

***City of Winnipeg***

BID OPPORTUNITY 280-2020

***Fire Station No. 13  
Interior Renovation***

**799 Lilac Street, Winnipeg, Manitoba**

# **SPECIFICATIONS**

ISSUED FOR CONSTRUCTION

Date: June 25, 2020

| x | architecture inc.

<u>Division</u>	<u>Section #</u>	<u>Title</u>	<u>No. of Pages</u>
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**List of Drawings**

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<b>Mechanical</b>	M2.1	Floor Plans - Mechanical
<b>Electrical</b>	E.0.1	Electrical Symbols and Abbreviations

EL2.1	Main Floor – Lighting Plan
EP2.1	Main Floor – Power Plan
E6.1	Electrical Schedules

END OF SECTION

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1 Documents and certain applicable terminology.
- .2 Associated requirements.
- .3 Work expectations.
- .4 Work by other parties.
- .5 Words and terms.
- .6 Examination
- .7 Closeout submittals
- .8 Operation and maintenance manual format.
- .9 Contents each volume.
- .10 Recording actual site conditions.
- .11 Record documents.
- .12 Warranties and bonds.
- .13 Quality Assurance.
- .14 Demonstration and Training
- .15 Conditions for Demonstrations
- .16 Shop drawings and product data.
- .17 Samples.
- .18 Certificates and transcripts.
- .19 Product quality, availability, storage, handling, protection, and transportation.
- .20 Product changes and substitutions.
- .21 Manufacturer's instructions.
- .22 Quality of Work, coordination and fastenings.
- .23 Accessibility of Equipment
- .24 Coordination, work for other trades, electrical requirements, temporary use of equipment.
- .25 Existing facilities.

**1.2                RELATED SECTIONS**

- .1 Applicable sections in Division 01, including:
  - .1 Allowances
  - .2 Construction Progress Documentation.
  - .3 Submittal Procedures.
  - .4 Product Exchange Procedures.
  - .5 Substitutions
  - .6 Closeout Submittals.

- .2 This section describes common work applicable to all Sections within project Divisions 21, 22, 23 and 25.

### **1.3 COMPLEMENTARY DOCUMENTS**

- .1 Drawings, specifications, and schedules are complementary to each other and what is called for by one will be binding as if called for by all.
- .2 Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of the plans, and specifications, the Contractor shall obtain a ruling in writing from the Consultant in writing before submitting the bid. If this is not done it will be assumed that the most expensive alternative has been included in the bid price.
- .3 The drawings for mechanical work are performance drawings. They are generally diagrammatic and are not to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions showing every offset, fitting, valve or every difficulty encountered during execution of work and will not be used as an excuse for deficiencies or omissions. Where required installations are not shown on plans or are only shown diagrammatically, install in such a way as to conserve headroom and interfere as little as possible with free use or space through which they pass, while adequate space is allowed for service, maintenance, repair, or replacement for all equipment.
- .4 Drawings indicate general location and route of new and existing mechanical systems. The review of exact location and routing of systems prior to bidding is the responsibility of the Contractor. Install piping and duct systems not exactly shown in plan or indicated by note, by graphic, or diagrammatically in schematic or riser diagrams to provide an operational assembly or system.
- .5 Install components to physically conserve headroom, to minimize furring spaces, to accommodate installed Work, or other obstructions.
- .6 Install ceiling mounted or exposed mechanical components such as diffusers, sprinkler heads and grilles in accordance with reflected ceiling drawings or floor plans.
- .7 Locate devices with primary regard for convenience of operation and usage.
- .8 Examine all discipline drawings, specifications, and schedules and related Work to ensure that Work can be satisfactorily executed. Conflicts or additional Work beyond Work described, to be brought to the attention of the Consultant.
- .9 All specification sections of the Project Manual and Drawings are affected by requirements of Division 01 sections.

### **1.4 DESCRIPTION OF THE WORK**

- .1 Division of the Work among other contractors, subcontractors, suppliers or vendors is solely the Contractor's responsibility. Neither the Owner nor Consultant assumes any responsibility to act as an arbiter to establish subcontract terms or disagreements between sectors or disciplines of the Work.

### **1.5 CONTRACT METHOD**

- .1 Construct Work under the contract requirements in the applicable Division 00 sections.
- .2 Refer to Section 01 21 00 for cash allowances.

- .3 Contract Documents were prepared by the Consultant for the Owner. Any use which a third party makes of the Contract Documents, or any reliance on or decisions to be made based on them, are the responsibility of such third parties. The Consultant accepts no responsibility for any damages suffered by any third party as a result of decisions made or actions based on the Contract Documents.

## 1.6 PERMITS, INSPECTION AND TESTING

- .1 File all necessary notices and approved layouts, obtain and pay for all Local Authority and Fire Underwriters Inspections, approvals and permits applicable to each Mechanical Section. Make changes required to secure Local Authorities approval, without extra cost. Where conflicting requirements occur, comply with most stringent regulation. Note that requirements shown or specified may exceed minimum standards set by Local Authorities.
- .2 The Regulations of the A.S.M.E. Code and the Provincial Labour Department shall cover the design, manufacture, installation, welding and tests of piping and other equipment as specified hereafter.
- .3 Obtain Registration Certificates for all pressure vessels, with suitable metal-framed glass covers installed where directed. Furnish all certificates required by Local Authorities before acceptance of building by Owner.
- .4 The owner may request the Mechanical Section to operate device or material installed for such time as Consultant may require, as a thorough test, before final acceptance. Such tests shall not be construed as evidence of acceptance, and no claim for cost of such operation for test, or damage due to inadequacy or defect will be recognized.
- .5 Note that site reviews by the Consultant are for the purpose of determining in general if the work is proceeding in accordance with the Contract Documents, and to endeavour to guard the Owner against defects and deficiencies and not to superintend the execution of the work, which is the Mechanical Contractor's and their Subcontractors' responsibility.

## 1.7 WORDS AND TERMS

- .1 Conform to definitions and their defined meanings as in Section 01 19 00.
- .2 Refer to Section 01 19 00 for Specification Grammar.
- .3 Conform to the following definitions and their defined meanings in addition to those referenced in Section 01 19 00:
  - .1 **Install:** To remove from site storage, move or transport to intended location, install in position, connect to utilities, repair site caused damage, and make ready for use.
  - .2 **Supply:** To acquire or purchase, ship or transport to the site, unload, remove packaging to permit inspection for damage, re-package, replace damaged items, and safely store on-site.
  - .3 **Provide:** Wherever the term "provide" is used in relationship to equipment, piping and other materials specified for the work, it means "supply, install and connect". Wherever the terms "provide" is used in connection with services such as testing, balancing, start-up, preparation of drawings for any part of the work, it means procure, prepare, supervise, take responsibility for, and pay for these services.
  - .4 **Typical:** A representative characteristic that is standard for all installations whether individually noted or not throughout the documents. "Typical" applies to

each individual or combined installation except where specifically noted or otherwise indicated that the application is non-typical.

- .5 **Exposed:** Any work not concealed in wall, shaft, or ceiling cavities or spaces. Work behind doors, in closets or cupboards or under counters is considered exposed.
- .6 **New:** Produced from new materials.
- .7 **Renewed:** Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.
- .8 **Defective:** A condition determined exclusively by the Consultant.

## 1.8 EXAMINATION

- .1 Inspect existing conditions, including elements or adjacent Work subject to irregularities, damage, movement, including Work during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of the Work.
- .3 Examine all contract documents to ensure work can be performed without changes to the Work as shown on plans. No allowance will be made later for necessary changes, unless notification of interferences have been brought to Consultant's attention in writing, prior to bid closing.
- .4 Verify that materials and equipment can be delivered to the place of the work and that sufficient space and access is available to permit installation as shown on the drawings.
- .5 Verify the locations and inverts of service lines leaving and entering building to ensure their proper function prior to commencing work.

## 1.9 CLOSEOUT SUBMITTALS

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Two (2) weeks prior to Substantial Performance of the Work, submit to the Consultant, three (3) final copies of operating and maintenance manuals in Canadian English.
- .3 Copy will be returned with Consultant's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

## 1.10 OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 8.5 x 11 inch (219 x 279 mm) with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

- .4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

#### **1.11 CONTENTS - EACH VOLUME**

- .1 Table of Contents: Provide:
  - .1 Title of project.
  - .2 Date of submission.
  - .3 Names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
  - .4 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- .4 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including code compliance certificate, life safety systems performance certificate, pressure vessel acceptance.
- .6 Training: Refer to Demonstration and Training in this Section.

#### **1.12 RECORDING ACTUAL SITE CONDITIONS**

- .1 Record information on a full-sized set of drawings, and within the Project Manual.
- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.
- .4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
  - .1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .2 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .3 Field changes of dimension and detail.
  - .4 Changes made by change orders.
  - .5 Details not on original Contract Drawings.



- .6 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .6 Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records required by individual specifications sections.

### **1.13 RECORD DOCUMENTS**

- .1 Prior to Substantial Performance of the Work, electronically transfer the marked-up information from the as-built documents, as follows:
  - .1 Drawings: Scan the full-sized field-verified as-built drawing set and save to PDF format. Scans shall be in colour and with good resolution to ensure drawings and markups are legible.
  - .2 Specifications: Adobe Acrobat (PDF).
- .2 Mark revised documents as "RECORD DOCUMENTS". Include all revisions.
- .3 Submit completed record documents to Consultant on a CD, DVD, or by electronic transfer.

### **1.14 WARRANTIES AND BONDS**

- .1 Refer also to Section 01 78 10 for Warranties and Bonds.
- .2 Provide written guarantee that complete installation including materials, work and operation of all equipment provide under Mechanical Sections are first class in every respect, subject only to improper usage by Owner, and make good forthwith when reported all defects which develop within one year from date of acceptance of building by Owner at no additional cost to the Owner.
- .3 In addition, guarantee heating and cooling systems through one complete heating or cooling season, as applicable.
- .4 Deliver to the Owner all equipment manufacturer's guarantees specified in excess of one year.

### **1.15 FABRICATION AND WORKMANSHIP**

- .1 Employ skilled mechanics in their respective trades, under competent supervision, and where required by Provincial or Local regulations holder of acceptable qualification certificates.

### **1.16 QUALITY ASSURANCE**

- .1 Provide testing organization services as specified in subsequent Sections.
- .2 Testing organization: Current member in good standing of their respective professional or industry organization and certified to perform specified services.
- .3 Comply with applicable procedures and standards of the certification sponsoring association.
- .4 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

- .5 Qualifications:
  - .1 Provide adequate workforce training through meetings and demonstrations.
  - .2 Provide a designated experienced person on site with de-construction experience throughout the project for consultation and supervision purposes.

#### **1.17 DEMONSTRATION AND TRAINING**

- .1 Instruct Owner's designated employees in proper care, operation, use and maintenance of all systems and equipment, and provide general explanatory literature required and start up supervision and instructions.
- .2 Provide two (2) weeks prior notice to the Owner to schedule the training.
- .3 The Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.
- .4 Upon completion of instructions, forward to Consultant with a copy to the Owner a letter indicating person instructed and dates that the instruction took place. If in Consultant's opinion, this is not done satisfactorily, Consultant may direct such instruction, and charge all costs involved to relevant section.

#### **1.18 CONDITIONS FOR DEMONSTRATIONS**

- .1 Equipment has been inspected and put into operation in accordance with related sections.
- .2 Testing, adjusting, and balancing have been performed and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

#### **1.19 SHOP DRAWINGS - ADMINISTRATIVE REQUIREMENTS**

- .1 **Shop drawings shall be submitted electronically in PDF format documents to [shopdrawings@eppsiepman.com](mailto:shopdrawings@eppsiepman.com).**
- .2 Shop drawing documents **shall be grouped by specification section**. Clearly list the specification section on the front page or cover sheet of the submittal. Shop drawings related to **multiple sections may not be grouped together** into a single document. Documents that are groups incorrectly will be returned without being examined and shall be considered rejected.
- .3 Each drawing shall include the name of project as found on the drawings or specifications, the equipment supplier and the specification section that the equipment is specified under.
- .4 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 Work affected by submittal shall not proceed until review is complete.
- .6 Present Shop Drawings, product data, samples and mock-ups in SI Metric and/or Imperial inch-pound units, to match the units used in the schedules.
- .7 Review submittals prior to submission to Consultant. 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.

- .8 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.
- .9 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .10 Verify field measurements and affected adjacent Work are coordinated.
- .11 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .12 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .13 Keep one (1) reviewed copy of each submission on site.

#### **1.20 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 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 coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications. Indicate layouts, quantity, details of equipment, control wiring diagrams, sizes, capacities and roughing in and exact requirements for concrete pits, bases and other supporting members.
- .3 Each shop drawing must be certified by manufacturer and as such shall indicate that all product engineering has been performed to ensure the product will meet the requirements of the intended installation.
- .4 Shop drawings for grilles, registers and diffusers shall be accompanied by an itemized list indicating the unit locations by room number and the unit size.
- .5 Allow fifteen (15) working days for Consultant's review of each submission.
- .6 Adjustments made on Shop Drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .7 Make changes in Shop Drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of any revisions other than those requested.
- .8 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.

- .9 Submissions shall 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 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to other parts of the Work.
- .10 After Consultant's review, distribute copies.
- .11 Submit one (1) copy of Shop Drawings as a pdf document by email attachment for each requirement requested in specification Sections and as consultant may reasonably request. Any electronic copy of shop drawings shall bear all the required marks of certification and approval by the manufacturer and contractor(s) as indicated above. The consultant will review and mark up one copy of the shop drawing, and return to the contractor by email attachment. The contractor shall then make copies as required for ordering and documentation purposes. Multiple copies of shop drawings will not be returned.
- .12 Submit one electronic copy of product data sheets or brochures for requirements requested in specification sections and as requested by Consultant where Shop Drawings will not be prepared due to standardized manufacture of product. Submittals shall be submitted as a pdf document by email attachment, or delivered as a hard copy. Any electronic copy of shop drawings shall bear all the required marks of certification and approval by the manufacturer and contractor(s) as indicated above.
- .13 Delete information not applicable to project.
- .14 Supplement standard information to provide details applicable to project.
- .15 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, one electronic copy will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed. The

contractor shall then make copies as required for ordering and documentation purposes. Multiple copies of shop drawings will not be returned.

- .16 Checking of shop drawings by the Consultant does not constitute acceptance of responsibility. Such checking constitutes assistance only to the Mechanical Division in the proper execution of their work.

#### **1.21 SAMPLES**

- .1 Submit for review samples in duplicate or triplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Consultant's business address unless otherwise instructed.
- .3 Notify Consultant 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 Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .6 Make changes in samples which Consultant 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.

#### **1.22 MOCK-UP**

- .1 Erect mock-ups to the requirements of Division 01.

#### **1.23 PROGRESS PAYMENT SUBMISSIONS**

- .1 Submit progress payment breakdowns for review by the Consultant to the requirements of Division 01.
- .2 For mechanical submissions, provide line item breakdowns to indicate the following:
  - .1 Equipment progress payments for Fire Protection, Plumbing, Hydronic and HVAC.
  - .2 Labour progress payments for Fire Protection, Plumbing, Hydronic and HVAC.
  - .3 Controls
  - .4 Insulation
  - .5 Air Balancing
  - .6 Commissioning, Start Up and Training
  - .7 Close out documents – Record drawings, Operation and Maintenance documents.

#### **1.24 PRODUCT QUALITY**

- .1 Products, materials, equipment, parts or assemblies (referred to as Products) incorporated in Work: New, not damaged or defective, of best quality (compatible with specification requirements) for purpose intended. If requested, provide evidence as to type, source and quality of Products provided.
- .2 Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is

precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.

- .3 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Consultant.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

#### **1.25 AVAILABILITY**

- .1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items.
- .2 If delays in supply of Products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .3 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available Products of similar character, at no increase in Contract Price or Contract Time.

#### **1.26 STORAGE AND PROTECTION**

- .1 Store and protect Products in accordance with manufacturers' written instructions.
- .2 Store with seals and labels intact and legible.
- .3 Store sensitive Products in weather tight, climate controlled, enclosures in an environment favourable to Product.
- .4 For exterior storage of fabricated Products, place on sloped supports above ground.
- .5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.
- .6 Cover open ends of pipes, fixtures, ductwork, etc. to prevent entry of building rubbish.
- .7 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- .8 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- .9 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

#### **1.27 TRANSPORTATION AND HANDLING**

- .1 Transport and handle Products in accordance with manufacturer's written instructions.
- .2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- .3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

- .4 Protect all finished and unfinished work from soiling or damage, cover floors with tarpaulins or plywood as necessary, and repair any damage resulting from work of Mechanical Section.
- .5 Protect finished surfaces to remain exposed, by paper, polyethylene or other satisfactory removable protective covering using paste acceptable to fixture manufacturer to prevent possible damage to finishes, until all reason for construction damage has passed and until acceptance by Owner, and make good any such damage.

#### **1.28 SPECIAL CLEANING**

- .1 Maintain tidiness within work of Mechanical Sections and at completion remove protective paper, labels, etc. and tools and waste materials. Leave clean and in perfect operating condition.
- .2 Remove dirt, rubbish, grease, and dust for which this section is responsible from all exposed surfaces and fixtures.
- .3 Operate, drain and flush out bearings and refill with new charge of lubricant, before final acceptance.
- .4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances within the scope of work area. Disconnect, clean and reconnect whenever necessary for purpose of locating and removing obstructions. Repair work damaged in course of removing obstructions. Refer to 23 31 00 for any additional duct cleaning requirements.
- .5 Clean exposed surfaces of mechanical equipment, ductwork, piping, etc., and polish plated work.
- .6 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install extended nipples to outside of bearing enclosures for lubrication purposes.
- .7 Remove tools, surplus, and waste material from the building site upon completion of work. Clean grease, dirt, and excess material from walls, floors, ceilings, surfaces, and fixtures for which this Contractor was responsible, and leave the premises suitable for immediate use.
- .8 At the end of construction all systems shall be left ready for operation.
- .9 This Section shall be responsible for repair work as may be necessary to remove dents and touch-up of factory finishes.

#### **1.29 PRODUCT CHANGES & SUBSTITUTIONS**

- .1 Change in Product/Products: Submit request for substitution or alternative in accordance with this Section, the Instructions to Bidders, and Division 01 Product Exchange Procedures Division 01 Substitutions Sections. In case of a discrepancy between this section and Division 00 and Divisions 01, the more stringent requirements shall apply.
- .2 The Instructions to Bidders specify time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section.
- .3 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- .4 Any substituted item submitted for consideration must not exceed the available space and weight limitations, and all additional costs for mechanical, electrical, structural and architectural revisions required to incorporate the substituted material shall be the

responsibility of the Mechanical Division. Review maximum dimensions and weights when provided in the specification and schedules, and where not specified review the drawings for space limitations.

- .5 A request constitutes a representation that the Bidder:
  - .1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
  - .2 Will provide the same warranty for the Substitution as for the specified Product.
  - .3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
  - .4 Waives claims for additional costs or time extension which may subsequently become apparent.
  - .5 Will reimburse Owner and Consultant for review or redesign services associated with re-approval by authorities.
- .6 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

### **1.30 EXISTING UTILITIES**

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to the Work, building occupants, or pedestrian or vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

### **1.31 MANUFACTURER'S WRITTEN INSTRUCTIONS**

- .1 Unless otherwise indicated in the specifications, install or erect Products to manufacturer's written instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.
- .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

### **1.32 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Consultant reserves right to require dismissal from site any workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.
- .4 Assume full responsibility for layout of own work and for any damage caused to property of others through improper location or poor workmanship.



### **1.33 ACCESSIBILITY OF EQUIPMENT**

- .1 The Owner places a high priority on being able to safely and efficiently gain access to systems and equipment for replacement and repair. All equipment must be accessible, as defined as follows:
  - .1 Ceiling mounted equipment shall only be considered accessible if a tradesman can place both hands on the equipment components which requires services (ie: fan motor, belt, pulley, bearing, fire damper linkages, valve/control valve, strainer or any other equipment component which requires periodic maintenance). The component must be in clear view, and access must be gained from an 8 or 10 foot step ladder. Access panels provided in drywall shall be sized and placed in such a manner that trades personnel can place two hands on the equipment components as stated above. Equipment located above acoustic tile ceiling shall be positioned in such a manner that equipment and its components can be accessed through a full tile which does not contain any devices such as light fixtures, speakers, smoke detectors or sprinkler heads. If this is not possible, it should be reviewed by the Consultant/Owner before deemed acceptable.
  - .2 Conduit, pipe, ducting and support racking or any other obstruction to accessibility shall be relocated at the contractor's expense by the contractor's forces.

### **1.34 COORDINATION**

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.
- .3 Check levels shown before commencement to ensure adequate falls for sewers and pipes and report discrepancies immediately. Failure to so check and report does not relieve this section from responsibility for consequent extra expenditures.
- .4 Where space is indicated as reserve for future equipment, leave clear and install piping and other work so that connections can be made to future equipment.
- .5 Secure approval where necessary to cut holes in either finished or unfinished work, employ section whose work is involved, cut openings no larger than necessary and without damage to adjoining work and carefully repair all damage to match adjacent work. Note the Mechanical Division is responsible for all required cutting and patching relating to this Contract, except as specifically noted otherwise.
- .6 Provide and set bolts, templates, sleeves and fixing materials for fixing work under this section securely to work provided under other sections, in advance of other work, where required.
- .7 Locate all openings in walls, partitions, beams, etc. required for installation of ducts, pipes and equipment, etc. specified in this section of the specifications and frame all openings as required.
- .8 Installation of all equipment shall allow sufficient space to facilitate ease of maintenance. Clearance space shall allow for the removal of all components of equipment without hindrance. Where clearance requirements are not shown on the mechanical plans, manufacturer clearances must be maintained at a minimum.

**1.35 WORK FOR OTHER TRADES**

- .1 The Mechanical Contractor shall install rough-ins and/or connections for all equipment requiring mechanical services, as shown on drawings or mentioned elsewhere in the specifications.
- .2 Supply other trades with all necessary details, rough-in drawings, wiring diagrams, etc. as required.

**1.36 ELECTRICAL REQUIREMENTS**

- .1 Motors and electrical equipment supplied under Mechanical Division shall comply with Electrical Section and electrical characteristics scheduled or shown.
- .2 See "Installation and Wiring Controls" in Electrical Section for equipment supplied under Electrical Section.
- .3 The Electrical section shall provide starters for all motors and wire from starters to motors, unless otherwise indicated.
- .4 The Electrical section shall wire between starters and switching components such as relays, float switches, and pressure switches.
- .5 Supply to Electrical Section within four (4) weeks after contract award, fully detailed diagrams of power and control wiring required for equipment supplied by Sections 21 – 25.
- .6 Motors shall be squirrel cage induction type 1800 RPM unless otherwise noted. Where dampness occurs, all motors and electrical apparatus such as float switches, etc. supplied integrally with any piece of apparatus, shall be totally enclosed.
- .7 All motors 1 hp and larger shall be high efficiency as defined in CSA C390.

**1.37 CONCEALMENT**

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Consultant if there is interference. Install as directed by Consultant.

**1.38 ACCESS PANELS**

- .1 Provide in ample time for installation under relevant sections all necessary access panels in walls and ceilings to allow access to dampers, valves, etc., size 300 mm x 300 mm (12" x 12") min. or as required for proper maintenance with steel panel and frame, similar to Acudor, type to suit application. Instruct relevant section for proper location of access panels. Final locations subject to Consultant's approval. ULC approved access panels must be provided where access is through or into a fire partition or assembly. If access doors have been specified by architectural sections the architectural specification shall supersede this section.

**1.39 REMEDIAL WORK**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

**1.40 ALTERATION WORK**

- .1 Where work is to be done in existing buildings, accurately survey, provide for avoidance of damage and interference to existing work and rectify any such damage due to work under Mechanical Sections. Accept existing work as it exists at time of tendering.
- .2 Carefully dismantle existing mechanical equipment to be removed or relocated. Temporarily disconnect, remove, and reinstall existing equipment, piping, ductwork, conduit, light fixtures, and similar items, which interfere with the new installation after completion of new work or of existing installations to be demolished. Store equipment and materials on the premises as directed by the Owner.
- .3 All usable salvaged equipment and materials shall remain the property of the Owner unless specifically noted otherwise. Such material shall be removed from the building and be safely and neatly stored on the site for removal by the Owner. The Contractor shall remove all rejected salvage from the site and legally dispose of it off site.
- .4 Reuse existing equipment in new work after first repairing and reconditioning any defective items where noted. Safely cap and seal disconnected mechanical services within finished surfaces.
- .5 The abandonment of existing equipment and material in place is not acceptable. All redundant services are to be removed back to active mains, which shall then be capped at existing point of connection.
- .6 All mechanical equipment conflicting with new equipment being installed shall be moved or disconnected, without damage, by Contractor and shall remain property of the Owner. Remove ducts and piping not required in revised systems and interfering with new installation. This material shall become property of Contractor.
- .7 Disconnect existing equipment indicated, intended to be reused, rough-in in new position, and after replacement connect fully, ready for use.
- .8 Removal and relocation of mechanical equipment by relevant Mechanical Sections.

**1.41 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Consultant of conflicting installation. Install as directed.

**1.42 FASTENINGS**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

**1.43 FASTENINGS - EQUIPMENT**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 304 or 316 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**1.44 TEMPORARY USE OF EQUIPMENT**

- .1 No portion of any mechanical system or equipment provided under Mechanical Sections may be used for temporary heating without Consultant's written permission and observance of the following procedure:
  - .1 Oil and grease motor, fan and pump bearings, etc. check on a regular basis and maintain as recommended by manufacturer.
  - .2 Maintain and clean when necessary cleanable type filters and clean and oil just prior to take-over of building by Owner. Replace throwaway type filters.
  - .3 Ensure that mechanical air handling equipment is not operated during painting.
  - .4 Employ equipment manufacturers and subtrades to ensure and certify that all systems and equipment are in proper condition, and guarantee all work used prior to take-over as for new work, from date of acceptance of building by Owner.
  - .5 If permission for temporary use of mechanical equipment is granted, use Canadian Plumbing and Mechanical Contractors Association standard form of agreement as basis of responsibilities. Guarantee on complete installation shall not start until acceptance of building by Owner.
- .2 All return air grilles/openings shall be equipped with MERV 8 filters to keep return air system clean of dust and dirt if air handling equipment is being used before turnover to the Owner.

**1.45 PROTECTION OF WORK IN PROGRESS**

- .1 Prevent overloading of any part of the Project.
- .2 Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Consultant.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1     Pipe, pipe fittings, valves, and connections for piping systems.
  - .1     Sanitary sewer.
  - .2     Domestic water.

**1.2                RELATED SECTIONS**

- .1     Section 08 31 13 - Access Doors and Frames.
- .2     Section 09 91 10 - Painting.
- .3     Section 23 07 19 - Piping Insulation.

**1.3                REFERENCES**

- .1     ASTM E814 - Fire Tests of Through-Penetration Fire Stops.
- .2     UL 1479 - Fire Tests of Through-Penetration Firestops.
- .3     CAN/ULC-S102.2 - Standard method of test for surface burning characteristics of flooring, floor covering and miscellaneous materials and assemblies
- .4     CAN/CSA-B1800 - Thermoplastic non-pressure piping
- .5     NSF/ANSI 14 - Plastics Piping System Components and Related Materials
- .6     NSF/ANSI 61 – Drinking Water System Components – Health Effects
- .7     ANSI/NSF 372 - Drinking Water System Components - Lead Content
- .8     ASME B31.9 - Building Services Piping.
- .9     ASME SEC IV - Construction of Heating Boilers.
- .10    ASME SEC IX - Welding and Brazing Qualifications.
- .11    ASME B16.3 - Malleable Iron Threaded Fittings.
- .12    MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- .13    MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .14    MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
- .15    MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

- .16 MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- .17 NCPWB - Procedure Specifications for Pipe Welding.
- .18 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .19 ASME B16.4 - Grey Iron Threaded Fittings.
- .20 ANSI/AWWA C651 - Disinfecting Water Mains.
- .1 AWS A5.8 - Filler Metals for Brazing and Braze Welding.
- .2 ASME B16.22-2001 (R2005) - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 ASME B16.26 - Copper Alloy Bronze Fittings for Flared Copper Tubes.
- .4 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .5 ASTM B42 - Seamless Copper Pipe, Standard Sizes.
- .6 ASTM B43 - Seamless Red Brass Pipe, Standard Sizes.
- .7 ASTM B68 - Seamless Copper Tube, Bright Annealed.
- .8 ASTM B75 - Seamless Copper Tube.
- .9 ASTM B22.18-03 - Seamless Copper Water Tube.
- .10 ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- .11 ASTM B302 - Threadless Copper Pipe, Standard Sizes.
- .12 ASTM B306 - Copper Drainage Tube (DWV).
- .13 ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- .14 ASTM B32-04 - Solder Metal.
- .15 ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .16 ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- .17 ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .18 ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- .19 AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 inch - 48 inch (350 mm - 1200mm).

**1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Submission procedures.
- .2 Product Data: Provide data on all valves larger than 50mm (2”), and all backflow prevention devices and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

**1.5 CLOSEOUT SUBMITTALS**

- .1 Section 21 05 00: Submission procedures.
- .2 Record Documentation: Record actual locations of valves on record drawings.

**1.6 QUALITY ASSURANCE**

- .1 Perform Work to the standards of the Province and Municipality of Jurisdiction.
- .2 Valves: Manufacturer's name and pressure rating marked on valve body.
- .3 Welding Materials and Procedures: Conform to ASME SEC IX and applicable Provincial labour regulations.
- .4 Welder's Certification: To Manitoba Department of Labour standards.
- .5 Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.
- .6 Carbon steel pipe and fittings manufactured in China or India will not be permitted.

**1.7 REGULATORY REQUIREMENTS**

- .1 Perform Work to the latest version of the Manitoba Plumbing Code and local Municipal requirements
- .2 Conform to applicable code for installation of backflow prevention devices.
- .3 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

**1.8 DELIVERY, STORAGE, AND PROTECTION**

- .1 Refer to specification section Product Requirements: Transport, handle, store, and protect products.
- .2 Accept valves on site in shipping containers with labelling in place. Inspect for damage.
- .3 Provide temporary protective coating on cast iron and steel valves.
- .4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

**Part 2 Products**

**2.1 SANITARY SEWER PIPING, ABOVE GRADE**

- .1 Copper Tube: ASTM B306, DWV.
  - .1 Fittings: ASTM B306 with lead-free soldered cast brass drainage fittings to CSA B158.1 or wrought copper fittings to ANSI B16-29
  - .2 Joints: ASTM B32, lead-free solder, Grade 50B.
- .2 PVC Pipe with FSR25: CAN/CSA B1800
  - .1 Fittings: PVC.
  - .2 Joints: ASTM D2855, solvent weld to ASTM D2564.
- .3 PVC Pipe with FSR25/SDC50: CAN/CSA B1800
  - .1 Piping shall be tested and listed in accordance with CAN/ULC-S102.2 and clearly marked with the certification logo indicating a flame spread rating (FSR) not exceeding 25 and a smoke developed classification (SDC) not exceeding 50.
  - .2 Fittings: PVC.
  - .3 Joints: ASTM D2855, solvent weld to ASTM D2564.
  - .4 Manufacturer: IPEX System XFR or equal.

**2.2 WATER PIPING, ABOVE GRADE**

- .1 Copper Tubing 50mm (2") and under: ASTM B88, Type L hard drawn.
  - .1 Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - .2 Joints ASTM B32, solder, Grade 95TA.

**2.3 FLANGES, UNIONS, AND COUPLINGS**

- .1 Pipe Size 80 mm (3 inches) and under:
  - .1 Ferrous pipe: Class 150 malleable iron threaded unions.
  - .2 Copper tube and pipe: Class 150 bronze unions with soldered joints.
- .2 Pipe Size Over 25 mm (1 inch):
  - .1 Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
  - .2 Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- .3 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- .4 Domestic Water Cap: Chrome Plated Brass, threaded fitting, suitable for potable water.
- .5 Cleanout Cover: Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.



## **2.4 BALL VALVES**

- .1 Manufacturers:
  - .1 MAS
  - .2 Kitz
  - .3 Crane.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Construction 63 mm (2.5 inches) and smaller:
  - .1 MSS SP-110, Class 150, 2760 kPa (400 psi) brass,
  - .2 Two piece body,
  - .3 316 stainless ball and trim, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder ends.

## **2.5 FIRE STOP SYSTEMS**

- .1 General Purpose Fire Stopping Sealant:
  - .1 Manufacturers:
    - .1 Dow Corning Silicone Elastomer Fire Stop Penetration Seal and/or Dow-Corning liquid silicone elastomer Fire Stop Foam of density, width and depth to maintain assembly fire resistive rating.
    - .2 Hilti.
    - .3 Substitutions: Refer to Section 21 05 00.
  - .2 Water based, non-slumping, premixed sealant with intumescent properties, rated for 3 hours per ASTM E814 and UL 1479.
- .2 DWV Plastic Pipe Systems Fire Stopping Sealant:
  - .1 Manufacturers:
    - .1 Hilti FS-ONE Intumescent Firestop Sealant
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Silicone based, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours per ASTM E814 and UL 1479 with metal collars.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Section 21 05 00: Verify existing conditions before starting work.
- .2 Verify that excavations are to required grade, dry, and not over-excavated.

### **3.2 PREPARATION**

- .1 Ream pipe and tube ends. Remove burrs.
- .2 Remove scale and dirt, on inside and outside, before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

### 3.3 INSTALLATION

- .1 Install to manufacturer's written instructions.
- .2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- .3 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- .4 Install piping to maintain headroom, conserve space, and not interfere with use of space.
- .5 Group piping whenever practical at common elevations.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .7 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- .8 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with architect.
- .9 Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- .10 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- .11 Install valves with stems upright or horizontal, not inverted.
- .12 Install water piping to ASME B31.9.
- .13 Sleeve pipes passing through partitions, walls and floors. Set sleeves in concrete forms for all pipes passing through concrete walls, beams and slabs.
- .14 Pipe sleeves to extend above floor line as follows:
  - .1 Unfinished areas – 25 mm (1 inches).
  - .2 Finished areas (copper sleeves) – 7 mm (1/4 inches).
  - .3 Mechanical rooms, kitchens and washrooms – 100 mm (4 inches).
- .15 Caulk sleeves to provide watertight installation.
- .16 Where pipes pass through floors and walls in finished areas and where exposed to view, provide Crane #10 B.C. chrome-plated, pressed steel floor plates.
- .17 Install galvanized, oversize pipe sleeves on passing through walls or partitions, for building into wall construction, by other trades.
- .18 Sleeves and holes for piping on cold water systems shall be large enough to accommodate pipe insulation. Insulation on piping for hot water systems may stop at walls or floors.
- .19 Prior to installing sleeves in concrete beams, receive final jobsite approval by Structural Consultant.

### **3.4 PIPE PRESSURE TESTING**

- .1 Do not insulate pipe prior to pressure testing. Pressure test in sections if necessary before concealing or insulating pipe.
- .2 Do not introduce water for testing where freezing conditions exist or where piping systems being tested are located above sensitive areas or equipment that may be damaged or contaminated by water leakage.
- .3 Hydraulically test all pipe. Pneumatic testing not permitted without prior approval from the Consultant and the Authority Having Jurisdiction.
- .4 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment. Pipe dope, caulking, tape, lead wool, dresser couplings, etc. shall not be used to correct deficiencies. The contractor shall be responsible for all cleanup related to leakage during flushing, testing, and chemical treatment of piping, including original building piping if included in the testing.
- .5 Subject piping to a hydrostatic pressure of at least that 1-½ times the operating pressure of the system for a period of at least 12 hours. If leaks are detected, such leaks shall be repaired and the test started over. Record results and submit witnessed (by consultant or Owner's representative) reports to the Consultant.
- .6 Register pressures at the highest system point.
- .7 Provide at least 48 hours (during working days) notice to Consultant or Owner's Representative prior to testing to allow the tests to be witnessed.

### **3.5 APPLICATION**

- .1 Use grooved mechanical couplings and fasteners only in accessible locations.
  - .2 Install unions downstream of valves and at equipment or apparatus connections.
  - .3 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
  - .4 Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
  - .5 PVC DWV piping installed in non-combustible buildings shall comply with the restrictions in the following table.
-

<b>COMBUSTIBLE PIPE APPLICATIONS SUITABILITY FOR USE</b>					
Product	NON-COMBUSTIBLE BUILDING				
	General Usage	Air Plenum <sup>1</sup>	Vertical Services Spaces <sup>2</sup>	High-Rise Building	Underground
Combustible Pipe FSR25: (eg. IPEX System 15)	P	N <sup>3</sup>	N	N	P
Combustible Pipe FSR25/SDC50: (eg. IPEX XFR, CPVC)	P	P	N	P	P
MJ Grey Coupling	P	P	N	P	N
1. Restrictions for air plenums also apply to combustible buildings as well. 2. Certified firestopping devices are required whenever the system penetrates a vertical or horizontal separation, and shall be certified to CAN4-S115 and tested with a pressure differential of 50 Pa. 3. Sizes 20" and 24" are N					

**3.6 ERECTION TOLERANCES**

- .1 Section 01 73 00: Tolerances.
- .2 Establish invert elevations, slopes for drainage to one percent (1/8 inch per foot) minimum, except pipe sized 75 mm (3 inches) or less shall have a slope no less than two percent (1/4 inch per foot). Maintain gradients.
- .3 Slope water piping minimum 0.25 percent and arrange to drain at low points.

**3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- .1 Prior to starting work, verify system is complete, flushed and clean.
- .2 Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- .3 Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- .4 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- .5 Maintain disinfectant in system for 24 hours.
- .6 If final disinfectant residual tests less than 25 mg/L, repeat treatment.

- .7 Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- .8 Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze to ANSI/AWWA C651.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Duct work insulation.

**1.2                RELATED SECTIONS**

- .1            Section 23 31 00 - Duct Work: Glass fibre duct work.
- .2            Section - Roofing: Installation and finishing of outdoor insulation jacket under roofing.

**1.3                REFERENCES**

- .1            Section 01 43 00: Requirements for references and standards.
- .2            ASTM
  - .1            ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
  - .2            ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .3            ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
  - .4            ASTM C553 - Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .5            ASTM C612 - Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
  - .6            ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation
  - .7            ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
  - .8            ASTM C1071 - Fibrous Glass Duct Lining Insulation(Thermal Sound Absorbing Material).
  - .9            ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
  - .10           ASTM E96 - Water Vapour Transmission of Materials.
  - .11           ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
  - .12           ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .3            NAIMA: North American Insulation Manufacturers Association
  - .1            National Insulation Standards.
- .4            NFPA: National Fire Protection Association
  - .1            NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems
  - .2            NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

- .3 NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- .5 SMACNA: Sheet Metal & Air Conditioning Contractors' National Association
  - .1 HVAC Duct Construction Standards - Metal and Flexible.
- .6 Standards Council of Canada
  - .1 CAN/ULC S102 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
  - .2 CAN/ULC-S701 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .7 Thermal Insulation Association of Canada (TIAC):
  - .1 National Insulation Standards.
- .8 UL – Underwriters Limited
  - .1 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### **1.4 SUBMITTALS FOR REVIEW**

- .1 Section 21 05 00: Procedures for submittals.
- .2 Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

#### **1.5 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- .2 Applicator Qualifications: Company specializing in performing the work of this section minimum three years documented experience.

#### **1.6 REGULATORY REQUIREMENTS**

- .1 Materials: Flame spread/smoke developed rating of 25/50 to CAN/ULC S102.

#### **1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### **1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Section 21 05 00: Environmental conditions affecting products on site.

- .2 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .3 Maintain temperature during and after installation for minimum period of 24 hours.

## **Part 2 Products**

### **2.1 FIRE AND SMOKE RATING**

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

### **2.2 VAPOUR BARRIER EXTERNAL DUCT WRAP, GLASS FIBRE, FLEXIBLE**

- .1 Manufacturers:
  - .1 Johns Manville Microlite FSK
  - .2 Owens Corning SoftR Duct Wrap.
  - .3 Other acceptable manufacturers offering equivalent products.
    - .1 Knauf.
- .2 Insulation: ASTM C553; flexible, noncombustible blanket.
  - .1 'ksi' ('K') value: ASTM C518, 0.045 W/m-K at 24°C (0.31 Btu-in/(hr ft<sup>2</sup>-°F) at 75 degrees F).
  - .2 Maximum service temperature: 121 °C (250°F).
  - .3 Maximum moisture absorption: 0.20 percent by volume.
  - .4 Density 12 kg/cu. meter (0.75 lb/cu. Foot).
- .3 Vapour Barrier Jacket:
  - .1 Kraft paper with glass fibre yarn and bonded to aluminized film (FRK).
  - .2 Moisture vapour transmission: ASTM E96; ASTM C1136: 0.02 perm.
  - .3 Secure with pressure sensitive tape.
- .4 Vapour Barrier Tape:
  - .1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- .5 Tie Wire: Annealed steel, 1.5 mm (16 gauge).

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Section 01 70 00 - Examination and Preparation: Verification of existing conditions before starting work.



- .2 Verify that duct work has been tested before applying insulation materials.
- .3 Verify that surfaces are clean, foreign material removed, and dry.

### **3.2 INSTALLATION**

- .1 Section 01 43 00 - Quality Assurance: Manufacturer's written instructions.
- .2 Install to NAIMA National Insulation Standards.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 All duct sizes on the drawings refer to inside duct dimensions.
- .5 Insulated duct work:
  - .1 Provide insulation with vapour barrier jackets.
  - .2 Finish with tape and vapour barrier jacket.
  - .3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - .4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- .6 External insulation on duct work exposed in Mechanical Equipment Rooms or Finished Spaces below 3 metres (10 feet) above finished floor: Provide canvas jacket ready for finish painting.
- .7 External Duct Insulation Application:
  - .1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.
  - .2 Secure insulation without vapour barrier with staples, tape, or wires.
  - .3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.
  - .4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.
  - .5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

### **3.3 SCHEDULES**

- .1 Duct insulation shall follow the Schedules below as a minimum requirement. These requirements shall apply regardless of whether or not duct insulation is shown on the drawings.
- .2 Where duct insulation is shown on the drawings (either with the hatching convention or by means of a key note) and exceeds the requirements of the schedules below, the additional insulation requirements shall be met.

### **3.4 EXTERNAL DUCT WRAP, GLASS FIBRE, FLEXIBLE**

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
Round exhaust ducts, from external wall or roof back for length of 3000mm (10 feet) or to within warm space, whichever is greater	All	57mm (2 1/4") Installed 75mm (3") Nominal

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Piping insulation.

**1.2                RELATED SECTIONS**

- .1            Section 09 91 10 - Painting.
- .2            Section 22 10 00 – Plumbing Piping.

**1.3                REFERENCES**

- .1            ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2            ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .3            ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .4            ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- .5            ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.
- .6            ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .7            ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .8            ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .9            ASTM C547 - Mineral Fibre Pipe Insulation.
- .10           ASTM C552 - Cellular Glass Thermal Insulation.
- .11           ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .12           ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- .13           ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.
- .14           ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.
- .15           ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .16           ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- .17           ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

- .18 ASTM E84 - Surface Burning Characteristics of Building Materials.
- .19 ASTM E96 - Water Vapour Transmission of Materials.
- .20 CAN/ULC-S102-M88 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .21 NFPA 255 - Surface Burning Characteristics of Building Materials.
- .22 UL 723 - Surface Burning Characteristics of Building Materials.

#### **1.4 QUALITY ASSURANCE**

- .1 Materials: Flame spread/smoke developed rating of 25/50 or less to ASTM E84: NFPA 255; UL 723.

#### **1.5 QUALIFICATIONS**

- .1 Applicator: Company specializing in performing the work of this section with minimum three years documented experience.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Section 21 05 00: Transport, handle, store, and protect products.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Store insulation in original wrapping and protect from weather and construction traffic.
- .4 Protect insulation against dirt, water, chemical, and mechanical damage.

#### **1.7 ENVIRONMENTAL REQUIREMENTS**

- .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .2 Maintain temperature during and after installation for minimum period of 24 hours.

### **Part 2 Products**

#### **2.1 GLASS FIBRE PRE-FORMED PIPE INSULATION WITH ALL-SERVICE JACKET**

- .1 Manufacturers:
  - .1 Johns Manville Micro-Lok.
  - .2 Knauf Earthwool 1000.
  - .3 Owens Corning FIBREGLAS.
  - .4 Substitutions: Refer to Section 21 05 00.
- .2 Insulation: ASTM C547; rigid moulded, non-combustible.

- .1 'ksi' ('K') value : ASTM C335, 0.035 at 24 degrees C (0.24 at 75 degrees F).
  - .2 Minimum Service Temperature: -28.9 degrees C (-20 degrees F).
  - .3 Maximum Service Temperature: 454 degrees C (850 degrees F).
  - .4 Maximum Moisture Absorption: 0.2 percent by volume.
- .3 Vapour Barrier Jacket
- .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
  - .2 Moisture Vapour Transmission: ASTM E96; 0.03 ng/(Pa s sq m) (0.02 perm inches).
  - .3 Secure with self sealing longitudinal laps and butt strips.
  - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Tie Wire: 1.3 mm (18 gauge) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.
- .5 Vapour Barrier Lap Adhesive
- .1 Compatible with insulation.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verify that piping has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

#### **3.2 INSTALLATION**

- .1 Install materials to manufacturer's written instructions.
- .2 On exposed piping, locate insulation and cover seams in least visible locations.
- .3 Insulated pipes:
  - .1 Provide vapour barrier jackets, factory applied or field applied.
  - .2 Insulate fittings, and joints with moulded insulation of like material and thickness as adjacent pipe.
  - .3 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

#### **3.3 TOLERANCE**

- .1 Substituted insulation materials: Thermal resistance within 10 percent at normal conditions, as materials indicated.

#### **3.4 FIBROUS GLASS INSULATION SCHEDULE**

	<b>PIPING SYSTEMS</b>	<b>PIPE SIZE</b> <Inch><mm>	<b>THICKNESS</b> <Inch><mm>
<b>Plumbing Systems</b>			
	Domestic Hot Water Supply & Domestic Hot Water Recirc	=< 2" (50mm)	1" (25mm)
	Domestic Cold Water piping	=< 2" (50mm)	1" (25mm)

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1            Metal duct work.

**1.2                RELATED SECTIONS**

- .1            Division 1.
- .2            Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- .3            Section 23 37 00 - Air Outlets And Inlets.

**1.3                REFERENCES**

- .1            ASTM A36/A36M - Carbon Structural Steel.
- .2            ASTM A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- .3            ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .4            ASTM A480/A480M - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .5            ASTM A568/A568M - General Requirements for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- .6            ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .7            ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.
- .8            ASTM A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.
- .9            ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .10           AWS D9.1 - Sheet Metal Welding Code.
- .11           NBS PS 15 - Voluntary Product Standard for Custom Contact-Moulded Reinforced-Polyester Chemical Resistant Process Equipment.
- .12           NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- .13           NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.
- .14           NFPA 91 - Exhaust Systems for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particulate Solids.

- .15 SMACNA - HVAC Air Duct Leakage Test Manual.
- .16 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .17 UL 181 - Factory-Made Air Ducts and Connectors.

#### **1.4 PERFORMANCE REQUIREMENTS**

- .1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

#### **1.5 PROJECT RECORD DOCUMENTS**

- .1 Section 21 05 00: Submittals for project closeout.
- .2 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

#### **1.6 QUALITY ASSURANCE**

- .1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal.
- .2 Maintain one copy of document on site.

#### **1.7 QUALIFICATIONS**

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.
- .2 Installer: Company specializing in performing the work of this section with minimum three years documented experience.

#### **1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- .2 Maintain temperatures during and after installation of duct sealants.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating of to ASTM A90.
- .2 Steel Ducts: ASTM A1008, A568.
- .3 Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.



- .4 Fasteners: Rivets, bolts, or sheet metal screws. NOTE: No screws shall be used on dryer exhaust ducting, dryer ducting shall be smooth and continuous to prevent lint build-up.
- .5 Sealant:
  - .1 Manufacturers:
    - .1 Duro-Dyne
    - .2 Substitutions: Refer to Section 21 05 00.
  - .2 Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- .6 Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

## **2.2 DUCT WORK FABRICATION**

- .1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Unless otherwise indicated fabrication shall conform to standards for duct pressure class rating of +2" w.g. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- .2 All rectangular ducts shall be constructed by breaking the corners and grooving the longitudinal seams using Pittsburgh seam or other approved airtight seam.
- .3 All elbows and transformation pieces shall be constructed using Pittsburgh corner seams or double seam corners. All transverse joints shall be constructed using S-slips, Bar Slips, Drive Slips, etc. where recommended in ASHRAE guide. All slips shall be not less than one gauge heavier than duct material. Open corners will not be accepted.

## **2.3 MANUFACTURED DUCT WORK AND FITTINGS**

- .1 Manufacture to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install to manufacturer's written instructions.
- .2 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- .3 No variation of duct sizes will be permitted except by written permission of the Consultant. In the event that additional offsets and changes in direction are required in the duct system, these changes shall be made by the Sheet Metal Trade without additional cost to the Owner. All ductwork shall be to the recommended practices as laid down by the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- .4 Where the width of the duct exceeds 450 mm (18") in its largest dimension such ductwork shall be suitably stiffened by breaking the sheets diagonally.

- .5 All laps shall be in the direction of air flow. Rivets and bolts shall be used throughout. All edges and slips shall be hammered down to leave a smooth interior duct.
- .6 Use crimp joints with or without bead for joining round duct sizes 200 mm (8 inch) and smaller with crimp in direction of air flow.
- .7 Where interior of duct is visible through grilles, registers or diffusers, paint interior of duct with flat black Tremco paint formulated for galvanized surfaces.
- .8 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.
- .9 Open ductwork exposed to the outdoors during construction shall also be weather proofed c/w insulation at sealed ends for any ducts exposed to sub-zero temperatures.
- .10 Seal ductwork so that it is sufficiently airtight to ensure economical and quiet performance of the system. All ductwork, except where otherwise indicated, shall have seams and joints sealed with Duro-Dyne S-2 duct sealer. Apply duct sealer and duct tape in strict accordance with manufacturer's recommendations, to joints and seams to provide an airtight, watertight installation. Prior to application, ductwork to be dry and free of grease, etc. Use 6mm bead of material along joints. Material, when dry, to have 3.2mm depth extending 25mm on each side of joint or seam.
- .11 Install ductwork free from pulsation, chatter, vibration or objectionable noises.
- .12 Should any of these defects appear after the system is in operation, correct problems by removing, replacing, or reinforcing the work as directed by the Consultant.

**3.2 CLEANING**

- .1 Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

**3.3 SCHEDULES**

**3.4 DUCT WORK MATERIAL SCHEDULE**

	<b>AIR SYSTEM</b>	<b>MATERIAL</b>
	Low Pressure Supply	Steel
	General Exhaust	Steel
	Clothes Dryer Exhaust	Aluminum

**3.5 DUCT WORK PRESSURE CLASS SCHEDULE**

	<b>AIR SYSTEM</b>	<b>PRESSURE CLASS</b>
	Supply	500 Pa (2 inch)
	Intake and Exhaust	250 Pa (1 inch)

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1        Electrical demolition.

**1.2                RELATED SECTIONS**

- .1        Section 02 41 19 - Selective Demolition.

**Part 2            Products**

**2.1                MATERIALS AND EQUIPMENT**

- .1        Materials and equipment for patching and extending work: As specified in individual Sections.

**Part 3            Execution**

**3.1                EXAMINATION**

- .1        Refer to 26 05 00 Common Work Results for Electrical.
- .2        Verify field measurements and circuiting arrangements are as shown on Drawings.
- .3        Verify that abandoned wiring and equipment serve only abandoned facilities.
- .4        Electrical drawings are based on existing record documents and/or casual field observations. Coordinate full extent of demolition work with all disciplines. Coordinate on site with all trades prior to commencement of demolition.
- .5        Report discrepancies to the Consultant, and Owner before disturbing the existing installation.
- .6        Beginning of demolition means installer accepts existing conditions.

**3.2                PREPARATION**

- .1        Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- .2        Reroute/extend/re-feed existing electrical as required to maintain existing systems not indicated to be removed.
- .3        Coordinate utility service outages with Utility Company.
- .4        Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- .5        Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switch overs and connections. Obtain permission from the Owner at least forty eight (48) hours before

partially or completely disabling system. Disable system at a time suitable to the Owner only. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area as required.

- .6 Where existing luminaires, equipment or devices are to be temporarily relocated, and are to remain in service, provide an apparatus suitable to support the equipment.

### **3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- .1 Demolish and extend existing electrical work to this Section and as indicated.
- .2 The construction documents indicate major items of equipment, fixtures and devices, that exist and may not indicate every item or supporting wiring and conduit to be removed and/or relocated.
- .3 Carefully examine the site and construction documents to verify the extent of work defined in the construction documents. Be responsible for determining which existing equipment and/or devices are to be removed and/or relocated.
- .4 Remove, relocate, and extend existing installations to accommodate new construction including all existing equipment and/or devices indicated within the construction documents.
- .5 Where existing equipment and/or devices are to be temporarily relocated, coordinate the required structure to support the equipment.
- .6 Remove abandoned wiring to source of supply.
- .7 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- .8 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- .9 Disconnect and remove abandoned panelboards and distribution equipment.
- .10 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- .11 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- .12 Repair adjacent construction and finishes damaged during demolition and extension work.
- .13 Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- .14 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

### **3.4 CLEANING AND REPAIR**

- .1 Clean and repair existing materials and equipment which remain or are to be reused.

- .2 Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, broken electrical parts and lenses.

### **3.5 FINISHES**

- .1 Clean, prime and paint exposed wiring, conduit, junction and pull boxes, hangers, racking, and fasteners to prevent rusting and to match existing finishes where applicable.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1    Division 0 – Bidding & Contract Requirements
- .2    General Requirements
- .3    All Electrical Drawings and Division 25, 26, 27, 28 Series Specification Sections.

**1.2                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.
- .2    CAN3-C235-83 (R2015) - Preferred Voltage Levels for AC Systems, 0 to 50 000 V.
- .3    CSA (Canadian Standards Association).
- .4    ULC (Underwriters' Laboratories of Canada).
- .5    ASTM E-814, - Fire Tests of Penetration Fire Stops.
- .6    ANSI/ UL1479 - Fire Tests of Through Penetration Firestops

**1.3                REGULATORY REQUIREMENTS**

- .1    Conform to CSA-C22.1-18.
- .2    Comply with all CSA Electrical Bulletins in force at time of tender submission.
- .3    Comply with all provincial by-laws, ordinances, codes, rulings, and other requirements.
- .4    Comply with requirements of the electrical supply authority and the local inspection authority.
- .5    Products: Listed and classified by CSA, or ULC and as suitable for the purpose specified and indicated. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the appropriate Inspection Departments.

**1.4                DEFINITIONS**

- .1    The following are definitions of terms and expressions used in the specification:
  - .1    **Consultant:** Electrical Engineering Consultant: Epp Siepman Engineering Inc.
  - .2    **Inspection Authority:** agent of any authority having jurisdiction over construction standards associated with any part of electrical work on site.
  - .3    **Supply Authority:** electrical power utility company responsible for delivery of electrical power to project.
  - .4    **Electrical Code:** Canadian Electrical Code or Local Code in effect at project location.
  - .5    **Indicated:** as shown on contract drawings or noted in Contract Documents.
  - .6    **Install:** To remove from site storage, move or transport to intended location, install in position, connect to utilities, repair site caused damage, and make ready for use.

- .7 **Supply:** To acquire or purchase, ship or transport to the site, unload, remove packaging to permit inspection for damage, re-package, replace damaged items, and safely store on-site.
- .8 **Provide:** Wherever the term "provide" is used in relationship to equipment, conduit and other materials specified for the work, it means "supply, install, connect and leave in working order all materials and necessary wiring, supports, access panels, etc., as necessary for equipment indicated." Wherever the terms "provide" is used in connection with services such as testing, load balancing, start-up, preparation of drawings for any part of the work, it means procure, prepare, supervise, take responsibility for, and pay for these services.
- .9 **Typical:** A representative characteristic that is standard for all installations whether individually noted or not throughout the documents. "Typical" applies to each individual or combined installation except where specifically noted or otherwise indicated that the application is non-typical.
- .10 **Exposed:** Any work not concealed in wall, shaft, or ceiling cavities or spaces. Work behind doors, in closets or cupboards or under counters is considered exposed.
- .11 **New:** Produced from new materials.
- .12 **Renewed:** Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.
- .13 **Defective:** A condition determined exclusively by the Consultant.

## 1.5 PERMITS & FEES

- .1 Submit all quantities of drawings and specifications necessary for examination and approval to Electrical Permit Department and Electrical Supply Authority prior to commencement of work.
- .2 Obtain and pay for all permits necessary for the electrical installation.

## 1.6 INSPECTION

- .1 Furnish a Certificate of Acceptance from the Inspection Authorities on completion of work. Copies of Certificate shall be included in Maintenance Manuals.
- .2 Certificate of Inspection and Approval shall be submitted before final payment may be considered to be due.
- .3 During the course of the project construction, the Consultant will carry out periodic site reviews and prepare a deficiency list for remedial action by the Electrical Subcontractor. When requested, the Electrical Contractor shall respond in writing to the Consultant, stating corrective action and completion date for each item listed as deficient. This response shall be in the hands of the Consultant within three working days of receipt of the Site Review Report.

## 1.7 PRODUCT CHANGES & SUBSTITUTIONS

- .1 Change in Product/Products: Submit request for substitution or alternative in accordance with this Section, the Instructions to Bidders, and Division 01 Product Exchange Procedures Division 01 Substitutions Sections. In case of a discrepancy between this section and Division 00 and Divisions 01, the more stringent requirements shall apply.

- .2 The Instructions to Bidders specify time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section.
- .3 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- .4 Any substituted item submitted for consideration must not exceed the available space limitations, and all additional costs for mechanical, electrical, structural and architectural revisions required to incorporate the substituted material shall be the responsibility of the Electrical Division. Review maximum dimensions and weights when provided in the specification and schedules, and where not specified review the drawings for space limitations.
- .5 A request constitutes a representation that the Bidder:
  - .1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
  - .2 Will provide the same warranty for the Substitution as for the specified Product.
  - .3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
  - .4 Waives claims for additional costs or time extension which may subsequently become apparent.
  - .5 Will reimburse Owner and Consultant for review or redesign services associated with re-approval by authorities.
- .6 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

## **1.8 SUBMITTALS FOR REVIEW**

- .1 Refer to Division 01.
- .2 Progress Payment Application Template
  - .1 Prior to the first application for payment, submit for review a draft progress application template.
  - .2 Progress Application shall contain separate line items for the following systems:
    - .1 Site Services
    - .2 Distribution Equipment including Panels, Distribution Panels, Transformers, etc.
    - .3 Emergency Generator and Standby Power Systems
    - .4 Lighting
    - .5 Lighting Controls
    - .6 Branch Wiring, Conduit, Raceway, Boxes
    - .7 Exit & Emergency Lighting
    - .8 Electric Heat
    - .9 Electric Vehicle Charging
    - .10 Photovoltaics
    - .11 Sound Masking



- .12 Voice/Data
- .13 Paging
- .14 Audio/Visual Systems
- .15 Intercom
- .16 Fire Alarm
- .17 CCTV
- .18 Intrusion
- .19 Access Control
- .20 Duress
- .21 Nurse Call
- .22 Infant Abduction
- .3 Progress for each system shall break out labor and materials separately.
- .3 Shop Drawings Administrative Requirements
  - .1 **Shop drawings shall be submitted electronically in PDF format documents to [shopdrawings@eppsiepman.com](mailto:shopdrawings@eppsiepman.com).**
  - .2 Shop drawing documents **shall be grouped by specification section**. Clearly list the specification section on the front page or cover sheet of the submittal. Shop drawings related to **multiple sections may not be grouped together** into a single document. Documents that are groups incorrectly will be returned without being examined and shall be considered rejected.
    - .1 Each drawing shall include the name of project as found on the drawings or specifications, the equipment supplier and the specification section that the equipment is specified under.
  - .3 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
  - .4 Work affected by submittal shall not proceed until review is complete.
  - .5 Present Shop Drawings, product data, samples and mock-ups in SI Metric and/or Imperial inch-pound units, to match the units used in the schedules.
- .4 Shop Drawings and Product Data
  - .1 Submit shop drawings and product data for review by the Consultant. All drawings shall be in English and metric dimensions or in imperial where indicated. Manufacture of equipment shall not commence until shop drawings have been reviewed.
  - .2 Material submitted for review shall be marked up bear the Contractor's and where applicable the Utility's reviewed stamp.
  - .3 Shop drawings shall be reviewed by the electrical contractor, general contractor, and where applicable the Utility prior to submittal to Consultant, confirming that they meet all the design requirements. 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.
- .4 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.
- .5 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .6 Where applicable, include wiring, single line and schematic diagrams.
- .7 Include wiring drawings or diagrams showing inter-connection with work of other sections.
- .5 Provide scaled drawings showing layout of all electrical equipment and coordination of same with mechanical equipment in all electrical, electrical/mechanical and voice data rooms.
- .6 Submit samples in accordance with General Conditions. Samples shall be forwarded to the Consultant's office and returned. Approved samples will be retained until after tender closing, then all samples will be returned except for the sample submitted by the Manufacturer who has been listed by the successful Contractor in the tender documents. This sample will be used for comparison with the actual production run of successful manufacturer.
- .7 Submit shop drawings of service entrance equipment to utilities.

## **1.9 CLOSEOUT SUBMITTALS**

- .1 Refer to Division 01.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 Four (4) weeks prior to Substantial Performance of the Work, submit to the Consultant, one (1) draft copy of operating and maintenance manuals in Canadian English.
- .4 Copy will be returned with Consultant's comments.
- .5 Revise content of documents as required prior to final submittal.
- .6 Two (2) weeks prior to Substantial Performance of the Work, submit to the Consultant, three (3) final copies of operating and maintenance manuals in Canadian English.
- .7 Summary audit documents associated with requirements for LEED classification documentation.
- .8 Maintenance Data:
  - .1 Provide operation and maintenance data for incorporation into Maintenance Manuals.
  - .2 Include details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
  - .3 Include technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.

- .4 Include all warranty information.
- .5 Submit Maintenance Manuals to the Consultant for review. Manuals that are incomplete shall be returned to the Electrical Sub-Contractor for completion. Completed manuals shall be submitted, to the satisfaction of the Consultant, before final payment may be considered to be due.
- .6 Format
  - .1 Refer also to Section 01 78 10 for formats for manuals. Where there is a discrepancy with this section, follow the requirements of 01 78 10.
  - .2 Organize data in the form of an instructional manual.
  - .3 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 8.5 x 11 inch (219 x 279 mm) with spine and face pockets.
  - .4 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
  - .5 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
  - .6 Arrange content by systems under Section numbers and sequence of Table of Contents.
  - .7 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
  - .8 Text: Manufacturer's printed data, or typewritten data.
  - .9 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .7 Contents
  - .1 Refer also to Section 01 78 10 for formats for contents. Where there is a discrepancy with this section, follow the requirements of 01 78 10.
  - .2 Table of Contents: Provide:
    - .1 Title of project.
    - .2 Date of submission.
    - .3 Names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
    - .4 Schedule of products and systems, indexed to content of volume.
  - .3 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
  - .4 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.
  - .5 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control, wiring, and schematic diagrams and performance curves.
  - .6 Include Systems Certifications where applicable.
  - .7 Include manufacturer specific warranties where applicable.

- .8 Include a list of maintenance materials provided in each related section.
  - .9 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including code compliance certificate, life safety systems performance certificate.
  - .10 Training: Record of owner's representative training as specified.
- .9 Maintenance Materials:
- .1 Provide maintenance materials as specified. Include a list of the maintenance materials in each related section of the operation and maintenance data.
  - .2 Turn materials over to Owner in an orderly fashion upon completion of installation.
- .10 Record Documentation:
- .1 Prior to Substantial Performance of the Work, electronically transfer the marked-up information from the as-built documents, as follows:
    - .1 Drawings: Scan the full-sized field-verified as-built drawing set and save to PDF format. Scans shall be in colour and with good resolution to ensure drawings and markups are legible.
    - .2 Specifications: Adobe Acrobat (PDF).
  - .2 Mark revised documents as "RECORD DOCUMENTS". Include all revisions.
  - .3 Submit completed record documents to Consultant on a CD, DVD, or by electronic transfer.
  - .4 Project record documents shall comprise a complete and accurate record of the actual electrical installation. Record drawings that are inaccurate or incomplete shall be returned to the contractor for correction and completion.
  - .5 Record drawings shall contain a stamp bearing the words "Record Drawing" or "As-Built Drawing", the electrical contractor's company name, date, and the contractor's signature.
  - .6 The consultants will recommend a suitable deficiency holdback until accurate and complete record drawings have been submitted in acceptable form.
  - .7 Indicate on record drawings, location of all buried services. This information is to be certified correct by Consultant before backfilling commences.
  - .8 Record actual size and location of all cables including depth of cables where buried.
  - .9 Contractor to take all schedules/details from specification and put onto additional drawing sheets for Record Drawings.

#### **1.10 EXAMINATION**

- .1 Prior to submitting a tender, examine the site and local conditions which will affect the work. Refer to the Architectural, Mechanical and Structural drawings, schedules and specifications for construction details to be certain that the electrical work can be satisfactorily carried out as specified. Claims for extra payments resulting from conditions which could reasonably be foreseen during an examination of the documents and/or site, will not be recognized.

- .2 Ensure that all equipment designated as “Existing to Remain” or “Existing to be Relocated” is suitable for its intended re-use, including panelboards and circuits. Report any discrepancies to the Consultant before tender close.
- .3 Refer to General Conditions for instructions regarding a prearranged site visit during the tender period.
- .4 Notify Consultant of any discrepancies, omissions, etc., prior to the awarding of the contract, otherwise the Electrical Contractor shall perform the work as directed at no additional cost to the Owner.

#### **1.11 MANITOBA HYDRO POWER SMART**

- .1 Electrical contractor shall make application on behalf of the owner for the Manitoba Hydro Power Smart Incentive for all available rebates under the Commercial Lighting Program.
- .2 Application shall be made and acceptance provided by MB Hydro prior to commencement of demolition.
- .3 Electrical Contractor shall gather all information as required to complete the application.
- .4 Electrical Contractor shall provide updates to the owner regarding status of the application and expected rebates.

### **Part 2 Products**

#### **2.1 MATERIALS AND EQUIPMENT**

- .1 Provide labour, materials, transportation, equipment and facilities, etc., required for the complete electrical installation as indicated or implied on the drawings and specifications.
- .2 Electrical equipment shall be new and of type and quality specified.
- .3 Request for approval of material, as equal, shall conform to the specification.
- .4 Equivalent materials and equipment
  - .1 Bidders shall submit a tender based on the specified materials and equipment only.
  - .2 Bidders may submit a tender based on equivalent materials and equipment only if such items have been approved as equals by the Consultant.
  - .3 Bidders may submit, with their tender, an alternate price based on alternate materials and equipment only if such items have been approved as alternates by the Consultant.
  - .4 Submissions for equals or alternates shall be received by the Consultant, ten (10) working days prior to tender closing. Submissions shall include sufficient manufacturer’s data to clearly show equivalency, as well as an itemized list of equal or alternate items, the items for which they were submitted and a space for the Consultant to indicate “approved equal”, “approved alternate”, or “not approved”. Submittal list will be returned or may be picked up at the Consultant’s office. Where submissions are not returned by the Consultant before tender closing or are not received by the Consultant ten (10) working days before close of tender, they are considered not approved.

- .5 All submissions shall include the following phrase “We have reviewed all contract documents, contract drawings and specifications relating to the equipment presented herein” and shall bear the name and signature of the manufacturer or their agent.

## **2.2 VOLTAGE RATINGS**

- .1 Operating voltages: to CAN3-C235-83(R2015).
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment shall operate in extreme operating conditions established in above standard without damage to equipment.

## **2.3 FINISHES**

- .1 Finish outdoor electrical equipment such as parking lot panels, to match light standards.
- .2 Paint indoor switchgear light grey to EEMAC-2Y-1.
- .3 Paint indoor distribution enclosure trims light grey to EEMAC-2Y-1. Distribution tub shall be galvanized.
- .4 Paint outdoor electrical equipment enclosures with two (2) coats of U.V. resistant Urethane Enamel to minimum 1.5 mil dry coat thickness. Colour shall be “equipment green” to EEMAC 2Y-1.
- .5 Clean and touch up surfaces of shop-painted equipment, scratched or marred during shipment or installation, to match original paint.
- .6 Clean, prime and paint exposed wiring, conduit, junction and pull boxes, hangers, racking, and fasteners to prevent rusting and to match surrounding finishes where applicable.

## **2.4 LABELS AND WARNING SIGNS**

- .1 Manufacturer’s nameplates and CSA labels shall be visible and legible after equipment is installed.
- .2 Provide warning signs on equipment, as required, to meet the requirements of the Inspection Authorities, including indication of multiple power sources.
- .3 Provide quantity as required of buried cable signs reading “Buried Cable” and “Buried High Voltage Cable”. Signs shall be installed at building structure/equipment, at locations as directed on site and as per Canadian Electrical Code.

## **2.5 PROTECTION**

- .1 Guards
  - .1 Provide guards for all electrical equipment and devices in gymnasium and other areas subject to damage.
- .2 Sprinkler Proof Equipment
  - .1 All surface mounted electrical equipment located in sprinklered areas shall be sprinkler proof and shall be provided with suitable hoods and shields.

- .2 Entrance of conduits into the top of surface mount electrical panels/cabinets/distributions and motor control centers shall utilize O-rings and watertight connectors.
- .3 All recessed mounted branch circuit panels and distribution panels shall be provided with a Type 2 enclosure.
- .3 Construction
  - .1 Protect exposed live equipment during construction for personnel safety.
  - .2 Shield and mark live part "LIVE ( ) VOLTS", with appropriate voltage.
  - .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision.

## **2.6 SPARE PARTS AND MAINTENANCE MATERIALS**

- .1 Assemble spare parts as specified.
- .2 Include the following:
  - .1 Part number.
  - .2 Identification of equipment or system for which parts are applicable.
  - .3 Installation instructions as applicable.
- .3 Provide a written list complete with Owner's signature assuring that spare parts have been received by the Owner.

## **2.7 ACCESS DOORS**

- .1 Access doors shall be minimum #12 gauge prime coat painted bonderized steel. Each shall be complete with a heavy flush frame and anchor, concealed hinges, positive locking screwdriver lock, and mounting and finishing provisions to suit the finish material for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc. shall be ULC. listed and labeled and of a rating to maintain the fire separation integrity.
- .2 Where access doors are located in surfaces where special finishes are required, they shall be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout.
- .3 Supply access doors in inaccessible construction shall give access to all concealed junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair.
- .4 Before commencing installation of electrical work, submit to the Architect for approval, a list of required access doors showing the exact sizes and locations of such access doors. Locate access doors in walls and partitions to the Architect's approval, and arrange electrical work to suit. Access doors shall be, wherever possible, of a standard size for all applications. Confirm exact dimensions with the Architect, prior to ordering.
- .5 Access doors will be installed by the Division responsible for the particular type of construction in which access doors are required. Supply the access doors to the Division installing same at the proper time to avoid construction delays.

**Part 3 Execution**

**3.1 COORDINATION WITH OTHER TRADES**

- .1 Refer to Mechanical, Structural, Architectural and Interior Design drawings and specifications for additional electrical work in connection with other Divisions. Where such work is included in other sections of the specifications, provide equipment, conduit, wiring, etc. (in accordance with the approved manufacturer's shop drawings), as required, for operation of the specified equipment.
- .2 Schedule execution of electrical work with associated work specified in other Divisions.
- .3 Coordinate electrical work with work of other trades to avoid conflicts with pipes, air ducts or other equipment. Provide additional supports, wiring, etc., to relocate electrical equipment, as required, where structural members, air ducts, piping or other equipment interferes with the electrical installation.
- .4 Prior to installation provide scaled drawings of all mechanical/electrical rooms and communication rooms showing layout of all equipment (mechanical and electrical) for Consultant review.

**3.2 QUALITY ASSURANCE**

- .1 Do complete installations in accordance with CSA C22.1-18.
- .2 While not identified and specified by number in this Division, comply with CSA Electrical bulletins in force at time of tender submission. Comply with the requirements of all Provincial and local laws, rules, ordinances and codes.
- .3 Electrical installations shall comply with all requirements of the electrical supply authority and the inspection authority.
- .4 Electrical installation shall be in accordance with the applicable versions of the Canadian Electrical Code, Provincial and other codes, rules and regulations. Supply material and labour required to meet the requirements of these codes, rules and regulations even though the work is not shown on the drawings or mentioned in the specifications. Where the electrical installation calls for better quality materials or construction than the minimum requirements of these codes, rules and regulations, the electrical installation shall be as shown on the drawings and as specified.

**3.3 WORKMANSHIP**

- .1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Consultant. Install conduit and cable runs parallel and perpendicular to building lines in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.
- .2 Install equipment/junction boxes and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearances and accessibility for same.
- .3 Provide for all requirements shown on shop drawings or manufacturer's installation instructions.
- .4 Work deemed by the Consultant to be unsatisfactory shall be replaced at no additional cost.



### **3.4 DELIVERY STORAGE AND HANDLING**

- .1 Deliver all materials to site in an orderly fashion.
- .2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials shall be left in shipping containers until required for use.
- .3 Provide additional protection such as tarps, padding, wood skids, etc., as required to ensure protection of equipment and as directed by the Architect.

### **3.5 CONDUIT SLEEVES AND HOLES**

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete shall be sized for free passage of conduit.
- .2 Holes through exterior walls and roof shall be flashed and made weatherproof.
- .3 Make necessary arrangements for cutting of chases, drilling of holes and other structural work required to install electrical conduits, cables, pullboxes and outlet boxes.
- .4 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .5 Provide a minimum of two (2) separate conduit sleeves embedded in each concrete lighting fixture base. At least one (1) unused conduit shall be for possible future extension of wiring.
- .6 All conduits and cables shall be entered into the building above grade unless otherwise noted.
- .7 All coring in buildings with electrical in the slab shall be scanned at contractor's expense to prevent damage.

### **3.6 CUTTING AND PATCHING**

- .1 Pay the costs of all cutting and patching required for the installation of electrical work. Payment for cutting and patching shall be made through the General Contractor.
- .2 Cutting and patching required for the installation of electrical work shall be done by the particular trade whose work is involved. No cutting or patching shall be carried out by the tradesman employed on the electrical work.
- .3 Obtain the approval of the Architect before arranging for any cutting. Patching shall restore the affected area to the original condition; materials and methods used for patching shall be in accordance with the requirements of the corresponding Divisions of the specification.

### **3.7 DEVICE INSTALLATION**

- .1 Device Location
  - .1 Locate devices as indicated.
  - .2 Do not install devices back-to-back in wall.
  - .3 Drawings are schematic only and do not indicate all architectural or structural elements.
  - .4 Change location of devices at no extra cost or credit, providing distance does not exceed 10'-0" (3 m) and information is provided before installation.

- .5 Locate light switches on latch side of doors.
  - .6 Vertically align devices of different systems when shown in close proximity to each other and occurring at different mounting heights.
  - .7 Coordinate mounting heights and location of all equipment with Architectural, Mechanical and Structural Drawings prior to installation of rough-in boxes.
- .2 Mounting Heights
- .1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.
  - .2 If mounting height of equipment is not indicated, verify with Architect before proceeding with installation.
  - .3 Install electrical equipment at the following heights unless indicated or directed otherwise:

Device / Equipment	Mounting Height	
Devices above counters	150mm	6"****
- General (Accessible Height)	450mm	18"
- Mechanical/Shop Areas	1000mm	40"
- Clock	2150mm	84"
- Above top of continuous baseboard heater	200mm	8"
- Exterior	1000mm	40"
Switches, Dimmers, push buttons, Luxo bracket		
- General	1200mm	47"
- Accessible Suites	900mm	36"
Clocks	2150mm	84"
Exit Signs	25mm*****	1"*****
Emergency Lighting Battery Banks/Remote Headers	2350mm* or 150mm**	92"* or 6"**
Automatic Door Operator Pushbuttons	900mm	36"
Occupancy Sensors – Switch based with manual override controls.	1200mm	47"
Occupancy Sensors – General	Per manufacturers recommendations	
Fire Alarm Visual, Audible, & Combination Devices	2350mm* or 150mm**	92"* or 6"**
Fire Alarm Manual Pullstations	1200mm	47"
Fire Fighter Handsets	1500mm	59"
Thermostats		
- General	1200mm	47"
- Accessible Suites	900mm	36"
Intercom Stations	1200mm	47"

Proximity/Card Readers	900mm	36"
Communication Outlets (Accessible Height)	450mm	18"
Hand Dryers	1200mm	47"
Branch Circuit Panelboards, Control Panels, Annunciators. Install panels taller than 1800mm (72") with bottom no more than 100mm (4") above floor.	2000mm*	78"*
Enclosed circuit breakers	1600mm***	60"***

\*Measured to top of device/equipment

\*\*Measured from Ceiling to top edge of device where mounting height would be lower than required specification.

\*\*\*Measured to operating handle of device.

\*\*\*\*Coordinate counter backsplash heights with architectural drawings prior to rough-in. Maintain minimum 1" clearance above backsplash height.

\*\*\*\*\*Measured above door trim to underside of device.

- .1 Coordinate all mounting heights with Architectural elevations.
- .2 Where installed in block or brick, mounting heights shall be as above or at bottom of nearest course.
- .4 Circuiting is representational within a panel only. Circuit all electrical equipment and devices to their individually respective, intended panels.
- .5 Panelboards and other equipment which are to be surface mounted shall be installed on minimum 19mm (3/4") good one side, fir plywood mounting backboards. Treat backboards with wood preservative prior to installation and paint with primer and two (2) coats gray enamel before any equipment is mounted. Provide plywood mounted boards unless specified otherwise in other sections.
- .6 Panelboards mounted on exterior concrete/block walls shall have minimum 3/4" air gap behind enclosure (to minimize condensation).
- .7 All transformers, motor control centers and floor-mounted distribution panels shall be mounted on 100mm (4") concrete housekeeping pads. The Electrical Contractors shall be responsible for provision of these pads.

### 3.8 FIREPROOFING

- .1 Where cables or conduits pass through block or concrete walls and floors and any fire-rated assembly, seal openings with firestopping systems that have been tested for specific fire-resistance-rated construction conditions conforming to the construction assembly type, penetrating item type, annular space requirements, and fire-rating involved in each instance.
- .2 Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
- .3 Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products.

- .4 Fire proofing of electrical cables, conduits, trays, etc, passing through fire barriers shall conform to local codes and inspection authorities.
- .5 Fire stop materials shall be asbestos free and have been tested in accordance with ASTM E-814, and ULC 1479.
- .6 Fire stop and smoke seals shall be done in accordance with Section 07 84 13.
- .7 Approved manufacturers:
  - .1 Nelson Firestop Products
  - .2 Specified Technologies
  - .3 Hilti Firestop

### **3.9 LOAD BALANCE**

- .1 Measure phase current to panelboards with normal loads operating at time of measurement. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, a report listing phase and neutral currents on panelboards, transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.
- .4 Include load balance test results in maintenance manuals.

### **3.10 TESTING**

- .1 Conduct and pay for tests including, but not limited to, the following systems:
  - .1 High voltage distribution equipment in accordance with relevant sections of specification.
  - .2 Power generation and distribution system.
  - .3 Circuits originating from branch distribution panels.
  - .4 Lighting and its control.
  - .5 Systems:
    - .1 Public Address
    - .2 Communication cabling systems.
  - .6 Grounding systems.
- .2 Insulation Resistance Testing
  - .1 Hi-pot all H.V. cable and equipment over 600 volts, to manufacturer's specifications.
  - .2 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
  - .3 Megger 350-600V circuits, feeders and equipment with a 1000V instrument.
  - .4 Check resistance to ground before energizing.
- .3 Furnish Manufacturer's Certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions. Submit letter in accordance with this section.

- .4 Carry out tests in presence of Consultant where directed.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results in Maintenance Manuals.

**3.11 CARE, OPERATION AND START-UP**

- .1 Instruct the Owner's operating personnel in the operation, care and maintenance of equipment. Arrangement of such instructional sessions shall be done at a time convenient to the Owner.
- .2 Arrange and pay for services of Manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such a period, and for as many visits as necessary to put equipment into operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

**3.12 CLEANING**

- .1 Final cleaning shall be done in accordance with the specification.
- .2 Final cleaning shall include, but not be limited to, all lighting reflectors, lenses, and other lighting surfaces that have been exposed to dust and dirt throughout the course of construction.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Armoured cable.
- .2    Metal clad cable.
- .3    Wiring connectors and connections.

**1.2                RELATED SECTIONS**

- .1    Section 26 05 53 - Electrical Identification.
- .2    Section 31 23 18 - Trenching: Trenching and backfilling for direct burial cable installation.

**1.3                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2    C22.2 No. 0.3-09 (R2014) - Test Methods for Electrical Wires and Cables.
- .3    CSA C22.2 No. 51-14 - Armoured Cables.
- .4    CAN/CSA-C22.2 No. 65-18 - Wire Connectors.
- .5    CSA C22.2 No. 75-17 - Thermoplastic-Insulated Wires and Cables.
- .6    CSA C22.2 No. 123-16 - Metal Sheathed Cables.
- .7    CAN C22.2 No.131-17 - Type TECK 90 Cable.
- .8    NECA (National Electrical Contractors Association) - National Electrical Installation Standards (NEIS).
- .9    NETA (InterNational Electrical Testing Association) - ANSI/NETA ATS-2017 - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
- .10    CSA (Canadian Standards Association).
- .11    ULC (Underwriters' Laboratories of Canada).

**1.4                ADMINISTRATIVE REQUIREMENTS**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Coordination:
  - .1    Coordinate with other work having a direct bearing on work of this section.
  - .2    Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

**1.5                SUBMITTALS FOR REVIEW**

- .1    Refer to 26 05 00 Common Work Results for Electrical.

- .2 Product Data: Provide for Fire Rated Cable.

#### **1.6 SUBMITTALS FOR INFORMATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- .3 Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

#### **1.7 CLOSEOUT SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Record Documentation:
  - .1 Record actual locations of components and circuits.
  - .2 Record routing of all equipment and panelboard feeders.

#### **1.8 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

#### **1.9 REGULATORY REQUIREMENTS**

- .1 Conform to CSA-C22.1.
- .2 Provide products listed and classified by CSA or ULC and as suitable for the purpose specified and indicated.

#### **1.10 PROJECT CONDITIONS**

- .1 Conductor sizes are based on copper unless indicated as aluminum or "AL".

### **Part 2 Products**

#### **2.1 ARMOURED CABLE**

- .1 Description: Type ACWU90 and AC90.
- .2 Conductor: Copper unless otherwise noted.
- .3 Insulation Voltage Rating: 600 volts.
- .4 Insulation Temperature Rating: 90 degrees C.
- .5 Insulation Material: Thermoplastic.

#### **2.2 METAL CLAD CABLE**

- .1 Description: Type TECK90.
- .2 Conductor: Copper unless otherwise noted.
- .3 Insulation Voltage Rating: 600 volts.

- .4 Insulation Temperature Rating: 90 degrees C.
- .5 Conductor Insulation Material: Cross-Linked Polyethylene (XPLE), type RW90.
- .6 Armour Material: Aluminum.
- .7 Armour Design: Interlocked metal tape.
- .8 Outer jacket: PVC.
- .9 Rating: Hazardous Location, CSA FT4

### **2.3 CONNECTORS**

- .1 Pressure type connectors, fixture type splicing connectors, cable clamps and lugs, as required.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that field measurements are as indicated.
- .3 Verify that interior of building has been protected from weather.
- .4 Verify that mechanical work likely to damage wire and cable has been completed.
- .5 Verify that raceway installation is complete and supported.

### **3.2 PREPARATION**

- .1 Completely and thoroughly swab raceway before installing wire.

### **3.3 WIRING METHODS**

- .1 Concealed Dry Interior Locations: Use only armoured cable and building wire in raceway.
- .2 Exposed Dry Interior Locations: Use only building wire in raceway.
- .3 Above Accessible Ceilings: Use only armoured cable, metal clad cable, and building wire in raceway.
- .4 Wet or Damp Interior Locations: Use only metal clad cable, armoured cable with jacket, and building wire in raceway.
- .5 Use wiring methods indicated.

### **3.4 INSTALLATION**

- .1 Route wire and cable as required to meet project conditions.
- .2 Install cable to the CSA-C22.1.
- .3 Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- .4 Use stranded conductors for control circuits.



- .5 Use conductor not smaller than 12 AWG for power and lighting circuits.
- .6 Pull all conductors into raceway at same time.
- .7 Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- .8 Protect exposed cable from damage.
- .9 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- .10 Single conductor cables shall be installed one cable diameter apart on suspended cable tray or channel supports and shall be clamped with aluminum cable clamps. Cables shall be terminated using non-magnetic connectors and shall be watertight for top entry. Cable armour shall be grounded via an aluminum plate at the supply end and isolated via an insulating plate, at the load end of the cable. A #3/0 AWG insulated (unless otherwise noted) copper ground wire shall be installed with each set of feeder cables. Cable bending radius shall be at least twelve times the overall cable diameter and bend shall not damage or distort the outer sheath.
- .11 Armoured cable shall be used for connections from conduit systems to recessed luminaires in accessible ceilings. Cable shall be of sufficient length to allow the lighting fixture to be relocated to any location within an 1800mm (6') radius. Cable shall be clamped before entering the lighting fixture and shall be clipped before entering the conduit system junction box. (Minimum requirements).
- .12 Armoured cable may be used for connections from conduit systems to wiring devices in steel stud partitions and for interconnection of wiring devices within steel stud partitions. Cables shall be clipped before entering junction or outlet boxes.
- .13 Use suitable cable fittings and connectors.
- .14 Neatly train and lace wiring inside boxes, equipment, and panelboards.
- .15 Clean conductor surfaces before installing lugs and connectors.
- .16 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- .17 Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- .18 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- .19 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- .20 Identify wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Equipment grounding conductors.
- .2    Bonding.

**1.2                RELATED SECTIONS**

- .1    Section 26 00 00 – Basic Electrical Materials and Methods.
- .2    Section 26 41 00 - Lightning Protection.
- .3    Section 33 79 19 - Site Utilities Grounding.

**1.3                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2    CSA-Z32-09 Electrical Safety & Essential Electrical Systems in Health Care Facilities.
- .3    IEEE 81-2012 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

**1.4                SYSTEM DESCRIPTION**

- .1    Metal and underground water pipe.
- .2    Metal frame of the building.
- .3    Ground ring specified in Section 33 79 19.
- .4    Metal and underground gas piping system.

**1.5                PERFORMANCE REQUIREMENTS**

- .1    Maximum Grounding System Resistance: 5 ohms.

**1.6                SUBMITTALS FOR REVIEW**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Product Data: Provide for grounding electrodes and connections.

**1.7                SUBMITTALS FOR INFORMATION**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Test Reports: Indicate overall resistance to ground.

**1.8                CLOSEOUT SUBMITTALS**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Record Documentation: Record actual locations of components and grounding electrodes.

- .3 Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

## **1.9 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.

## **1.10 REGULATORY REQUIREMENTS**

- .1 Products: Listed and classified by ULC and/or CSA as suitable for the purpose specified and indicated.

## **Part 2 Products**

### **2.1 MECHANICAL CONNECTORS**

- .1 Material: Bronze.

### **2.2 WIRE**

- .1 Material: Stranded copper.
- .2 Grounding Electrode Conductor: Size to meet CSA-C22.1 requirements.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that final backfill and compaction has been completed before driving rod electrodes.

### **3.2 INSTALLATION**

- .1 Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- .2 Provide bonding to meet Regulatory Requirements.
- .3 Exposed conductors shall be protected from mechanical injury.
- .4 Mechanical connections shall be used for bonding connections to equipment. Soldered joints shall not be permitted.
- .5 Buried connections of grounding and bonding conductors shall be made using exothermic welding process.
- .6 Provide bonding wire connected to both ends of flexible conduit. Neatly attach to exterior of flexible conduit.
- .7 Provide separate ground conductors for all exterior pole mounted luminaires.
- .8 Interface with site grounding system.

- .9 Interface with lightning protection system.
- .10 Bonding connections shall be made using a star configuration. Loop connections shall be avoided.
- .11 Single conductor cables with metallic armour shall be bonded at the supply end only. Provide non-metallic entry plates for load end terminations. Provide a separate bonding conductor.
- .12 Provide separate bonding conductor in all non-metallic raceways.
- .13 Bond together metal siding not attached to grounded structure; bond to ground.
- .14 Bond together reinforcing steel and metal accessories in fountain and pool structures.
- .15 Install transient suppression plate where indicated.
- .16 Provide isolated grounding conductor for circuits supplying
- .17 Provide additional separate bonding conductor within branch circuit raceways where indicated on the drawings. Terminate each end on suitable lug, bus, or bushing.

### **3.3 SYSTEM GROUNDING**

- .1 Install system and circuit grounding connection to neutral points of 600V and 208V systems.
- .2 Grounding conductors shall be routed in or adjacent to primary conduits or cables.

### **3.4 EQUIPMENT BONDING**

- .1 Install bonding connections to typical equipment included in, but not necessarily limited to:
  - .1 Service equipment
  - .2 Distribution Panels
  - .3 Transformers
  - .4 Generators
  - .5 Motor Frames
  - .6 Motor Control Centres
  - .7 Starters
  - .8 Control Panels
  - .9 Building Steel Work
  - .10 Elevators
  - .11 Outdoor lighting

### **3.5 COMMUNICATION SYSTEMS**

- .1 Install communications grounding system for bonding of all telephone, data, fire alarm, paging as follows:
  - .1 Provide minimum #6 AWG ground (or larger as indicated on drawings) from all voice/data, server, and IT communications rooms to main building ground.

- .2 Provide grounding for utility telephone and data demarcation locations in accordance with utility requirements.
- .3 Sound, fire alarm, and other communication systems as indicated.

**3.6 FIELD QUALITY CONTROL**

- .1 Perform ground continuity and resistance tests using fall-of-potential measurement system method per IEEE 81-2012 standards. A report shall be submitted to the Consultant from the testing agency.
- .2 Perform tests before energizing electrical system.
- .3 Disconnect ground fault indicator, if provided, during tests.
- .4 A ground electrode with an unsatisfactory resistance test result shall be altered as necessary until the required resistance reading is achieved.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Conduit and equipment supports.
- .2    Anchors and fasteners.

**1.2                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2    CECA - Canadian Electrical Contractors Association.
- .3    CSA (Canadian Standards Association).
- .4    ULC (Underwriters' Laboratories of Canada).

**1.3                SUBMITTALS FOR REVIEW**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Product Data: Provide manufacturer's catalogue data for fastening systems.

**1.4                REGULATORY REQUIREMENTS**

- .1    Provide products listed and classified by CSA and as suitable for purpose specified and shown.

**Part 2            Products**

**2.1                PRODUCT REQUIREMENTS**

- .1    Materials and Finishes: Provide adequate corrosion resistance.
- .2    Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- .3    Anchors and Fasteners:
  - .1    Concrete Structural Elements: Use expansion anchors.
  - .2    Steel Structural Elements: Use beam clamps and spring steel clips.
  - .3    Concrete Surfaces: Use expansion anchors.
  - .4    Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
  - .5    Solid Masonry Walls: Use expansion anchors.
  - .6    Sheet Metal: Use sheet metal screws.
  - .7    Wood Elements: Use wood screws.

**2.2 STEEL CHANNEL**

- .1 U-shape, galvanized steel, size 1.6" x 1.6" (40 x 40 mm), 0.1" (2.5 mm) thick, surface-mounted, suspended or set in poured concrete walls and ceilings as required.

**2.3 INSTALLATION**

- .1 Install products to manufacturer's written instructions.
- .2 Provide anchors, fasteners, and supports to CSA-C22.1.
- .3 Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- .4 Do not use powder-actuated anchors.
- .5 Obtain permission from Consultant before using powder-actuated anchors.
- .6 Do not drill or cut structural members.
- .7 Obtain permission from Consultant before drilling or cutting structural members.
- .8 Do not use plastic cable ties.
- .9 Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- .10 Install surface-mounted cabinets and panelboards with minimum of four anchors.
- .11 In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 inch) off wall.
- .12 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Metal conduit.
- .2      Flexible metal conduit.
- .3      Electrical metallic tubing.

**1.2                RELATED SECTIONS**

- .1      Section 07 84 00 - Firestopping.
- .2      Section 26 05 34 - Boxes.
- .3      Section 26 05 26 - Grounding And Bonding.
- .4      Section 26 05 29 - Electrical Supporting Devices.
- .5      Section 26 05 53 - Electrical Identification.

**1.3                REFERENCES**

- .1      CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2      CSA C22.2 No. 18.1-13 (R2018) - Metallic Outlet Boxes.
- .3      CSA C22.2 No. 45.1-07 (R2017) - Electrical Rigid Metal Conduit - Steel.
- .4      CSA-C22.2 No. 83.1-07 (R2017) - Electrical Metallic Tubing - Steel.
- .5      CSA (Canadian Standards Association).
- .6      ULC (Underwriters' Laboratories of Canada).

**1.4                ADMINISTRATIVE REQUIREMENTS**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Coordination:
  - .1      Coordinate with other work having a direct bearing on work of this section.

**1.5                CLOSEOUT SUBMITTALS**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Record Documentation:
  - .1      Accurately record actual routing of conduits equal to or larger than 35mm (1-1/4").
  - .2      Accurately record actual routing of backbone conduit runs.
  - .3      Accurately record actual routing of all conduit in slab.

**1.6                REGULATORY REQUIREMENTS**

- .1      Design conduit size to CSA-C22.1.



- .2 Provide products listed and classified by CSA or ULC as suitable for purpose specified and shown.

### **1.7 DELIVERY, STORAGE, AND PROTECTION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Accept conduit on site. Inspect for damage.
- .3 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- .4 Protect PVC conduit from sunlight.

## **Part 2 Products**

### **2.1 CONDUIT REQUIREMENTS**

- .1 Minimum Size: 21 mm (3/4 inch) unless otherwise specified.
- .2 Underground Installations:
  - .1 More than 1525 mm (5 ft) from Foundation Wall: Use thick wall non-metallic conduit.
  - .2 Within 1525 mm (5 ft) from Foundation Wall: Use rigid steel conduit.
  - .3 In or Under Slab on Grade: Use thick wall non-metallic conduit.
  - .4 Minimum Size: 27 mm (1 inch).
  - .5 Provide a separate ground wire in all below-grade conduits.
  - .6 Provide an exterior trace wire for all conduits containing non-current carrying cabling.
  - .7 Use waterproof fittings.
- .3 Outdoor Locations, Above Grade: Use rigid steel conduit.
- .4 In Slab:
  - .1 Use electrical non-metallic tubing.
  - .2 Maximum Size Conduit in Slab: 27mm (1 inch).
- .5 Wet and Damp Locations: Use non-metallic conduit.
- .6 Dry Locations:
  - .1 Concealed: Use electrical metallic tubing.
  - .2 Exposed: Use electrical metallic tubing.
- .7 Hazardous Areas: Use rigid steel conduit or TECK cable complete with conduit seal fittings and compound.

### **2.2 METAL CONDUIT**

- .1 Rigid Steel Conduit: C22.2 No. 45.1.
- .2 Fittings and Conduit Bodies: All steel fittings.

### **2.3 ELECTRICAL METALLIC TUBING (EMT)**

- .1 Description: CSA C22.2 N0. 83.1; galvanized tubing.
- .2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel, set screw type in dry locations, watertight connectors in sprinklered areas
- .3 Refer to Section 26 05 53 for colour requirements.

### **2.4 FITTINGS**

- .1 Fittings shall be manufactured for use with conduit specified.
- .2 Insulated throat liners on connectors.
- .3 Steel raintight connector fittings complete with O-rings, for use on weatherproof or sprinklerproof enclosures. Steel raintight couplings shall be used for surface conduit installation exposed to moisture or sprinkler heads. Steel raintight connectors shall be used for all top entries to panels, contactors and motor control centres.
- .4 Expansion fittings
  - .1 Outdoor locations - Weatherproof expansion fittings with internal bonding assembly, suitable for 100 mm (4") or 200 mm (8") linear expansion.
  - .2 Wet and Damp Locations - Watertight expansion fittings with integral bonding jumper suitable for linear expansion, and 21 mm (3/4") deflection in all directions, as required.
  - .3 Panel Entry - Weatherproof expansion fittings for linear expansion as required.
  - .4 PVC Conduit - O-ring type expansion fittings.
  - .5 Flexible watertight conduit between junction boxes with integral bonding jumper suitable for linear and lateral movement greater than 19 mm (3/4").

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that field measurements are as shown on Drawings.
- .3 Verify routing and termination locations of conduit prior to rough-in.
- .4 Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.
- .5 Drawings do not contain all conduits. Provide all conduit as required for a complete system.
- .6 All conduit sizes indicated on drawings are minimum sizes unless otherwise noted. Where larger conduit sizes are required to meet Canadian Electrical Code requirements, contractor shall provide larger size at no additional cost. Increase conduit size at no extra costs where required to accommodate length of run and voltage drop requirements in accordance with Canadian Electrical Code requirements.

### 3.2 INSTALLATION

- .1 Install conduit to CSA C22.1.
- .2 Install non-metallic conduit to manufacturer's written instructions.
- .3 Arrange supports to prevent misalignment during wiring installation.
- .4 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- .5 Group related conduits; support using conduit rack.
- .6 Construct rack using steel channel. Provide space on each for 25% additional conduits.
- .7 Fasten conduit supports to building structure and surfaces to Section 26 05 29.
- .8 Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- .9 Do not attach conduit to ceiling support wires.
- .10 Arrange conduit to maintain headroom and present neat appearance.
- .11 Provide flexible metal conduit for all connections to motors, recessed lighting, suspended lighting, transformers, and equipment subject to movement or vibration.
- .12 Conduit Routing:
  - .1 All conduit shall be concealed except in mechanical and electrical rooms or as otherwise noted.
  - .2 Where surface conduit is installed:
    - .1 Locate more than 2000 mm (78 inches) from infrared or gas-fired heaters.
    - .2 Group conduits on suspended or surface rack support.
  - .3 Route conduit parallel and perpendicular to walls.
  - .4 Route conduit installed above accessible ceilings parallel and perpendicular to walls.
  - .5 Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
  - .6 Route conduit in and under slab from point-to-point.
  - .7 Do not route conduits through structural members unless otherwise indicated.
  - .8 Do not route conduit through terrazzo or concrete toppings unless otherwise indicated.
  - .9 Do not route conduit horizontally in masonry walls unless otherwise indicated.
  - .10 Do not cross conduits in slab.
- .13 Conduits in Poured Concrete:
  - .1 Submit marked up drawings of proposed conduit routing complete with conduit sizes to Structural and Electrical consultants for approval prior to installation.
  - .2 Coordinate installation of conduit to suit reinforcing steel.
  - .3 Locate in centre third of slab.
  - .4 Provide minimum separation of 150 mm (6") between parallel conduit runs.

- .5 Do not install conduit in drop panels, beams, or columns unless approved by the Structural Consultant.
- .6 Where conduits are grouped, or do not follow perpendicular to parallel to building lines, provide photos in electronic format (minimum resolution 1920x1080) of conduit installation prior to concrete pour.
- .7 Record drawings shall indicate location of all conduit embedded in concrete, or run below slab complete with dimensions to building lines.
- .8 For slab-on-grade, conduit larger than 27 mm (1") shall be routed below slab and encased in minimum 75 mm (3") of concrete.
- .14 All conduit below grade shall be sloped to provide drainage away from the building.
- .15 Maintain adequate clearance between conduit and piping.
- .16 Maintain 300 mm (12 inch) clearance between conduit and surfaces with temperatures exceeding 40 degrees C (104 degrees F).
- .17 Cut conduit square using saw or pipe cutter; de-burr cut ends.
- .18 Bring conduit to shoulder of fittings; fasten securely.
- .19 Where threaded connections are used, threads shall be of sufficient length to ensure a tight connection.
- .20 Where conduit becomes blocked, remove and replaced blocked sections.
- .21 Join non-metallic conduit using cement as recommended by manufacturer.
  - .1 Wipe non-metallic conduit dry and clean before joining.
  - .2 Apply full even coat of cement to entire area inserted in fitting.
  - .3 Allow joint to cure for 20 minutes, minimum.
- .22 Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- .23 Install no more than equivalent of two 90-degree bends between boxes.
  - .1 Use conduit bodies to make sharp changes in direction, as around beams.
  - .2 Use hydraulic one-shot bender to fabricate and factory elbows for bends in metal conduit larger than 53 mm (2 inch) size.
  - .3 All metallic conduit shall be bent cold. Replace sections where conduit is kinked or flattened by more than 10% of its original diameter.
- .24 Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- .25 Ensure conduit systems are dry prior to installation of wiring.
- .26 Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic and control expansion joints, and where conduit transitions from below to above grade.
- .27 Provide polypropylene pull string in each empty conduit except sleeves and nipples.
- .28 Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- .29 Ground and bond conduit to Section 26 05 26.

.30 Identify conduit to Section 26 05 53.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Wall and ceiling outlet boxes.
- .2      Pull and junction boxes.

**1.2                RELATED SECTIONS**

- .1      Section 07 84 00 - Firestopping.
- .2      Section 08 31 13 - Access Doors And Frames.
- .3      Section 26 27 26 - Wiring Devices.
- .4      Section 26 27 16 - Cabinets And Enclosures.

**1.3                REFERENCES**

- .1      CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2      CSA C22.2 No. 18.1-13 (R2018) - Metallic Outlet Boxes.
- .3      CSA C22.2 No. 40-17 - Junction and Pull Boxes.
- .4      CSA C22.2 No. 85-14 - Rigid PVC Boxes and Fittings.
- .5      CSA (Canadian Standards Association).
- .6      ULC (Underwriters' Laboratories of Canada).

**1.4                ADMINISTRATIVE REQUIREMENTS**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Coordination:
  - .1      Coordinate with other work having a direct bearing on work of this section.
  - .2      Coordinate installation of outlet box for equipment connected under Section 26 05 80.

**1.5                CLOSEOUT SUBMITTALS**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Record Documentation: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

**1.6                REGULATORY REQUIREMENTS**

- .1      Products: Listed and classified by CSA or ULC, and as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 OUTLET BOXES**

- .1 Sheet Metal Outlet Boxes: CSA-C22.2 No. 18, galvanized steel.
  - .1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm (1/2 inch) male fixture studs where required.
  - .2 Concrete Ceiling Boxes: Concrete type.
- .2 Non-metallic Outlet Boxes: CSA-C22.2 No. 18.
- .3 Cast Boxes: CSA-C22.2 No. 18, Type FS or FD as indicated or as required, cast ferric alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- .4 In-wall Boxes: 18 gauge white powder coated steel complete with trim ring, will accept standard single gang outlet boxes, wiring devices and cover plates, complete with screw-on steel cover with cable exit.
- .5 Wall Plates for Finished Areas: As specified in Section 26 27 26.

**2.2 PULL AND JUNCTION BOXES**

- .1 Sheet Metal Boxes: CSA-C22.2 No. 18, galvanized steel.
- .2 Hinged Enclosures: As specified in Section 26 27 16.
- .3 Surface Mounted Cast Metal Box: CSA-C22.2 No. 18, Type 4 or Type 6 as required or as indicated; flat-flanged, surface mounted junction box:
  - .1 Material: Galvanized cast iron.
  - .2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.
- .4 In-Ground Cast Metal Box: CSA-C22.2 No. 18, Type 6, flanged, recessed cover box for flush mounting:
  - .1 Material: Galvanized cast iron.
  - .2 Cover: Non-skid cover with neoprene gasket and stainless steel cover screws.
  - .3 Cover Legend: "ELECTRIC".
- .5 Fibreglass Hand Holes: Die moulded glass fibre hand holes:
  - .1 Cable Entrance: Pre-cut 150 x 150 mm (6 x 6 inch) or as indicated, cable entrance at centre bottom of each side.
  - .2 Cover: Glass fibre weatherproof cover with non-skid finish.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify locations of floor boxes and outlets throughout prior to rough-in.

### 3.2 INSTALLATION

- .1 Install boxes to CSA-C22.1.
- .2 Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- .3 Set wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device and as indicated. Coordinate locations with architectural drawings.
- .4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 ft) if required to accommodate intended purpose.
- .5 Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- .6 Maintain headroom and present neat mechanical appearance.
- .7 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- .8 Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 150 mm (6 inches) from ceiling access panel or from removable recessed luminaire.
- .9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- .10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- .11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- .12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- .13 Use flush mounting outlet box in finished areas.
- .14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- .15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm (6 inches) separation. Provide minimum 600 mm (24 inches) separation in acoustic rated walls.
- .16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- .17 Use stamped steel bridges to fasten flush mounting outlet box between studs.
- .18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- .19 Use in-wall boxes for wall mounted television and smart board power and communications applications.
- .20 Do not install in-wall box back-to-back in walls; provide minimum 150 mm (6 inches) separation. Provide minimum 600 mm (24 inches) separation in acoustic rated walls.
- .21 Secure in-wall box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- .22 Use stamped steel bridges to fasten in-wall outlet box between studs.



- .23 Install in-wall mounting box without damaging wall insulation or reducing its effectiveness.
- .24 Use adjustable steel channel fasteners for hung ceiling outlet box.
- .25 Do not fasten boxes to ceiling support wires.
- .26 Support boxes independently of conduit.
- .27 Use gang box where more than one device is mounted together.
- .28 The use of sectional boxes is not permitted.
- .29 Use gang box with plaster ring for single device outlets.
- .30 Use cast outlet box in exterior locations where exposed to the weather and wet locations.
- .31 Set floor boxes level.
- .32 Large Pull Boxes: Where pull boxes have a long dimension of 305 mm (12 inches) or more, use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

**3.3 ADJUSTING**

- .1 Adjust floor box flush with finish flooring material.
- .2 Adjust flush-mounting outlets to make front flush with finished wall material.
- .3 Install knockout closures in unused box openings.

**3.4 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Clean interior of boxes to remove dust, debris, and other material.
- .3 Clean exposed surfaces and restore finish.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Nameplates and labels.
- .2      Wire markers.
- .3      Conduit markers.

**1.2                RELATED SECTIONS**

- .1      Section 09 91 10 - Painting.

**1.3                REFERENCES**

- .1      CSA (Canadian Standards Association).
- .2      ULC (Underwriters' Laboratories of Canada).

**1.4                SUBMITTALS FOR REVIEW**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Product Data: Provide catalogue data for nameplates, labels, and markers.
- .3      Installation Data: Provide list of all equipment requiring nameplates complete with associated nameplate configuration for review.

**1.5                REGULATORY REQUIREMENTS**

- .1      Provide products listed and classified by CSA or ULC and as suitable for purpose specified and shown.

**1.6                LANGUAGE**

- .1      All identification shall be in English.

**Part 2            Products**

**2.1                NAMEPLATES AND LABELS**

- .1      Nameplates:
  - .1      Exterior –Stainless steel, etched and color filled with stamped product specific labelling.
  - .2      Interior - Engraved three-layer laminated plastic, white letters on blue background for normal power and systems, white letters on red background for life safety power and systems, and white letters on orange background for standby power and systems.
  - .3      Locations:
    - .1      Electrical distribution, motor control centres, disconnect switches, panelboards and control equipment enclosures.

- .1 Nameplate shall include:
  - .1 Distribution Name
  - .2 Distribution Voltage, Phase, Wires, Amperage
  - .3 Room Location
  - .4 Fed From:
    - .1 Panel Name
    - .2 Supplying Breaker Size/Poles
    - .3 Room Location
- .2 Electrical distribution and motor control centres..
  - .1 Nameplates at individual breakers shall include:
    - .1 Load Name
    - .2 Room Location of Load
    - .3 Breaker Size/Poles
- .3 Electrical distribution and panelboards where breakers are applied in series ratings shall also include:
  - .1 “BREAKERS ARE INSTALLED IN A SERIES RATED COMBINATION AND SHALL ONLY BE REPLACED WITH COMPONENTS OF THE SAME TYPE AND RATING.”
- .4 Circuit breakers and fused switches which directly feed a single conductor cable shall include the maximum continuous load allowed:
  - .1 “MAXIMUM CONTINUOUS LOAD: X AMPS”
- .5 Adjustable circuit breakers shall include the maximum continuous load allowed:
  - .1 “MAXIMUM CONTINUOUS LOAD: X AMPS”
- .6 Mechanical equipment disconnect switches:
  - .1 Nameplate shall include:
    - .1 Mechanical Equipment Mark
    - .2 Panel Name & Circuit number
- .7 Communication/Systems Racks & Cabinets
  - .1 Nameplate shall include:
    - .1 System Name
    - .2 Room Number
    - .3 Rack/Cabinet Number (if applicable)
    - .4 Fed From:
      - .1 Room Number.
      - .2 Rack/Cabinet Number (if applicable)
      - .3 Patch Panel and/or Rack Position (if applicable)
- .8 Fire Alarm System Equipment
  - .1 Nameplate shall include:
    - .1 Room Number
    - .2 Equipment Name

- .3 Fed From:
  - .1 Room Number.
  - .2 Panel Name and Circuit Number
- .9 Fire Alarm Equipment Branch Circuit Breakers
  - .1 Nameplate shall be red and meet AHJ requirements. Nameplate shall indicate “FIRE ALARM PANEL”, “NACPS” etc. or approved wording.
- .10 Pole mounted luminaires.
  - .1 Nameplate shall include:
    - .1 Manufacturer & Model # of Pole
    - .2 Manufacturer & Model # of Luminaire
    - .3 Voltage
    - .4 Ballast Model #
    - .5 Lamp Wattage & Model #
    - .6 Fed From Panel & Circuit Number
- .11 Emergency Lighting Units.
  - .1 Nameplate shall include:
    - .1 Unit #
    - .2 Manufacturer & Model # of unit equipment
    - .3 AC circuit supplying unit
    - .4 AC lighting circuits monitored (voltage relay)
    - .5 Date installed
- .12 Parking receptacles.
  - .1 Nameplate shall include:
    - .1 Circuit number
- .4 Letter Size:
  - .1 Use 6 mm (1/4 inch) letters for identifying equipment mark designations and system types.
  - .2 Use 3 mm (1/8 inch) letters for identifying supporting information.
  - .3 Use 6 mm (1/4 inch) letters for identifying grouped equipment and loads.
- .5 Nameplates on exterior equipment shall be UV & weather resistant.
- .6 Wording on nameplates shall be approved prior to manufacture. Submit schedule of nameplates and wording.
- .2 Labels: Plastic self-adhesive non-smear labels with 5mm (3/16 inch) black letters on white background.
  - .1 Locations:
    - .1 Wiring devices, including lighting control devices and receptacles.
      - .1 Label shall include:
        - .1 Indicate associated panel and circuit number.
        - .2 E.g. “A-32” (A is for Panel-A, and 32 is the circuit number)

- .3 Lighting controls to include brief description of lighting being controlled.
- .4 E.g. "Pendants"
- .2 Voice/Data Outlets
  - .1 Label shall include:
    - .1 Indicate associated rack or cabinet name
    - .2 Indicate associated patch panel and drop number
    - .3 E.g. "IDC-A-13" (IDC is for rack name, patch panel A, drop number 13)
  - .3 Voice/Data Patch Panels
    - .1 Label shall include:
      - .1 Indicate associated rack or cabinet name
      - .2 Indicate patch panel name.
      - .3 E.g. "IDC-A" (IDC is for rack name, patch panel A)

## 2.2 WIRE MARKERS

- .1 Wire Markers: Permanent tape type wire markers not susceptible to thermal or mechanical influence.
- .2 Locations:
  - .1 Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.
    - .1 Legend:
      - .1 Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
      - .2 Control Circuits: Control wire number indicated on Shop Drawings.
    - .2 Voice/Data drops including both ends of cable.
      - .1 Label shall include:
        - .1 Indicate associated rack or cabinet name
        - .2 Indicate associated patch panel and drop number
        - .3 E.g. "IDC-A-13" (IDC is for rack name, patch panel A, drop number 13)

## 2.3 CONDUIT MARKERS

- .1 Manufacturers:
  - .1 Brady; Product: BMP71 Indoor/Outdoor Vinyl Labels.
  - .2 Substitutions: Refer to Section 26 05 00.
- .2 Description: Vinyl label.
- .3 Location: Provide markers for each conduit longer than 4.7m (10 ft).
- .4 Spacing: 6m (20 ft) on centre.
- .5 Colour:

- .1 Normal Power System: Blue
- .2 Life-Safety Power System: Red
- .3 Standby Power System: Orange
- .4 Fire Alarm System: Red.
- .5 Communication System: Yellow
- .6 Legend:
  - .1 600 Volt System: 600V.
  - .2 120/208 Volt System: 120/208V.
  - .3 Fire Alarm System: FIRE ALARM.
  - .4 Communication System:
    - .1 VOICE
    - .2 DATA
    - .3 VOICE/DATA
  - .5 Public Address System: PA

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Degrease and clean surfaces to receive nameplates and labels.

#### **3.2 APPLICATION**

- .1 Install nameplate and label parallel to equipment lines.
- .2 Secure nameplate to equipment front using rivets or screws.
- .3 Conduit shall be integrally colour coded through a colouring process applied by the conduit manufacturer.
- .4 Colour:
  - .1 208 Volt System: Blue
  - .2 Fire Alarm System: Red.
  - .3 Communication System: Yellow
- .5 Provide identification on all junction box covers indicating associated system, panel and circuit numbering using permanent marker.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Hinged cover enclosures.
- .2      Cabinets.
- .3      Terminal blocks.
- .4      Accessories.

**1.2                RELATED SECTIONS**

- .1      Section 26 05 29 - Electrical Supporting Devices.

**1.3                REFERENCES**

- .1      CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2      CAN/CSA-C22.2 No. 94-M91 (R2006) - Special Purpose Enclosures.
- .3      CSA-C22.2 No. 158-10 - Terminal Blocks.
- .4      CSA (Canadian Standards Association).
- .5      ULC (Underwriters' Laboratories of Canada).

**1.4                SUBMITTALS FOR REVIEW**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Product Data: Provide manufacturer's standard data for enclosures and cabinets.

**1.5                SUBMITTALS FOR INFORMATION**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

**1.6                MAINTENANCE MATERIAL SUBMITTALS**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Extra Stock Materials: Provide two (2) of each key.

**1.7                REGULATORY REQUIREMENTS**

- .1      Conform to requirements of CSA-C22.1.
- .2      Products: Listed and classified by CSA and as suitable for the purpose specified and indicated.

**Part 2 Products**

**2.1 HINGED COVER ENCLOSURES**

- .1 Construction: CAN/CSA-C22.2 No. 94.
  - .1 Surface Mounted Indoor: Type 1 16 gauge steel enclosure
  - .2 Recessed Mounted Indoor: Type 2 16 gauge steel enclosure.
  - .3 Exterior Use: Type 4 14 gauge steel enclosure or as indicated.
- .2 Covers: Surface or Flush cabinet front with continuous hinge,
  - .1 Indoor: Held closed by flush latch operable by key.
- .3 Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- .4 Enclosure Finish: Manufacturer's standard grey enamel.

**2.2 CABINETS**

- .1 Boxes: Galvanized steel with removable end walls.
- .2 Box Size: 600mm (24 inches) wide x 150mm (6 inches) deep.
- .3 Backboard: Provide 19mm (3/4 inch) thick plywood backboard for mounting terminal blocks. Paint matte white.
- .4 Fronts: Steel, flush and type with screw cover front and door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- .5 Provide metal barriers to form separate compartments wiring of different systems and voltages.
- .6 Provide accessory feet for free-standing equipment.

**2.3 TERMINAL BLOCKS**

- .1 Terminal Blocks: CSA-C22.2 No. 158.
- .2 Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- .3 Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- .4 Provide ground bus terminal block, with each connector bonded to enclosure.

**2.4 ACCESSORIES**

- .1 Description: Plastic channel with hinged or snap-on cover.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install components to CSA-C22.1 and to manufacturer's written instructions.



- .2 Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner to Section 26 05 29.
- .3 Install cabinet fronts plumb.

**3.2 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Clean electrical parts to remove conductive and harmful materials.
- .3 Remove dirt and debris from enclosure.
- .4 Clean finishes and touch up damage.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1    Wall switches.
- .2    Wall dimmers.
- .3    Receptacles.
- .4    Device plates and decorative box covers.
- .5    Floor box service fittings.
- .6    Poke-through service fittings.
- .7    Access floor box.

**1.2                RELATED SECTIONS**

- .1    Section 26 05 34 - Boxes.

**1.3                REFERENCES**

- .1    CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .2    CSA C22.2 No. 42-10 (R2015) - General Use Receptacles, Attachment Plugs, and Similar Wiring Devices
- .3    CSA C22.2 No. 42.1-13 (R2017) - Cover Plates for Flush-Mounted Wiring Devices.
- .4    CSA C22.2 No. 55-15 - Special use switches.
- .5    CAN/CSA C22.2 No. 111-18 - General-Use Snap Switches.
- .6    CSA C22.2 No. 184-15 - Solid-State Lighting Controls.
- .7    CSA (Canadian Standards Association).
- .8    ULC (Underwriters' Laboratories of Canada).

**1.4                SUBMITTALS FOR REVIEW**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

**1.5                SUBMITTALS FOR INFORMATION**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Installation Data: Submit manufacturer's installation instructions.

**1.6                MAINTENANCE MATERIAL SUBMITTALS**

- .1    Refer to 26 05 00 Common Work Results for Electrical.
- .2    Extra Stock Materials:

- .1 Provide two (2) of each style, size, and finish wall plate.

## **1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

## **1.8 REGULATORY REQUIREMENTS**

- .1 Provide products listed and classified by CSA and as suitable for the purpose specified and indicated.

## **Part 2 Products**

### **2.1 WALL SWITCHES**

- .1 Manufacturers:
  - .1 Leviton
  - .2 Hubbell
  - .3 Cooper
  - .4 Legrand
  - .5 Substitutions: Refer to Section 26 05 00.
- .2 General-use snap switch:
  - .1 Grade: Commercial Specification Grade CSA-C22.2 No. 111
  - .2 Style: Standard toggle
  - .3 Device Body: White nylon toggle.
  - .4 Ratings: Match branch circuit and load characteristics. Amperage rating shall be marked on body of switch.
- .3 Body and Handle: White with nylon toggle.

### **2.2 WALL DIMMERS**

- .1 Manufacturers:
  - .1 Lutron
  - .2 Substitutions: Refer to Section 26 05 00
- .2 Description: Wall dimmer complete with slide to off control and surge protection.
- .3 Body and Handle: White with linear slide control.
- .4 Voltage: 120 volts.
- .5 Power Rating: Match load as required for circuits controlled.
- .6 Products:
  - .1 Electronic Low Voltage: NTELV series
  - .2 LED 0-10VDC: NTSTV-DV

## 2.3 RECEPTACLES

- .1 Manufacturers:
  - .1 Leviton
  - .2 Hubbell
  - .3 Cooper
  - .4 Legrand
  - .5 Substitutions: Refer to Section 01 62 00.
- .2 General-duty duplex convenience receptacle:
  - .1 Grade: Commercial Specification Grade Nema WD-6 Compliant, CSA-C22.2 No.42.
  - .2 Style: Standard.
  - .3 Device Body: Smooth white nylon face and base.
  - .4 CSA Configuration: Type as specified and indicated.
  - .5 Tamper resistant as indicated or as per Electrical Code.
- .3 GFCI Receptacle: Duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements complete with steady-on “Green-Power-On” and steady-on “Red-Power-Tripped Off” LED indicator lights.
- .4 Exterior Use Receptacle: Extra Heavy Duty Industrial grade duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements complete with steady-on “Green-Power-On” and steady-on “Red-Power-Tripped Off” LED indicator lights complete with UV and corrosion resistant device body complete with CSA 5-20R configuration only.
- .5 USB Charger Receptacle: General-duty tamper resistant decorator style duplex receptacle with USB type A and type C chargers with smart chips optimized for USB power delivery. Type A port to be rated 2.4A @5V and type C to be rated 3A @5V. Standard of acceptance Leviton T5633 for 5-15R and T5833 for 5-20R.
- .6 Controlled Receptacle: General-duty dual-controlled duplex receptacle with integral relay, wireless RF communication, and manual override button. Control system shall be complete with wireless RF signal packs to control all receptacles in individual rooms as indicated on drawings. RF signal packs shall be integrated with room lighting control occupancy sensor to turn off controlled receptacle within 20 minutes of unoccupied state.
- .7 Surge Protection Receptacle: General-duty duplex receptacle with integral surge protection device, power-on indicator light and damage-alert alarm with silencing screw. Surge suppression shall be 240 joules/15000A per mode. Device body shall be decorator style, smooth blue nylon face and base.
- .8 Isolated Ground Receptacle: General-duty duplex receptacle with insulation barrier between green grounding screw and metal box mounting strap. Device body shall be smooth orange nylon face with “IG triangle”.
- .9 Receptacle on Emergency Circuit: Heavy Duty Specification grade duplex receptacle with smooth red nylon face. CSA configuration as indicated. Type as indicated.
- .10 Range Receptacle: CSA configuration 14-50R commercial specification grade complete with stainless steel faceplate.

- .11 Dryer Receptacle: CSA configuration 14-30R commercial specification grade complete with stainless steel faceplate.
- .12 Suitable for No. 10 AWG for back and side wiring.
- .13 Break-off links for use as split receptacles.
- .14 Double wipe contacts and riveted grounding contacts.
- .15 Receptacles shall be of one manufacturer throughout the project.

#### **2.4 WALL PLATES**

- .1 Standard Stainless Steel Cover Plate: 430 type stainless steel cover plate complete with protective plastic film. Combination or multi-gang covers as required or indicated. Jumbo or standard size as indicated or specified.

#### **2.5 ACCESSORIES:**

- .1 Audible Device Vandal Guard: Clear vandal resistant, UV Stabilized polycarbonate shield and frame complete with integral 95db piezo horn and battery. Flush mounted or surface as indicated. Outdoor rated as required. Vandal guard shall be equal to STI Stopper II series.
- .2 Device Vandal Guard: Clear vandal resistant, UV Stabilized polycarbonate shield and frame. Flush mounted or surface as indicated. Outdoor rated as required. Vandal guard shall be equal to STI Stopper II series.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Verify that outlet boxes are installed at proper height.
- .3 Verify that wall openings are neatly cut and will be completely covered by wall plates.
- .4 Verify that floor boxes are adjusted properly.
- .5 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- .6 Verify that openings in access floor are in proper locations.

#### **3.2 PREPARATION**

- .1 Provide extension rings to bring outlet boxes flush with finished surface.
- .2 Clean debris from outlet boxes.

#### **3.3 INSTALLATION**

- .1 Install to CSA-C22.1 and to manufacturer's written instructions.
- .2 Install devices plumb and level.
- .3 Install switches with OFF position down.

- .4 Provide neutral conductor in box for all line voltage lighting control devices.
- .5 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
- .6 Do not share neutral conductor on load side of dimmers.
- .7 Install receptacles with grounding pole on bottom.
- .8 Use exterior use receptacles for exterior applications unless noted otherwise.
- .9 Connect wiring device grounding terminal to branch circuit equipment grounding conductor and outlet box.
- .10 Install locator pilot light for lighting controls located in crawlspace.
- .11 Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- .12 Connect wiring devices by wrapping conductor around screw terminal.
- .13 Use jumbo size plates for outlets installed in masonry walls.
- .14 Stainless steel protective coverings shall be maintained until project completion and turn-over to owner.
- .15 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- .16 Use weatherproof covers for parking receptacles, and dust-tight applications only, or as indicated.
- .17 Install protective rings on active flush cover service fittings.

### **3.4 INTERFACE WITH OTHER PRODUCTS**

- .1 Coordinate locations of outlet boxes provided under Section 26 05 34 to obtain mounting heights specified and as indicated on drawings.
- .2 Coordinate installation of access floor boxes with access floor system.
- .3 Coordinate the installation of wiring devices with underfloor duct service fittings provided under Section 26 05 39.

### **3.5 FIELD QUALITY CONTROL**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Inspect each wiring device for defects.
- .3 Operate each wall switch with circuit energized and verify proper operation.
- .4 Verify that each receptacle device is energized.
- .5 Test each receptacle device for proper polarity.
- .6 Test each GFCI receptacle device for proper operation.

### **3.6 ADJUSTING**

- .1 Adjust devices and wall plates to be flush and level.

**3.7 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Clean exposed surfaces to remove splatters and restore finish.

**END OF SECTION**

**Part 1            General**

**1.1                SECTION INCLUDES**

- .1      Luminaires.
- .2      Emergency lighting units.
- .3      Emergency remote fixtures
- .4      Exit signs.
- .5      LED luminaires and drivers.
- .6      Luminaire accessories.

**1.2                REFERENCES**

- .1      ANSI/NEMA C78.379-2006 - American National Standard for Electric Lamps - Classification of the Beam Patterns of Reflector Lamps.
- .2      CSA-C22.1-18 - Canadian Electrical Code, Part I (24<sup>th</sup> Edition), Safety Standard for Electrical Installations.
- .3      CSA-C22.2 No. 9.0-96 (R2006) - General Requirements for Luminaires.
- .4      CSA-C22.2 No. 250.0-08 - Luminaires.
- .5      CSA-C22.2 No. 141-15 - Emergency lighting equipment.
- .6      NEMA WD 6-2002 (R2008) - Wiring Devices - Dimensional Requirements.
- .7      CSA (Canadian Standards Association).
- .8      ULC (Underwriters' Laboratories of Canada).

**1.3                SUBMITTALS FOR REVIEW**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- .3      Product Data: Provide dimensions, ratings, and performance data.

**1.4                SUBMITTALS FOR INFORMATION**

- .1      Refer to 26 05 00 Common Work Results for Electrical.
- .2      Installation Data: Submit data indicating application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

**1.5                CLOSEOUT SUBMITTALS**

- .1      Refer to 26 05 00 Common Work Results for Electrical.



- .2 Operation and Maintenance Data: Submit manufacturer's operation and maintenance instructions for each product.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Extra Stock Materials:
  - .1 Provide two (2) of each plastic lens type.
  - .2 Provide ten (10) replacement lamps for each lamp type.
  - .3 Provide two (2) of each ballast type.

## **1.7 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.
- .2 Conform to requirements of CSA C22.1, and to the Manitoba Hydro Power Smart Commercial Lighting Program.
- .3 Products: Listed and classified by CSA, and as suitable for the purpose specified and indicated.

## **Part 2 Products**

### **2.1 LUMINAIRES**

- .1 Manufacturers:
  - .1 Refer to Luminaire Schedule on drawings.
  - .2 Substitutions: Refer to Section 26 05 00 Common Work Results for Electrical.
    - .1 All requests for substitutions shall be complete with photometric layouts indicating proposed luminaire performance in a 1' by 1' grid.

### **2.2 EMERGENCY LIGHTING UNITS**

- .1 Description: Self-contained LED emergency lighting unit.
- .2 Battery: 12 volt, lead acid type, with minimum 1/2 hour capacity.
- .3 Battery Charger: Solid state pulse type charger, current limited, temperature compensated, short circuit proof, and reverse polarity protected.
- .4 Lamps: LED, 5W minimum, 340 lumens minimum.
- .5 Housing: Factory white, corrosion resistant steel cabinet.
- .6 Indicators: Lamps to indicate AC ON and RECHARGING.
- .7 TEST Switch: Transfers unit from external power supply to integral battery supply.
- .8 Electrical Connection: 1800 mm cord with plug cap, NEMA WD 6, Type 5-15 configuration.
- .9 Input Voltage: Universal 120-347V.

- .10 Accessories:
  - .1 4 voltage sensing relays integral to battery bank unit.
  - .2 AC/DC terminal blocks
  - .3 Auto test function
  - .4 Mounting shelf (200W and over)
  - .5 Voltage sensing relay panel.
- .11 Manufacturers:
  - .1 Refer to Emergency Lighting Schedule on drawings.
  - .2 Substitutions: Refer to Section 26 05 00

## **2.3 EMERGENCY REMOTE FIXTURES**

- .1 General:
  - .1 Voltage: To match emergency battery bank.
  - .2 Spring capture for all lamps.
- .2 Compact Mini Remote Heads
  - .1 Lamps: LED, 5W minimum, 340 lumens minimum or as indicated. Quantity of 2 or as indicated.
  - .2 Housing: injection molded, impact resistant, thermoplastic, .
  - .3 Tool less adjusting.
- .3 Cubic Twin Remote Heads
  - .1 Lamps: LED, 5W minimum, 340 lumens minimum or as indicated. Quantity of 2.
  - .2 Housing: Polycarbonate frosted lens.
- .4 Enclosed Remote Heads
  - .1 Lamps: LED, 5W minimum, 340 lumens minimum or as indicated. Quantity of 2.
  - .2 Housing: Polycarbonate clear lens.
- .5 Decorative Remote Heads
  - .1 Lamps: LED, 5W minimum, 340 lumens minimum or as indicated. Quantity of 2 or as indicated.
  - .2 Housing: Powder coated die cast aluminum.
- .6 Manufacturers:
  - .1 Refer to Emergency Lighting Schedule on drawings.
  - .2 Substitutions: Refer to Section 26 05 00.

## **2.4 EXIT SIGNS**

- .1 Housing: Extruded aluminum
- .2 Face: Aluminum face with red letters on white background.
- .3 Directional Arrows: Universal type for field adjustment
- .4 Mounting: Universal, for field selection and as indicated

- .5 Lamps: LED
- .6 Input Voltage: Universal 120-347VAC, 6-24VDC.
- .7 Manufacturers:
  - .1 Refer to Emergency Lighting Schedule on drawings.
  - .2 Substitutions: Refer to Section 26 05 00

## **2.5 LED LUMINAIRES AND DRIVERS**

- .1 All Luminaires
  - .1 Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.
  - .2 Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.
  - .3 LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
  - .4 LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
  - .5 LED luminaires shall deliver a minimum of 60 lumens per watt.
    - .1 LED's shall be "Bin No. 1" quality.
  - .6 Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.
  - .7 The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
  - .8 LED color temperatures: CRI 85, 2700K as noted +/- 145K.
  - .9 LED color temperatures: CRI 85, 4000K as noted +/- 275K.
  - .10 LED color temperatures: CRI 85, 5000K as noted +/-283K.
  - .11 Luminaires shall have internal thermal protection.
  - .12 Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
  - .13 Color spatial uniformity shall be within .004 of CIE 1976 diagram.
  - .14 Color maintenance over rated life shall be within .007 of CIE 1976.
  - .15 Indoor luminaires shall have a minimum CRI of 85.
  - .16 Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management
  - .17 LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.
  - .18 Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.
- .2 Power Supplies and Drivers
  - .1 MB Hydro Powersmart approved.
  - .2 Power Factor: 0.90 or higher

- .3 Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.
  - .4 Output operating frequency: 60Hz.
  - .5 Interference: EMI and RFI compliant with FCC 47 CFR Part 15.
  - .6 Total Harmonic Distortion Rating: 20% Maximum.
  - .7 Meet electrical and thermal conditions as described in LM-80 Section 5.0.
  - .8 Primary Current: Confirm primary current with Drawings.
  - .9 Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.
  - .10 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.
  - .11 Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.
- .3 Controller and Control System
- .1 System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required.
  - .2 The Contractor shall ensure that external control equipment is compatible with LED control requirements
  - .3 Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.
  - .4 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers
  - .5 Luminaires used for emergency lighting connected to emergency lighting inverter to be controlled by relay type control that senses loss of normal power and controls the fixture to operate at 100%, locking out all other control until normal power is restored.

## **2.6 ACCESSORIES**

- .1 Description: Standard down light reflector shall be semi-specular unless noted otherwise.
- .2 Joiner Fittings: As specified for linear lighting systems, or as required for end to end continuous row mounting as indicated on drawings. Fittings to match style and finish of luminaire specified.
- .3 End Caps: As specified for linear lighting systems, or as required for end of row or stand-alone luminaire installations as indicated on drawings. End caps to match style and finish of luminaire specified.
- .4 Power Cord: As required for suspended lighting systems where wiring is exposed between fixture canopy and fixture lamp assembly. Power cord shall match finish of lighting fixture. Provide 0-10V combination cable as required for dimming purposes. Length of cable shall be suitable for minimum suspension length of 4'-0" from ceiling finish. Confirm final lengths with installation requirements.

**2.7 SOURCE QUALITY CONTROL**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Certify fluorescent ballast design and construction by Certified Ballast Manufacturers, Inc.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Support luminaires larger than 600 x 1200 mm (24 x 48 inch) size independent of ceiling framing.
- .2 Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- .3 Install surface mounted luminaires, emergency lighting, and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- .4 Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling grid members using bolts, screws, or suitable clips.
- .5 Install recessed luminaires to permit removal from below.
- .6 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- .7 Install clips to secure recessed grid-supported luminaires in place.
- .8 Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated.
- .9 Install end to end, or continuous rows of luminaires with appropriate joiner fittings to match the luminaire manufacturer and finish.
- .10 Install linear lighting with appropriate end caps where practicable.
- .11 Lighting installed in corridors shall be oriented to maximize light distribution along the corridor rather than across it.
- .12 Install accessories provided with each luminaire.
- .13 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .14 Bond products and metal accessories to branch circuit equipment grounding conductor.
- .15 Install specified lamps in each luminaire, emergency lighting unit and exit sign.
- .16 Wire remote heads to separate lamp load evenly to the output circuits of the associated battery bank.

**3.2 INTERFACE WITH OTHER PRODUCTS**

- .1 Interface with air handling accessories provided and installed under Section 23 37 00.

**3.3 FIELD QUALITY CONTROL**

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.

**3.4 ADJUSTING**

- .1 Aim and adjust luminaires as directed.
- .2 Position exit sign directional arrows as indicated.

**3.5 CLEANING**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.

**3.6 CLOSEOUT ACTIVITIES**

- .1 Demonstration: Demonstrate luminaire operation for minimum of one (1) hours.

**3.7 PROTECTION OF FINISHED WORK**

- .1 Refer to 26 05 00 Common Work Results for Electrical.
- .2 Re-lamp luminaires that have failed lamps and at Substantial Completion.

**3.8 SCHEDULES**

- .1 Refer to light fixture schedule on drawings

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 26 05 26 – Grounding and Bonding.

**1.2 REFERENCES**

- .1 American National Standards Institute
  - .1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
  - .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
    - .1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.

**1.3 SYSTEM DESCRIPTION**

- .1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

**Part 2 Products**

**2.1 BONDING CONDUCTOR FOR TELECOMMUNICATIONS**

- .1 3/0 AWG copper conductor, green marked to: ANSI J-STD-607-A.

**2.2 WARNING LABELS**

- .1 Non-metallic warning labels in English to: ANSI J-STD-607-A.
- .2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

**Part 3 Execution**

**3.1 BONDING CONDUCTORS GENERAL**

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using grounding bushing and #6 AWG copper conductor.

**3.2 BONDING TO TGB**

- .1 Bond metallic raceways in telecommunications room to TGB using #6 AWG copper conductor.
- .2 For cables within telecommunications room having shield or metallic member, bond shield or metallic member to TGB using #6 AWG copper conductor.
- .3 Bond equipment racks and cabinets located in telecommunications room to TGB using #6 AWG copper conductor.

**3.3 LABELLING**

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to: TIA/EIA-606.

**END OF SECTION**



**Part 1            General**

**1.1                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Product Data:
  - .1            Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.

**1.2                DELIVERY, STORAGE AND HANDLING**

- .1            Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3            Storage and Handling Requirements:
  - .1            Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2            Store and protect communication raceway systems from nicks, scratches, and blemishes.
  - .3            Replace defective or damaged materials with new.

**Part 2            Products**

**2.1                SYSTEM DESCRIPTION**

- .1            Empty telecommunications raceways system consists of outlet boxes, cover plates, terminal and distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.
- .2            Overhead distribution system.

**2.2                MATERIAL**

- .1            Conduits: EMT type, in accordance with Section 26 05 33 - Conduits.
- .2            Overhead distribution system: J-hooks.
- .3            Junction boxes, and cabinets in accordance with Section 26 05 34 - Boxes.
- .4            Outlet boxes, conduit boxes, and fittings: in accordance with Section 26 05 34 - Boxes.
- .5            Fish wire: polypropylene type.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied.

**3.2 INSTALLATION**

- .1 Install empty raceway system, including overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.
- .2 Maintain the following clearances from all electrical equipment as follows:
  - .1 Transformers above 5kVA – 1000mm
  - .2 347/600V power – 1000mm
  - .3 120V power – 50mm
  - .4 208/240V power – 300mm
  - .5 Motors – 1000mm
  - .6 120V fluorescent lighting – 300mm

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 00 50 - General Instructions.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 50 - General Instructions.
- .3 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 00 50 - General Instructions .
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

**END OF SECTION**

**Part 1 General**

**1.1 DEFINITIONS**

- .1 The following are definitions of terms and expressions used in the specification:
  - .1 DROP means a communication outlet assembly complete with faceplate, cabling, and termination. A DROP may consist of one or more terminated cables assembled into a common faceplate.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for communication cabling systems and include product characteristics, performance criteria, physical size, finish, limitations, and product warranty.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect communication cabling systems from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**1.4 SYSTEM DESCRIPTION**

- .1 Structured cabling system consists of all cabling, terminations, faceplates, outlet jacks, supporting means, racks, cabinets, and patch panels to support interconnections to active telecommunications equipment for voice and data applications in a multi-vendor, multi-product environment.
- .2 The structured cabling system shall adhere to ANSI/TIA 568 C; 569-A; 606-A; J-STD-607-A and TIA 942 standards with respect to pathways, distribution, administration, and grounding of the system.
- .3 Empty telecommunications raceways system consists of outlet boxes, cover plates, terminal and distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.
- .4 Overhead distribution system.
- .5 All cabling, patch panels, termination jacks, and faceplates shall be of one manufacturer.

**Part 2 Products**

**2.1 COPPER CABLE**

- .1 Category 6A:
  - .1 Meets or exceeds requirements of ANSI/TIA-568-C.2 Category 6A, IEEE 802.3an-2006, and ISO 11801 Class EA channel standards
  - .2 Meets or exceeds requirements of IEEE 802.af and IEEE 802.3at for PoE applications
  - .3 Meets or exceeds requirements of ANSI/TIA-568-C.2 Category 6A and IEC 61156-5 Category 6A component standards
  - .4 Cable diameter: 0.310”(7.9mm) nominal
  - .5 Configuration:
    - .1 Unshielded
    - .2 Twisted pairs – 4
    - .3 Conductors – 23 AWG
  - .6 Installation temperature range: 32°F to 140°F(0°C to 60°C)
  - .7 Operating temperature range: -4°F to 167°F(-20°C to 75°C)
  - .8 Descending length cable markings enable easy identification of remaining cable.
  - .9 Flammability Rating – Plenum FT6 (CMP).
- .2 Category 6:
  - .1 Meets or exceeds requirements of ANSI/TIA-568-C.2 Category 6 and ISO 11801 2nd Edition Class E channel standards
  - .2 Meets or exceeds requirements of ANSI/TIA-568-C.2 and IEC 61156-5 Category 6 component standards
  - .3 Meets or exceeds requirements of IEEE 802.af and IEEE 802.3at for PoE applications
  - .4 Cable diameter: 0.236”( 5.9mm) nominal
  - .5 Configuration:
    - .1 Unshielded
    - .2 Twisted pairs – 4
    - .3 Conductors – 23 AWG
  - .6 Installation temperature range: 32°F to 122°F(0°C to 50°C)
  - .7 Operating temperature range: 14°F to 140°F(-10°C to 60°C)
  - .8 Descending length cable markings enable easy identification of remaining cable.
  - .9 Flammability Rating – Plenum FT6 (CMP).
- .3 Category 5e:
  - .1 Meets or exceeds requirements of ANSI/TIA-568-C.2 Category 5e and ISO 11801 2nd Edition Class D channel standards
  - .2 Meets or exceeds requirements of ANSI/TIA-568-C.2 and IEC 61156-5 Category 5e component standards

- .3 Meets or exceeds requirements of IEEE 802.af and IEEE 802.3at for PoE applications
  - .4 Cable diameter: 0.207”( 5.3mm) nominal
  - .5 Configuration:
    - .1 Unshielded
    - .2 Twisted pairs – 4
    - .3 Conductors – 24 AWG
  - .6 Installation temperature range: 32°F to 122°F (0°C to 50°C)
  - .7 Operating temperature range: 14°F to 140°F(-10°C to 60°C)
  - .8 Descending length cable markings enable easy identification of remaining cable.
  - .9 Flammability Rating – Plenum FT6 (CMP).
- .4 Manufacturers:
- .1 Tyco-AMP
  - .2 Belden
  - .3 Panduit
- .5 Cabling reel to also include footage marking on the cable jacket.

## **2.2 MULTI-PAIR 100 Ω BALANCED TWISTED PAIR CABLE**

- .1 100 ohm, 50 pairs, sheath consists of thermoplastic jacket without underlying metallic shield,
  - .1 Category 3 to: TIA/EIA-568-C,
  - .2 Flame test classification: Plenum FT6 (CMP).

## **2.3 WORK AREA UTP 4-PAIR MODULAR JACK**

- .1 Eight-position modular jack ("RJ-45"), type T568A to: TIA/EIA-568-B.2:
  - .1 Category rating to match installed cabling.
  - .2 In self-contained surface-mount box, 4 jacks per box.
  - .3 Mounted in compatible single gang faceplate, angle entry, 4 jack positions per faceplate.

## **2.4 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP**

- .1 IDC Terminal strips, 25 pair, for terminating multi pair 100 Ω balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 3 to: TIA/EIA-568-C.
- .2 Mount or block for housing 10 IDC terminal strips, mounted on wall.
  - .1 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires.
- .3 Patch panel, 2 rack units high, 48 ports:
  - .1 Each port equipped with factory installed "RJ-45" jacks, type T568Ato: TIA/EIA-568-C. Category rating to match installed cabling.

- .2 Horizontal cable-management unit for every 48 ports.
  - .1 Horizontal cable-management to be installed above and below all patch panels.

**2.5 UTP CROSS-CONNECT WIRE**

- .1 Category 3 1 pair to: TIA/EIA-568-C.

**2.6 UTP PATCH CORDS**

- .1 3 metres (10') long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack, 4-pairs to: TIA/EIA-568-C. Category rating to match installed cabling.
- .2 Colour - Blue
- .3 Provide one patch cord for every terminated cable installed.

**2.7 UTP WORK AREA CORDS**

- .1 3 metres (10') long, each end equipped with "RJ-45" plug to: TIA/EIA-568-C. Category rating to match installed cabling.
- .2 Colour - Blue
- .3 Provide one work area cord for every terminated cable installed.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Provide all labor, materials, tools and equipment required for the complete installation of the structured cabling system.
- .2 Install, terminate, test and guarantee each drop
- .3 Install structured cabling in accordance with manufacturer's recommendations and best industry practices.
- .4 A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- .5 Cable raceways shall not be filled greater than the TIA/EIA-569-A maximum fill for the particular raceway type
- .6 Cables shall be installed in continuous lengths from origin to destination (no splices).
- .7 The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
- .8 If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 36" (900mm) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
- .9 Horizontal distribution cables shall be bundled in groups of no more than 25 cables.
- .10 Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware

shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

- .11 Cables shall not be attached to ceiling grid or lighting fixture wiring. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.
- .12 Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
- .13 Cables shall be identified by a self-adhesive label in accordance with ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- .14 Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
- .15 Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

### **3.2 CONTRACTOR CERTIFICATION**

- .1 The cabling system shall be installed by a contractor or sub-contractor certified by the cable manufacturer.

### **3.3 TESTING**

- .1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy, electronic record on CD.
  - .1 Perform tests for Permanent Link on installed cables, including spares:
    - .1 Category 6 using certified level III tester to: TIA/EIA-568-C.
    - .2 Perform the following tests: wire map, length, insertion loss, NEXT loss, ELFEXT, PSELFEXT, ACR, PSACR, propagation delay, delay skew, return loss.
  - .2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.
    - .1 Category 6 using certified level III tester to: TIA/EIA-568-C.
    - .2 Perform the following tests: wire map, length, insertion loss, NEXT loss, ELFEXT, PSELFEXT, ACR, PSACR, propagation delay, delay skew, return loss.
- .2 Test backbone Category 3 voice cables as specified below and correct deficiencies: provide record of results as hard copy, electronic record on CD.
  - .1 Perform Wire Map tests on multi-pair Category 3 cables to: TIA/EIA-568-B.1.
  - .2 Provide loop resistance measurements in ohms and dB at 1KHz, 8KHz, and 256 KHz.
  - .3 Test multi-pair Category 3 cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors.

- .3 Test Optical-fiber strands for attenuation to: TIA/EIA-568-C and correct deficiencies: provide record of results as hard copy, and electronic record on CD.
  - .1 Test backbone links in both direction[s]. Backbone links:
    - .1 Test multi-mode fiber at both applicable wavelengths (850 nm and 1300 nm).
    - .2 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.
      - .1 Multi-mode-fiber attenuation coefficients:
        - .1 3.0 db/km @ 850 nm; and
        - .2 1.5 db km @ 1300 nm
      - .2 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.
  - .4 Perform additional Tier 2 tests using optical time domain reflectometer (OTDR) on backbone fiber pairs.
    - .1 Correct deficiencies.
    - .2 Provide record of results as described in SUBMITTALS.
  - .5 Provide record of results as electronic record on CD to: TIA/TSB-140.

### **3.4 WARRANTY**

- .1 The installation Contractor shall support the installed system for a period of two years from the date of acceptance by the Owner.
- .2 Contractor shall be responsible for obtaining all documentation necessary to achieve manufacturer's warranty
- .3 The manufacturer shall provide a minimum 15 year warranty for the complete cabling system.
- .4 The manufacturer's warranty shall be provided directly to the owner and shall be independent of the installation contractor.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by structured cabling systems installation.

**END OF SECTION**