Insul-Energy Ltd..

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather, construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions required by manufacturer.

Part 2 Products

2.1 FIRE AND SMOKE RATING

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

2.2 FIBREGLASS INSULATION

.1 Application: Condensate drainage piping.

.2 Pipe insulation will be pre-formed glass fibre having a nominal density of 56.06 kg/cu. M (3.5 lb/ft$^{3)}$.

.3 For condensate drainage piping, provide vapour barrier jacket. Jacket shall be factory applied and to CGSB 51-GP-52Ma.

.4 Acceptable Materials: Owens Corning; Knauf Insulation; Manson Insulation Products Ltd.; Johns Manville; Roxul.

2.3 FLEXIBLE ELASTOMERIC CLOSED CELL INSULATION

.1 Application: Refrigeration suction and liquid piping.

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

.3 Flexible elastomeric in tubular foam. This product meets the requirements as defined in ASTM C 534, Grade 1, Type I, “Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form”.

.4 Materials shall have a flame spread index of less than 25 and a smoke developed index of less than 50 when tested in accordance with ASTM E-84, latest version.

.5 Materials shall have a maximum thermal conductivity of 0.039 W/m-K (0.27 Btu-in./h-ft2-°F) at a 24°C (75°F) mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

.6 Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.

.7 Adhesive shall be the insulation manufacturer's recommended contact adhesive (eg: Armaflex 520).

.8 Acceptable Materials: Armacell AP/Armaflex.

2.4 TIAC CODES

.1 TIAC Code A-1: Rigid moulded mineral fibre with factory applied vapour retarder jacket.
- .1 Mineral fibre: to CAN/ULC-S702.
- .2 Jacket: to CGSB 51-GP-52MA.
- .3 Maximum "k" factor: to CAN/ULC-S702.

.2 TIAC Code A-2: rigid moulded mineral fibre without factory applied vapour retarder jacket.
- .1 Mineral fibre: to (CAN/ULC-S702) (ASTM C547).
- .2 Jacket: to CGSB 51-GP-52MA.
- .3 Maximum "k" factor: to CAN/ULC-S702.

.3 TIAC Code A-3: flexible unicellular tubular elastomer.
- .1 Insulation: with vapour retarder jacket.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC-S702.
- .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.5 INSULATION SECUREMENT

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

.2 Contact adhesive: Quick setting.

2.6 VAPOUR RETARDER LAP ADHESIVE

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

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 JACKETS

.1 Polyvinyl Chloride (PVC) - interior piping:
- .1 One-piece moulded type to CGSB 51-GP-53M with pre-formed shapes as required.
- .2 Colours: White.
- .3 Minimum service temperatures: -20°F.
- .4 Maximum service temperature: 65.6°C.
- .5 Moisture vapour transmission: 0.02 perm.
- .6 Thickness: 0.50 mm
- .7 Fastenings:
  - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
  - .2 Tacks.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

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

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards and the Manufacturer's recommendations.

.2 Apply materials in accordance with manufacturer's instructions and this Specification Section.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 50 mm.

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

.5 Supports, Hangers:
.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

.6 Provide 50 mm longitudinal overlap and butt joints.

3.3 PIPING INSULATION SCHEDULES

.1 Includes valves and fittings unless otherwise specified.

.2 TIAC Code: A-1 with vapour retarder jacket.
.1 Insulation securements: 75 mm wide pressure sensitive tape.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code: 1501-C.

.3 TIAC Code: A-2 without vapour retarder jacket.
.1 Insulation securements: 75 mm wide pressure sensitive tape.
.2 Seals: lap seal adhesive, lagging adhesive.
.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-3 flexible elastomeric insulation.
.1 Contact adhesive.
.2 Installation: TIAC Code: 1501-C.

Application	Temperature °C	Type	Pipe Sizes and Insulation Thickness (mm)				
			to 25	32 to 50	63 to 100	150	200 & Over
Refrigeration	4	Elastomeric	19	19	25	38	50
Condensate Drainage	4	Fibreglass	25	25	25	25	25

5 Finishes:

.1 Exposed indoors: PVC jacket where the temperature of the medium is less than 65° C.

.2 Finish attachments: SS bands, at 150 mm oc.

.3 Installation: To appropriate TIAC code CRF/1 through CPF/5.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Scope of Work:
- .1 Modifications to existing refrigeration piping affected by the scope of work indicated.
- .2 Install new insulated liquid and suction refrigerant piping as indicated and as required for a fully operational system.
- .3 Evacuate the existing R-404A refrigerant charge from the existing system and properly dispose according to Federal Halocarbon Regulations, 2003. Complete disposal paperwork for the Departmental Representative.
- .4 Complete leak testing of both new and existing piping using dry nitrogen. After completion of testing refrigeration system for leaks, remove all air and moisture from the system by using a high vacuum pump.
- .5 Recharge entire system with new CFC-free R-404A refrigerant. Record the weight of refrigerant, verify correct test pressures and provide report to the Departmental Representative.

1.2 RELATED SECTIONS

.1 Section 21 05 01 - Common Work Results - Mechanical.
.2 Section 23 05 05 - Installation of Pipework.
.3 Section 23 05 53 - Mechanical Identification.
.4 Section 23 07 15 - Thermal Insulation for Piping.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME):
- .1 ASME B16.22-01, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
- .2 ASME B16.24-02, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
- .3 ASME B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.
- .4 ASME B31.5-01, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM):
- .1 ASTM A307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM B280-03, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)
- .1 CSA B52-99, Mechanical Refrigeration Code.

1.4 SUBMITTALS

.1 Provide Shop Drawing and Maintenance Manual submittals in accordance with Section 21 05 01 – Common Work Results - Mechanical.

Part 2 Products

2.1 REFRIGERANT PIPING AND TUBING

.1 Type ACR, copper, dehydrated, cleaned and capped.
.2 Provide braided flexible piping connections at equipment- both ends of piping.
.3 Insulate all piping as per Section 23 07 15 - Thermal Insulation for Piping.
.4 Provide all pipeline accessories and valves not provided by the equipment manufacturers.

2.2 FITTINGS

.1 Service: design pressure 2070 kPa and temperature 121 degrees C.

.2 Brazed:
  .1 Fittings: wrought copper to ASME B16.22.
  .2 Joints: silver solder, 15% Ag-80% Cu-5%P or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 Flanged:
  .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
  .2 Gaskets: suitable for service.
  .3 Bolts, nuts and washers: to ASTM A307, heavy series.

.4 Flared:
  .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

.1 Refer to Section 21 05 01 – Common Work Results – Mechanical.

2.4 VALVES

.1 25 mm and under: Class 500, 3.5 MPa, globe or angle non-directional type, diaphragm, pack-less type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 25 mm: Class 375, 2.5 MPa, globe or angle type, diaphragm, pack-less type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

.1 All refrigeration work must be completed by a red-seal certified refrigeration and air conditioning mechanic.

.2 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework.

3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

.1 General:
- .1 Soft annealed copper tubing: bend without crimping or constriction - Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Pipe clamps to be on the outside of insulation so that insulation remains unbroken.
- .3 Insulate piping after piping has been successfully pressure tested.
- .4 Provide piping identification as per Section 23 05 53- Mechanical Identification.

.2 Hot gas lines:
- .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
- .2 Provide trap at base of suction line risers greater than 1000 mm high and at each 3600 mm thereafter.
- .3 Provide trap at base of discharge line risers greater than 2000 mm high and at each 4600 mm thereafter.
- .4 Provide inverted deep trap at top of risers.
- .5 Provide double risers for compressors having capacity modulation.
  - .1 Large riser: install traps as specified.
  - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2 MPa and 1 MPa on high and low sides respectively.

.3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

.4 Do not insulate piping prior to pressure test.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:
- .1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
- .1 Twice to 14 Pa absolute and hold for 4 hours.
- .2 Break vacuum with refrigerant to 14 kPa.
- .3 Final to 5 Pa absolute and hold for at least 12 hours.
- .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
- .5 Submit test results/report to the Departmental Representative.

.7 Charging:
- .1 Recharge entire system with CFC-free refrigerant. Record the weight of refrigerant and provide to the Departmental Representative.
- .2 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
- .3 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
- .4 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:
- .1 Record and report measurements to the Departmental Representative.

.9 Manufacturer's Field Services:
- .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product(s) and submit written reports, in acceptable format, to verify compliance of Work with Contract.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, at stages listed:
  - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
  - .2 Twice during progress of Work at 25% and 60% complete.
  - .3 Upon completion of the Work, after cleaning is carried out.
- .4 Obtain reports, within three (3) days of review, and submit, immediately to the Departmental Representative.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Air-Conditioning and Refrigeration Institute (ARI).

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
- .1 ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.

.3 Environment Canada:
- .1 EPS 1/RA/2, Code of Practice for the Reduction of Chlorofluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
- .2 Environment Canada, Ozone-Depleting Substances Alternatives and Suppliers List.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 21 05 01- Common Work Results – Mechanical.

.2 Indicate:
- .1 Capacities.
- .2 ARI Ratings.
- .3 Sound Power levels.
- .4 Installation instructions.
- .5 Start-up Instructions.
- .6 O&M Instructions.
- .7 Dimensions and weights.
- .8 Clearances.

1.3 WARRANTY

.1 Contractor hereby warrants the compressors for the two (2) rooftop condenser units and the refrigeration system for a minimum period of five (5) years.

Part 2 Products

2.1 GENERAL - ROOFTOP UNITS

.1 The operating range will be between 35°C and -18°C.

.2 Cooling performance will be rated in accordance with ARI testing procedures. Unit will be factory assembled, internally wired, fully charged with an environmentally approved R-404a refrigerant and 100% factory tested to check cooling operation, fan and blower rotation and control sequence before leaving the factory. Wiring internal to the unit will be numbered for simplified identification.

2.2 UNIT CASING

.1 Unit casing will be constructed of zinc coated, galvanized steel. All components will be mounted in a weather resistant steel cabinet. Where top cover seams exist, they will be double hemmed and gasket sealed to prevent water leakage. Cabinet construction will allow for all maintenance on one side of the unit. Service panels shall be removable while providing a water tight seal.

2.3 COMPRESSOR(S)

.1 Minimum of one scroll compressor per unit. Scroll type compression provides inherently low vibration. Completely enclosed compression chambers which leads to increased efficiency. Direct-drive, suction gas-cooled hermetic motor c/w centrifugal oil pump, oil level sight glass and oil charging valve. Control of compressor shall allow lead/lag of multiple compressors/circuits for even run time to increase life of compressors. Compressors c/w anti-short cycle run timers.

2.4 REFRIGERANT CIRCUIT

.1 Each refrigerant circuit will have independent thermostatic expansion devices, service pressure ports, and liquid line filter drier as standard. An area will be provided for suction line drier installation.

.2 Refrigerant type shall be R404a - environmentally acceptable.

2.5 CONDENSER COILS

.1 Condenser coils will have copper tubes mechanically bonded to high performance aluminum plate fins. All coils will be leak tested to 1379.0 Pa and pressure tested to 3102.8 kPa.

2.6 OUTDOOR FANS

.1 The outdoor fan will be direct-drive, statically and dynamically balanced, in a horizontal discharge position. The fan motors will be permanently lubricated, high efficiency and have built-in thermal overload protection.

2.7 UNIT CONTROLS

.1 Unit shall be completely factory wired and necessary controls and terminal block for power wiring. Units shall provide an external location for mounting fused disconnect device. Microprocessor controls will be provided for all 24 volt control algorithms and will make all cooling decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm maintains accurate temperature control, minimizes drift from set point. A centralized microprocessor shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection.

2.8 ELECTRICAL CONNECTION

.1 An electrical service entrance shall be provided on the side of the condenser section for routing high and low voltage wiring to the control panel.

2.9 ELECTRICAL NON-FUSED UNIT DISCONNECT SWITCH

.1 A heavy duty non-fused weather proof disconnect switch shall be provided that satisfies NEC requirements for a service disconnect.

.2 Electrical power supply: 208/3/60.

2.10 INDOOR EVAPORATORS

.1 Relocate existing evaporator, EV.1, to new location as indicated on the Drawings.

Part 3 Execution

3.1 INSTALLATION

.1 Install where indicated and in accordance with manufacturer ' s instructions.

.2 Level unit with fans running. Flexible piping and electrical connections. Misalignment with fan stopped not to strain or damage flexible connection.

.3 Make all piping connections; provide flexible piping connections for refrigerant lines.

.4 Nothing to obstruct ready access to all components or to prevent removal of components for servicing.

3.2 START-UP

.1 Manufacturer’s representative to certify installation.

.2 Manufacturer’s representative to test and start-up units, commission the units and certify performance.

.3 Manufacturer’s representative to provide verbal and written instructions/training to operating personnel.

.4 Manufacturer’s representative to work with Controls Contractor to set up protocols and communications for the rooftop units and the existing four (4) evaporators (EV.1, EV.2, EV.3, and EV.4) located within the walk-in cooler.

.5 Submit written report to Consultant.

END OF SECTION

1.1 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.

.2 Nova Scotia Building Code Regulations – Building Code Act – 2010.

.3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.4 National Electrical Manufacturers Association (NEMA).

.5 These standards together with all Local or Municipal Rules, Regulations, and Ordinances shall be considered as the Latest Approved Editions at the time of Tender Closing. In no instance, shall the standard established by the drawings and specifications, be reduced by any codes.

1.2 PERMITS AND FEES

.1 The Contractor shall obtain all inspections and permits required by all laws, ordinances, rules, and regulations by public authority having jurisdiction in this district, and shall obtain certificates of such inspections and submit same and shall pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due. In no instance shall the standard established by the drawings and specification be reduced by any codes.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 SUBMITTALS

.1 Shop drawings:

.1 All shop drawings, other than standard manufacturers' dimensions and data sheets shall bear the stamp of a registered professional Engineer who shall be fully responsible for the Engineering content of such drawings. Where such drawings are prepared in Nova Scotia and/or apply to products to be manufactured in Nova Scotia, the Engineer shall be a member of APENS.

.2 Prior to submission, the Contractor shall carefully check all shop drawings to ensure that they comply with the drawings and specifications in both intent and detail. No consideration will be given to shop drawings submitted without this review and review from the Contractor. Submissions not accompanied by Appendix A at the end of Part 1 will be returned for re-submission.

.3 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.4 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.5 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.6 The Engineer's review of these drawings is general and is not intended to serve as a check and shall not release the Contractor from responsibility for errors or from the necessity of checking the drawings himself, or of furnishing the materials and performing the work as required by the plans and specifications.

.2 Quality Control:

.1 Provide CSA certified equipment and material.

.2 Submit test results of installed electrical systems and instrumentation.

.3 Permits and fees: in accordance with General Conditions of contract. The Contractor shall obtain all inspections and permits required by all laws, ordinances, rules, and regulations by public authority having jurisdiction in this district, and shall obtain certificates of such inspections and submit same and shall pay all charges in connection therewith. The final certificate of inspection shall be obtained before final payment for work shall be considered due. In no instance shall the standard established by the drawings and specification be reduced by any codes, etc..

.4 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

.5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Engineer.

.3 Manufacturer's Field Reports: submit to Engineer manufacturer's written report, within 5 days of review, verifying compliance of Work and electrical system testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

.1 Quality Assurance:

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Engineer with schedule within 2 weeks after award of Contract.

1.8 SYSTEM STARTUP

.1 At the conclusion of the job, the Contractor shall review and demonstrate to the Owner, all electrical equipment and their respective functions and operation. Such demonstration shall be provided for such reasonable periods of time as the complexity of the job warrants, and as approved by the Engineer. Such review and demonstration shall be made by an authorized representative of the Contractor, who shall be fully knowledgeable of the project, its installation and operation.

.2 Instruct Engineer and operating personnel in operation, care and maintenance of systems, system equipment and components.

.3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

- .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- .3 Safety precautions.
- .4 Procedures to be followed in event of equipment failure.
- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.

.4 Post instructions where directed.

.5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

.7 Three bound maintenance and operational manuals shall be reviewed and left with the Owner. These manuals shall be custom written for materials and systems supplied for this project. Generic information may accompany the manuals but must only be supplemental information. These manuals shall include, but not be limited to, approved copies of all shop drawings, guarantees, manufacturers maintenance instructions, diagrams, and parts lists, all packaging and installation instructions, and all operating instructions. Where manufacturers' literature is not available, or appropriate, the Contractor shall provide same in written form. This shall apply particularly to the general light power and control system. Prior to final inspection, submit these manuals to the Departmental Representative for review.

1.10 CONTRACT DRAWINGS

.1 No omissions in the drawings or specifications are intended and the Contractor shall give due consideration to this matter. Any work or material referred to in the drawings and not in the specifications, or vice versa, shall be furnished and performed as though fully covered in both. This shall apply particularly to the drawings where descriptions are sufficiently detailed so as to require little or no mention in the specifications. Items indicated on floor plans and not on riser diagrams, or vice versa, shall be considered fully covered by both.

.2 Runs of conduit and outlet locations indicated on the drawings are diagrammatic and exact locations must be determined by the Contractor as the work proceeds, with due regard to the structure and the work of other trades. The Departmental Representative reserves the right to alter locations of conduit and outlets up to 3000 mm without extra cost, provided that the Contractor is advised prior to roughing in. The Contractor shall make any changes dictated by structural requirements, or conflicts with other trades, without charge to the Owner.

.3 Any error or omission shall be referred to the Engineer whose decision shall be final.

.4 Building dimensions shall not be scaled from the electrical drawings but shall be obtained from the Architectural and/or Structural drawings. Any discrepancy between the drawings and the building shall be questioned before proceeding with the installation.

1.11 EXAMINATION OF THE SITE

.1 Prior to Tender, the Contractor shall visit the site and familiarize himself with all matters which may affect his work. No consideration will be given to items arising from the Contractors failure to do so.

1.12 PROPOSED CHANGES, SUBSTITUTIONS, ETC.

.1 Wherever it is proposed to make a change or changes in the design arrangement or type of equipment as called for in this specification, and upon written request by the Departmental Representative, the Contractor shall estimate the cost of same and submit in triplicate detailed itemized estimates of the costs of all apparatus, material and labour entering into the change or substitution. Work shall be carried out upon written request by the Departmental Representative.

1.13 UNIFORMITY

.1 For the purposes of uniformity similar materials shall be of one manufacturer (i.e. all panels and switchgear; all motor control equipment; all fixtures in as much as is possible; etc.).

1.14 OTHER TRADES

.1 The Contractor shall co-operate and investigate with other trades to make maximum use of the spaces and avoid conflict with pipes, ducts, equipment radiation, etc.. Shop drawings shall be prepared by the Contractor indicating the route of main conduits and ducts which shall be submitted to the Departmental Representative for review.

.2 The Contractor shall co-operate with other Contractors on the site and carry out the work, in such a way, as not to hinder or hold-up the work of other trades.

.3 The Contractor shall consult with other Contractors, where their respective installations conflict and shall re-route conduits, ducts, outlets, equipments, etc., as required, subject to the approval of the Departmental Representative.

.4 The Contractor shall obtain from the mechanical and other trades complete detailed wiring diagrams of equipment requiring connections and shall be responsible for pointing out any discrepancies or the reason why they cannot be adhered to.

1.15 WORK INCLUDED

.1 The specifications complement the drawings in describing the supply and installation of complete electrical system. These systems shall include but not be limited to the following:

.1 120/208V-3 phase-4 wire Light & Power Systems.

.2 Fire Alarm System.

1.16 CUTTING AND PATCHING

.1 Make every effort to minimize cutting and patching by providing dimensions, locations and other data for bases, sleeves, boxes, etc., to be built in as construction proceeds. Set sleeves and mark openings in concrete forms and masonry before placing concrete and masonry.

1.17 MOTOR AND EQUIPMENT CONNECTIONS

.1 Provide final connections to all motors, equipments, controls, etc. indicated on the drawing. These motors, equipment, controls, etc. shall include those supplied under other sections of this specification, as well as Owner supplied items. Ensure that equipment will operate properly (e.g. proper rotation) and report any instance of defective equipment to the Departmental Representative.

1.18 RENOVATION WORK

.1 Co-ordinate removal or shutdown of existing services with the Owner or the Owners' representative. Indicate intent to remove, disconnect, or shut down services in writing, and receive an affirmative written reply, prior to the start of such work.

.2 Remove all equipment and services indicated on the drawings or made redundant by renovation. If doubt exists, with reference to the removal of same items, obtain clarification from the Departmental Representative before proceeding. All equipment removed shall be brought to the attention of the Owner, or his representative, who shall take possession of such items. If the Owner, or his representative, deems such equipment redundant, the Contractor shall remove and dispose of such items at his own cost.

.3 Maintain services to, and reconnect all equipment and apparatus to remain, should such services be disrupted during the renovation work.

.4 Where circuitry to an existing panelboard has been changed, revise the existing directory accordingly. In the absence of a directory, provide one and detail the new and/or revised circuitry.

.5 Remove existing T-Bar ceiling tiles to perform work in ceiling space with areas of T-Bar ceilings and replace ceiling tiles upon completion. Damaged tiles shall be replaced with new to match existing.

1.19 FIRE PENETRATIONS

.1 Where conduits and cables pass through fire separations and sound rated separations, including floors, walls, membranes, etc., provide a metallic sleeve, or core drill to 27 mm radius larger than the conduit or cable passing through the fire separation. Construct a ceramic fibre insulation dam, or dams as required, and fill the penetration with 3M PUTTY 303 or 3M CAULK CP25. A minimum depth of 50 mm of putty or caulk is required. As an alternate system, pack the space with ceramic fibre insulation to 27 mm of Electrovert AA-400 FLAMESEAL PUTTY, on each side. Either installation shall be in strict accordance with manufacturers recommendations and to suit UL and/or ULC requirements. All such work shall be performed by personnel familiar and experienced with this type of work.

1.20 ACCESS DOORS

.1 Supply access doors for furred ceilings or spaces for servicing equipment and accessories or for inspection of safety, operating or fire devices for installation under section erecting the walls or ceilings.

.2 Access doors shall be flush mounted 609 mm x 609 mm for body entry and 305 mm x 305 mm for hand entry, unless otherwise noted. Doors shall open 180^{o}, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Doors shall be of approved manufacturer with published literature. Access doors shall be minimum 14 gauge thick.

.1 General: Prime coated steel.

.2 Special areas such as tiled or marble surfaces: stainless steel.

1.21 RECORD DRAWINGS

.1 Maintain project "as-built" record drawings and accurately record significant deviations from the Contract documents, caused by site condition or Contract change. Mark changes on white prints in "RED".

.2 Identify each drawing in the lower right hand corner in letters at least 13 mm high as follows: "AS-BUILT DRAWINGS". (This drawing has been revised to show electrical systems as installed) (Signature of Contractor) (Date).

.3 Submit to Engineer for approval. Make all corrections as directed.

.4 Testing, balancing and adjusting to be performed using as-built drawings.

1.22 GUARANTEE

.1 The Contractor shall guarantee all work, under this Division, free from defects, for a period of one (1) year, after final acceptance of the work. The Contractor shall make good all defects, other than normal wear and tear, during the life of the guarantee. Notwithstanding the above, longer guarantees may be required for specific installations or equipments, as indicated in other sections of the specifications.

.2 Guarantees shall be submitted in writing, bound, where more than one is required, and submitted to the Engineer for review. Each guarantee shall include:

.1 Project name and address.

.2 Guarantee time period (commencement date shall be the date as shown on the project final certificate of completion, unless otherwise indicated).

.3 Clear and concise definition of what is guaranteed.

.4 Signatures of company officers of the Contractor and/or manufacturers, as applicable.

1.23 APPENDIX A 15-206

SHOP DRAWING SUBMITTAL FORM

General Contractor:	
Phone Number:	Fax No:

Electrical Contractor:	
Phone Number:	Fax No:

Electrical Contractor Project Representative:	
Phone Number:	Fax No:

Shop Drawing Items:
Number of Shop Drawing Copies:
Supplier of Shop Drawings:
Manufacturer of Shop Drawings:
Specification Section and Items:

Drawing Reference:

Specified Options Indicated □ ***Yes*** □ ***No***

Items are in Conformance with Plans and Specifications Confirmed by Contractor.

(If No, explain):

Contractor's Signature:

Date:

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Material and equipment to be CSA certified.

.2 Factory assembled control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit: in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction and inspection authorities.

.2 Decal signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors.

2.5 EQUIPMENT IDENTIFICATION

.1 All new panels, disconnect switches, power/voice/data outlets, control panels, magnetic starters, TOL's, time clocks, are to be provided with “lamicoid” nameplates as further described herein. Care is to be taken to ensure that all plates are affixed true and level, and plumb in all instances.

.2 Where a lamicoid identified item is installed above an accessible ceiling, two (2) lamicoid plates are to be provided - one at the item location and one directly below on the underside of the ceiling.

.3 Nameplates are to be affixed to all “metal” surfaces with metal type “pop-rivets.”

.4 Nameplates are to be affixed to other types of surfaces with contact type cement.

.5 Nameplates are to be affixed to building “exterior” surfaces with nylon inserts and self tapping screws unless specifically indicated otherwise.

.6 Contact type cement is to be applied (buttered) to "complete" rear side of plate, as opposed to several points or locations on same.

.7 Lamicoid nameplates installed on distribution panelboards shall indicate the following:

.1 Designated name of equipment.

.2 Amperage of overcurrent protection device.

.3 Voltages, number of phases and wires.

.4 Designation of power source.

EXAMPLE

PANEL H - 150 AMPS

120/208V - 3PH - 4W

FED FROM MAIN SWITCHBOARD # CDP-A

.8 Lamicoid nameplates installed on combination starters, magnetic starters, manual starter and all various systems controls, control panels, disconnect switches, , shall contain the following information:

.1 Designated name of equipment.

.2 Designated name of power source.

.3 Branch circuit breaker number(s) where possible.

.4 Voltage(s).

Example:	**Example:**
SUPPLY FAN NO. 5 **PANEL H – CCT. NO. 17** **120V – 1 PH**	**SUPPLY FAN NO. 3** **MCC NO. 1** **600V – 3 PH**

.9 Lamicoid nameplates installed on fusible type disconnect switches are to also indicate "maximum" fuse size, where sized smaller than actual rated switch size.

.10 Lamicoid nameplates are to be installed on all junction and/or pull boxes sized 150 mm x 150 mm and larger indicating name of system, designated panel name and electrical characteristics where applicable.

.11 Lamicoid nameplates are to be installed above all types of receptacles and abutted directly to tops of their respective device plates. Identification is to indicate respective panel source c/w associated circuit breaker number(s) as per the following:

.1 1.6 mm thick x 13 mm high c/w 6 mm black letters on white face, directly above all flush receptacles (identical width as finish device plate for both single and double gang outlets):

Example:	**H - 20**

.12 Receptacles intended for computer, electronic or other sensitive types of electronic equipment, are to be identified as per the following:

.1 1.6 mm thick x 19 mm wide c/w 6 mm black letters on white face above all flush receptacles (identical width as finish device plate for both single and double gang outlets):

Example:	**FOR COMPUTER USE ONLY** **PANEL M - 20**

.13 Lamicoid nameplates installed above 120 volt receptacles protected by GFCI circuit breakers, or GFCI type receptacles (where their use is permitted) are to be identified as per the following:

Example:	**GFCI PROTECTED** **PANEL M - 22**

.14 Receptacles that are an integral part of systems furniture are not to be lamicoid identified since this is not practical. The power outlet feeding the systems furniture, however, is to be lamicoid identified similar to receptacles.

.15 Allow for an "average" of 40 letters for each lamicoid nameplate.

.1 Lamicoid 1.6 mm thick plastic engraving sheet, black core, white face.

.2 1.6 mm thick nameplates above receptacles as previously indicated shall have top left and right corners rounded off. (1.6 mm where not applied to metals)

.3 Lettering on lamicoid nameplates shall not "start," nor "end" nearer than 13 mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates shall be as indicated in following chart:

NAMEPLATE SIZES

Size 1 – 9.5 mm x 50 mm	**1 line – 4.8 mm high letters**
Size 2 – 13 mm x 75 mm	**1 line – 6 mm high letters**
Size 3 – 16 mm x 75 mm	**2 lines – 4.8 mm high letters**
Size 4 – 19 mm x 89 mm	**1 line – 9.5 mm high letters**
Size 5 – 38 mm x 89 mm	**2 lines – 13 mm high letters**

Size 6 – 25 mm x 100 mm	**1 line – 13 mm high letters**
Size 7 – 25 mm x 100 mm	**2 lines – 6 mm high letters**
Size 8 – 50 mm x 150 mm	**2 lines – 13 mm high letter**

.16 Coverplates for junction and/or pull boxes located above or within finish ceilings containing branch circuits, are to have each branch circuit number neatly identified on coverplate. Felt marker-pen may be used for this purpose.

.17 Examples of "grouped" electrical equipment that could have identical types of removable covers, that will require their Lamicoid nameplates installed on wall(s) adjacent to control, rather than directly to their covers (this is to avoid the possibility of cover mix-up occurring): magnetic starters, magnetic contactors, manual T.O.L. switches, and relays.

.18 Lamicoid nameplates shall be provided and installed on, or adjacent to, all various systems' control panels and/or cabinets c/w information as indicated. Nameplates are to reflect individual system's assigned name, and where applicable, shall also indicate both, designated panel name and associated branch circuit breaker number(s).

.1 Security access control panels

.2 Energy management panels

.3 Intrusion alarm panels

EXAMPLE: SECURITY ACCESS CONTROL PANEL BO. 1 – LPA – 36

.19 Control Transformers:

.1 Concealed control transformers located within ceiling spaces are to have Lamicoid nameplates installed adjacent to same indicating their identified system, primary power source including designated panel name, c/w associated branch circuit breaker number(s).

.2 A second plate with identical information is to be installed on underside of room grid system or access opening frame directly below control transformer, so as to identify its concealed location directly above same.

.3 All control transformers installed in either control cabinets or on walls adjacent to same, are to be identified with Lamicoid nameplates containing information as previously indicated.

.20 All various pieces of mechanical equipment are to be identified with "identical" information as indicated on electrical equipment Lamicoid nameplate feeding aforesaid mechanical equipment. Both "Lamicoid" nameplates are to be supplied and installed by the electrical contractor in the absence of any mechanical trade identification.

.21 All junction and/or pull boxes, conduit fittings (and respective covers), complete with their respective cover plates are to be colour coded as per the following: Boxes are to be coloured both inside and outside, where "one" colour only is required. Boxes are to be coloured on inside only where "two" colours are required. Metal coverplates are to have both colours applied diagonally where "two" colours are required. Complete plate is to be painted where one colour only is required. All junction boxes are to be colour identified prior to installation.

.22 All various systems concealed junction and/or pull boxes located “within” ceiling spaces are to have their locations identified on room side of T-Bar grid spline or access cover frames with appropriate colour coded, circular shaped, self adhering discs. Discs are to be both, 19mm and 6mm in diameter as indicated in the following legend, with 6.5mm discs always being centered in middle of 19mm discs:

VARIOUS SYSTEMS	19 mm DISCS	6 mm DISCS
0 to 50 Volts	Violet	
51 to 240 Volts	Yellow	
241 to 600 Volts	Orange	
Fire Alarm	Red	
Telephone (voice only)	Black	
P.A. and Intercom	Blue	
Security (access control)	Brown	
Ground or Bond	Green	
Energy Management	Red	White
Cable Television	Yellow	White
Computer (data only)	Black	White
Voice and Data	Blue	White

.23 Where boxes are not concealed, such as in an open ceiling concept, discs are to be fastened directly to the outside of the boxes after architectural painting is complete. Coverplates for boxes containing branch circuits, are to have each branch circuit number neatly identified on the inside of the coverplate. Felt marker-pen may be used for this purpose.

.24 A legend of colour coding used is to be provided under plexiglass and located in the main electrical room (609 mm x 609 mm minimum size frame).

2.6 WIRING IDENTIFICATION

.1 Labelling of all branch circuit phase and neutral conductors is to be done on both ends of all circuit conductors, plus in "all" junction and/or pull boxes located in between. Use write-on, indelible, identifying markings, self laminating labels sized as necessary. To be installed in a "flagged" manner around individual conductor(s). Maintain phase sequence and colour coding throughout.

.2 Colour coding: to CSA C22.1.

.1 Colour coded "conductor insulation" as per the following:

.1 All sizes of phase conductors up to and including #2 AWG.

.2 All sizes of neutral, bond and/or ground conductors, up to and including #3/0 AWG.

.3 Approved coloured tapes in lieu of insulation colouring may be used to identify conductors that exceed sizes as previously indicated. To take place on "both ends," of all runs, a minimum of 305 mm from where terminations take place, in addition to within all or any boxes located in-between both ends of runs.

.3 Bonding conductors require labelling on both ends of runs where they are "dedicated" solely to the designated branch circuit they accompany. Identify with same number(s) as being used to identify accompanying branch circuit phase(s) and neutral conductor(s).

.4 Use colour coded wires in communication cables, matched throughout system.

2.7 SPRINKLER PROTECTION

.1 All equipment such as panelboards, transformers, switchgear, relay cabinets, control cabinets, etc., installed in areas equipped with sprinkler protection shall be fitted with sprinkler hoods and shall comply with the intent of C.E.C. Section 26-008 and Appendix B-26-008..

2.8 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish to Munsell #7GY3.29/1.5.

.2 Paint indoor switchgear and distribution enclosures light gray to Munsell #8.3G6.1/0.53.

Part 3 Execution

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 and No. 7 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

3.4 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1200 mm.

.2 Wall receptacles:

.1 General: 450 mm.

.2 Above top of continuous baseboard heater: 150 mm.

.3 Above top of counters or counter splash backs: 150 mm.

.4 In mechanical rooms: 1200 mm.

.3 Panelboards: 1800 mm to top or as indicated.

.4 Telephone and interphone outlets: 450 mm.

.5 Wall mounted telephone and interphone outlets: 1200 mm.

.6 Fire alarm stations: 1200 mm.

.7 Fire alarm horn/strobes: 2280 mm.

.8 Door bell pushbuttons: 1200 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to new panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on new panelboards, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

.1 Circuits originating from branch distribution panels.

.2 Lighting and its control.

.3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.4 Systems: fire alarm system, access control and intrusion alarm systems.

.5 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.

.2 Megger 350-600V circuits, feeders and equipment with a 1000V instrument.

.3 Check resistance to ground before energizing.

.3 Submit test results to Engineer and include in operations manual.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

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

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

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

3.8 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CAN/CSA-C22.2No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65-93(R1999), Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC):

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA).

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper or copper alloy sized to fit copper conductors as required.

.2 Twist type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper or copper alloy sized to fit copper conductors 8 AWG or less.

.3 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, as required to: CAN/CSA-C22.2No.18.

.1 Steel connectors are required for all armoured cable unless noted otherwise. Die-cast or malleable type connectors are not permitted.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install twist type connectors and tighten. Use pliers or nut driver for final tightening.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 Common Work Results for Electrical.

1.2 REFERENCES

.1 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 12 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Non Jacketed.

.3 Conductors pertaining to the wiring of thermostats, motorized valves, damper actuators, and electric pneumatic relays shall be stranded copper conductor of 95% conductivity and of full size and AWG gauge. Insulation shall be thermoplastic "TW" rated 600 volts. Colour code shall be orange and brown. Minimum size shall be No. 18 AWG.

.4 Colour coding shall be by insulation colour as follows:

.1 Phase conductors on sizes up to and including No. 2 AWG. Neutral, ground and bond conductors on sizes up to and including No. 3/0 AWG. Approved coloured tape, in lieu of coloured insulation, may be used for phase conductors sized No. 1 AWG and larger, neutral, ground and bond conductors sized No. 4/0 AWG and larger.

2.2 ARMOURED CABLES

.1 Conductors: insulated, copper size as indicated. Insulation shall be cross linked polyethylene rated 600 volts. Outer armour shall be of interlocking aluminum.

.1 Phase conductors: Black or Red
.2 Neutral conductor: White
.3 Bond conductor: Bare

.2 Type: AC90.

.3 Connectors: steel anti short connectors.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 Common Work Results - Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with Section 26 05 20 Wire and Box Connectors (0-1000V).

.2 Cable Colour Coding: to Section 26 05 00 Common Work Results - Electrical.

.3 Conductor length for parallel feeders to be identical.

.4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Wiring from below and horizontal wiring in walls to be avoided unless indicated.

.6 The Contractor shall run all circuits so that the voltage drop, in no case exceeds 3% of the line volts. The neutral wire, wherever it is run shall be continuous with no fuses, switches, or breaks of any kind.

.7 The installation of more than 3 conductors in a run of conduit is permissible provided C.E.C. Section 4-004(1) is adhered to with respect to the derating of the conductors.

.8 The minimum conductor size for all 15 amp branch circuits is to be #12 AWG. For 15 amp 120 volt branch circuits, the following table shall be followed:

Branch Circuit One-Way Length from Panel to Load (Including Vertical Drops)	Phase Wire Size	Dedicated Neutral Wire Size	Shared Neutral Wire Size	Bond Wire Size
Up to (80'-0")(24.38 m)	#12 AWG	#12 AWG	#10 AWG	#12 AWG
(81'-0" to 125'-0") (24.68 m to 38.1 m)	#10 AWG	#10 AWG	#8 AWG	#10 AWG
(126'-0" to 185'-0") (38.4 m to 56.38 m)	#8 AWG	#8 AWG	#6 AWG	#10 AWG

.9 The requirements for accommodating larger common or "shared" branch circuit neutral conductors where the application might warrant such, could restrict the use of some types of AC-90 cables. In certain instances however, the installation of AC-90 cable (where permissible), and the use of "oversized" neutral conductors where required, is more than acceptable.

.10 Oversized #10 AWG branch circuit wiring conductors to be extended to outlet box of device they feed. Oversized #8 or #6 AWG branch circuit wiring conductors to be extended from panelboard to junction box located on wall or in ceiling space directly above outlet or device they feed. #8 or #6 AWG wire to be reduced to #10 AWG for vertical portion of drop only.

.11 All "stranded" conductors are to be "twisted together" prior to any types of terminations taking place, but not necessarily limited to, some of the following areas:

.1 Receptacles.
.2 Light switches.
.3 Neutral terminal strips.
.4 Bonding terminal strips.
.5 Circuit breakers.
.6 Disconnect switches.
.7 Magnetic and manual starters.
.8 Magnetic contactors.
.9 Relays.
.10 Terminating lugs, etc.

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Where pulling wires and cables, the use of an approved lubricant only will be permitted. No wires or cables shall be pulled in conduits until such conduits are free from moisture.

.3 All various types of cables are to be installed parallel or perpendicular to building lines and shall be adequately secured to the building structure at not less than 1500 mm intervals or as otherwise indicated, in such a manner as to ensure they are protected from potential types of mechanical damage occurring. Install independent supports for cabling in ceiling spaces, and do not use those of other trades. Do not secure cables to mechanical systems piping or ducts, suspended ceiling support wires, etc.. The laying of "unsupported" cables of any types whatsoever directly atop ceiling grid system is strictly prohibited.

.4 Install and secure surface cables directly to underside of metal decking and/or ceiling slab where installed in any concealed ceiling spaces.

.5 Cables are always to be installed as high as possible to underside of structure.

.1 Where metal type Q-Deck is used, all cables are to be installed in upper portions of same (above tops and at right angles to steel joists) and secured directly to sides of metal flutes and/or structure.

.2 Where cables are installed in the same direction as steel joists, they are also to be secured as high as possible to underside of metal decking and/or structure.

.3 Note that this shall apply to all cables, with the exception of voive and data cabling, which shall run no higher than 762 mm above the suspended ceiling.

.6 The grouping together of cables to form a "bundle" for securing purposes, is acceptable provided that the following procedures are adhered to:

.1 In addition to securing cables to the structure at 1500 mm intervals, multiple or bundled groups of cables (including low voltage types) shall be tye-wrapped together at midpoint between each structure support, or every 750 mm. Secure to structure at 1500 mm intervals, and secure together (between structure supports) at 1500 mm intervals.

.7 After all wiring devices have been installed, the Contractor shall test all systems to ensure there are no grounds, leaks, or shorts. Such tests shall be performed to the satisfaction of both the inspection authority having jurisdiction and the Engineer.

3.4 INSTALLATION OF ARMOURED CABLES

.1 All AC-90 cable shall be run parallel to building lines, secured in accordance with C.E.C. 12-618 and shall be adequately clamped and "ty-rapped" to the building structure in such a manner that they are protected from mechanical damage. This contractor shall install his own supports for cabling in ceiling spaces and he shall not use those of other trades or secure cabling to pipes, ducts, suspended ceiling support wires, etc.. The laying of cables directly atop ceiling grids is strictly prohibited. The incoming (Panel Side) grounding conductor shall be secured to the grounding screw of each outlet box, before connecting to the other grounding conductors. Twist all grounding conductors to the back of the outlet box, such that the grounding conductors obstruct as little room as possible.

.2 All flexible conduit or AC-90 fixture feeds shall originate from the side of the outlet box and not from the box cover. Where 3 or 4 drops extend from one outlet box, the box shall be a minimum 119 mm square. There shall be no more than 4 drops from any one box. All flex or AC-90 cables used for fixture drops are to be secured within 300 mm of the junction box.

.3 Grouping of AC-90 cables shall be limited to a maximum of eight current carrying conductors, including associated oversized neutral conductors where phase sharing occurs.

.4 The following examples incorporate uses of both common and dedicated (separate) branch circuit neutral conductors:
- .1 Maximum of two runs of #12/4 conductor cables, including common (oversized) branch circuit neutral in each.
- .2 Maximum of two runs of #12/3 conductor cables, including (oversized) branch circuit neutrals (if not 3 phase, 3 wire), plus one run of #12/2 cable.
- .3 Maximum of four runs of #12/2 conductor cables, each including a separate, dedicated branch circuit neutral conductor.

.5 Where dedicated or separate branch circuit neutral conductors are non phase sharing, they need not be sized larger than phase conductors they accompany unless specifically indicated otherwise.

.6 Fixture drop is defined as that portion of AC-90 cable or flexible conduit being used to make final connection between "accessible" type junction or outlet box located in ceiling space (above T-bar ceiling) and its respective light fixture.
- .1 Fixture drops are not to exceed 4500 mm in total length unless noted otherwise.
- .2 There shall be not more than four drops from any one box regardless of size. All AC-90 cables used for fixture drops are to be secured within 300 mm of the junction box. Each fixture is to be complete with its own separate fixture drop originating from junction box located within same room.
- .3 Provide 20 amp O.C. protection for "all" lighting branch circuits, unless specifically indicated otherwise.
- .4 No. 12 AWG and No. 14 AWG Type AC-90 cables may be used where total fixture drop "loads" do not exceed the following:
  - .1 Maximum of 5000 watts at 347 volts using #12 AWG drop.
  - .2 Maximum of 3500 watts at 347 volts using #14 AWG drop.
  - .3 Maximum of 1800 watts at 120 volts using #12 AWG drop.
  - .4 Maximum of 1300 watts at 120 volts using #14 AWG drop.

.7 Separate pig-tail type leads shall be provided in each light fixture junction/outlet box for "final" connections to fixture drops. These pig-tail leads are to be "only" connected to light fixture "returns" and associated "neutral" conductors.

.8 AC-90 drops are permitted from a junction box in the ceiling space to light fixtures, receptacles, etc. in the same room only.

.9 The installation of AC-90 cable branch circuit home runs is not acceptable.

.10 AC90 cabling shall only be installed in locations where it will be concealed.

3.5 STRANDED CONDUCTORS

.1 All stranded conductors prior to terminating under device bolts such as circuit breakers, switches, receptacles, etc., are to be twisted together so as to form a single conductor to ensure a reliable mechanical connection.

3.6 CAPACITIVE LEAKAGE WIRING METHODS

.1 The following wiring methods detailed below are designed to enhance the ability of the Owner to perform capacitive leakage tests in the future. The capacitive leakage tests are not in contract.

.1 All circuit conductors are to be individually ty-wrapped to their corresponding labelled neutral conductor in all panelboards, pull boxes and junction boxes. Enough slack conductor length should be left to enable the ability to clamp the ground detector around the individually ty-wrapped circuit conductor and its corresponding labelled neutral. This wiring method is to be neat and of good workmanship quality.

.2 The ty-wrapping of the neutral with its respective phase conductors is to be made at the closest point of entry into panelboards, pull boxes and junction boxes.

.3 Panelboards are have their respective feeder phase and neutral conductors ty-wrapped together with enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is to be neat and of good workmanship quality. This ty-wrapping is to be located such that ease of clamping the ground detector can be accomplished without excessive exposure to live bussing.

.4 After all electrical wiring has been completed by the Electrical Sub-Contractor, he is to test the grounded electrical distribution system to ensure there are no ground shorts or grounds.

.5 All feeders or branch circuits which do not have neutral conductors are to have their respective phase conductors ty-wrapped together in accordance to the methods described previously.

3.7 CONTROL CIRCUIT WIRING – 50 VOLTS OR LESS

.1 The installation of "surface" wiring on walls or in open (non-enclosed) type ceilings, shall be Type EMT conduit complete with associated steel type connectors and couplings.

.2 EMT conduit is to be extended to within 600 mm of "all" various control devices associated with the operation of any given piece of mechanical equipment.

.3 Unless specifically indicated otherwise, liquid tight, flexible metal type conduit complete with steel type connector and steel locknut may be used for the "final" 600 mm connection between the end of the EMT conduit and the applicable control device.

.4 EMT or PVC type conduit "wall stubs" complete with flush installed device box shall be installed in all masonry or concrete partitions where, and as may be required, where plenum rated cabling is used.

.5 EMT connectors complete with nylon insulated throat or threaded type bushing shall be installed on end of EMT stub above "finish" type ceilings, etc., where plenum rated cabling is used.

.6 All EMT conduit stubs are to be "bonded" to ground as per CEC.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 00 Common Work Results for Electrical.

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape, size 38 mm x 38 mm, 12 gauge, surface mounted and suspended.

.2 All strut to be galvanized.

.3 All threaded hanger rods to be minimum 9.5 mm diameter, larger if required, made from mild steel.

.4 In concrete, use cast-in threaded inserts wherever possible. Should additional inserts be required, use a "red-head" type of insert capable of carrying at least 227 kg.

.5 Supports for all conduit work shall be one or two hole steel pipe, as detailed in Part 3 (Execution); unistrut, or equal, with necessary fittings, or caddy clips, or equal, approved for their respective use.

.6 All pull and junction boxes, trays, wireways, and multiple conduits shall be supported by a steel channel support system with all components, hangers, wall supports, cable clamps, etc., specifically manufactured and approved for their application.

.7 Fastening devices for cabinets, boxes, supports, etc., shall be nut and bolt, expansion shields, wedge anchors, or toggle bolts, size and number to suit the application or as detailed on the drawings. Toggle bolts may not be used in plasterboard construction.

.8 Fastening devices for outlet boxes shall be nut and bolt, expansion shields, wedge anchors or caddy clips, size and number to suite the application or as detailed on the drawings.

.9 Where outlet boxes are set in drywall construction, a piece of steel stud shall be secured to either side of the outlet box or use caddy quick-mount box supports, or caddy J-1-A for side box supports.

Part 3 Execution

3.1 INSTALLATION

.1 EMT shall be securely fastened in place within 1 metre of each outlet box, junction box, pull box, cabinet or condulet fitting, with spacing between supports as per the CEC. Securing of surface and concealed conduits to the structure for sizes up to and including 35mm diameter may be done utilizing one-hole steel straps. Utilize two-hole steel straps for all sizes 41mm diameter and larger. Grouped or singularly suspended conduits of all sizes shall be supported with minimum size 9.5 threaded rods and concrete shields. Where possible, two or more suspended type conduits shall be secured to a common steel support channel system and are to be suspended utilizing minimum 9.5 threaded rods, washers and nuts. Channel is to be sandwiched between nuts and washers located on both upper and lower portions of channels.

.2 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.3 Secure equipment to poured concrete with expandable inserts.

.4 Secure equipment to hollow masonry with toggle bolts.

.5 Do not use toggle bolts in plasterboard construction.

.6 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.7 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.8 Suspended support systems:

- .1 Various suspended types of outlet, pull and/or junction boxes including conduits, are to be supported with minimum size 9.5mm threaded rod, nuts and flat washers. Threaded rode are to be secured to boxes with one flat washer and nut installed on both sides of box.
- .2 One rod required for all types of boxes sized 150mm x 150mm … 225 sq. cm and smaller.
- .3 Two rods required for all types of boxes sized larger than 225 sq. cm, up to, and including those sized 305mm x 305mm …930 sq. cm.
- .4 Minimum of four rods required for all boxes sized larger than 930 sq. cm

.9 For surface mounting of two or more conduits use channels.

.10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.12 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Engineer.

.14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

.1 Construction: welded steel enclosure.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on flat covers.

.4 Boxes 150 mm x 150 mm and larger to have bonding terminal strip.

Part 3 Execution

3.1 JUNCTION AND PULL BOXES INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Do not install pull or junction boxes more than 762 mm above accessible ceiling.

.3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.2 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00 Common Work Results - Electrical.

.2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 26 05 00 Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 100 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Single and multi gang flush device boxes for flush installation, minimum size 75 mm x 50 mm x 38 mm or as indicated or required. 100 mm square outlet boxes when more than one conduit enters one side with extension and square welded tile rings as required.

.3 100 mm square or octagonal outlet boxes for lighting fixture outlets.

.4 Extension and rings for flush mounting devices in finished plasterboard or tile walls. The use of plaster rings is not permitted.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and tile rings as required.

2.5 CONDUIT BOXES

.1 Cast FS and FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 OUTLET BOXES FOR AC-90 CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 75 mm x 50 mm x 64 mm with two double clamps to take AC-90 cables. Dual rated boxes (AC-90 NMD90) are not permitted.

2.7 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.8 SERVICE FITTINGS

.1 'High tension' receptacle fitting made of 2 piece die cast aluminum with brushed aluminum housing finish for 1 duplex or two duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 13 mm x 100 mm extension piece as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using square welded tile rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

.7 Sectional type boxes are not to be used with rigid galvanized steel conduit, type PVC, or thinwall EMT type conduit installation. Sectional type boxes are only to be used with flexible conduits, AC-90, and/or other types of pliable cables, including those associated with other systems rated less than 50 volts.

.8 Cast type "FS" or "FD" boxes are to be utilized for all surface wiring of devices installed lower than 2,438 mm AFF, (regardless of systems type involved) c/w matching steel type "FS" metal device plates unless specifically indicated otherwise. Cover plates are to be specifically made for FS & FD boxes and are to utilize 4 point fastening.

.9 Flush installed 100 mm square, or a 119 mm square box being used as a junction or pull box that requires a blank metal coverplate, is to have an appropriate sized, square welded one or two gang “tile ring” installed on same. This permits the use of a standard, one or two gang (blank) finish metal coverplate to be used, and avoids the necessity of acquiring an oversized, custom made coverplate.

.10 Tile type extension rings are not to be used on boxes that have not been “flush” installed. They are not intended, nor acceptable for “surface” type application.

END OF SECTION

Applicable Sections of Division 0, Division 1, applicable drawings and amendments are part of and are to be read in conjunction with this Section.

Part 1 General

1.1 RELATED SECTIONS

.1 26 05 00 Common Work Results - Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International):

- .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
- .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
- .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.

Part 2 Products

2.1 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded, minimum size 21 mm.

.2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings, minimum size 21 mm.

.3 Rigid PVC conduit: to CSA C22.2 No. 211.2, minimum size 21 mm.

.4 Flexible metal conduit: to CSA C22.2 No. 56, steel liquid tight flexible metal, minimum size 21 mm.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller.

- .1 Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 Threaded rods, 9.5 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Set screw couplings and connectors for EMT where run concealed in ceilings and walls or run horizontally. Rain tight compression connectors and couplings for EMT shall be used for vertical conduits which enter into the tops of equipment incorporating drip shields or hoods.

2.4 FISH CORD

.1 Polypropylene 6 mm.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Use electrical metallic tubing (EMT) for all systems except in cast concrete and where not subject to mechanical injury.

.4 Use rigid PVC conduit underground.

.5 Use liquid tight flexible metal conduit for connection to motors or equipment.

.6 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.7 Mechanically bend steel conduit over 21 mm diameter.

.8 Install fish cord in empty conduits.

.9 Run 2- 25 mm spare conduits up to ceiling space from each flush panel.

.1 Terminate these conduits in 150 mm x 150 mm x 100 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.

.10 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.11 Dry conduits out before installing wire.

.12 In addition to the CEC minimum conduit support spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 305mm from the midpoint of all 90 degree bends. Maximum spacing between conduit support channels shall be as dictated by the smallest size conduit(s) being supported and/or secured to same.

.13 EMT shall be securely fastened in place within 1 metre of each outlet box, junction box, pull box, cabinet or condulet fitting, with spacing between supports as per the CEC. Securing of surface and concealed conduits to the structure for sizes up to and including 35mm diameter may be done utilizing one-hole steel straps. Utilize two-hole steel straps for all sizes 41mm diameter and larger. Grouped or singularly suspended conduits of all sizes shall be supported with minimum size 9.5mm threaded rods and concrete shields. Where possible, two or more suspended type conduits shall be secured to a common steel support channel system and are to be suspended utilizing minimum 9.5mm threaded rods, washers and nuts. Channel is to be sandwiched between nuts and washers located on both upper and lower portions of channels.

.14 Wiring for all various systems devices and/or outlets installed below ground floor concrete floor slabs may utilize code approved rigid PVC conduit. Transition from rigid PVC conduit to rigid steel threaded conduit shall take place below the floor slab. Transition from rigid steel threaded conduit to EMT shall take place above the floor slab.

.15 Rigid PVC conduits of all sizes prior to turning-up through floor slabs, unless specifically indicated otherwise, shall have transition to rigid steel threaded conduit as previously indicated.

.16 The installation of rigid PVC conduit above ground is prohibited.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1524 mm clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Provide 150 mm surround of fresh water sand.

3.6 CLEANING

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

END OF SECTION